Power Systems

Managing adapters for the Machine Types 5105, 9008, 9009, 9040, 9080, 9223, and EMX0 PCIe3 expansion drawers

Note

Before using this information and the product it supports, read the information in “Safety notices” on page v, “Notices” on page 267, the *IBM Systems Safety Notices* manual, G229-9054, and the *IBM Environmental Notices and User Guide*, Z125–5823.

This edition applies to IBM® Power Systems servers that contain the POWER9™ processor and to all associated models.

Contents

Safety notices

Safety notices may be printed throughout this guide:

- **DANGER** notices call attention to a situation that is potentially lethal or extremely hazardous to people.
- **CAUTION** notices call attention to a situation that is potentially hazardous to people because of some existing condition.
- **Attention** notices call attention to the possibility of damage to a program, device, system, or data.

World Trade safety information

Several countries require the safety information contained in product publications to be presented in their national languages. If this requirement applies to your country, safety information documentation is included in the publications package (such as in printed documentation, on DVD, or as part of the product) shipped with the product. The documentation contains the safety information in your national language with references to the U.S. English source. Before using a U.S. English publication to install, operate, or service this product, you must first become familiar with the related safety information documentation. You should also refer to the safety information documentation any time you do not clearly understand any safety information in the U.S. English publications.

Replacement or additional copies of safety information documentation can be obtained by calling the IBM Hotline at 1-800-300-8751.

German safety information

Das Produkt ist nicht für den Einsatz an Bildschirmarbeitsplätzen im Sinne § 2 der Bildschirmarbeitsverordnung geeignet.

Laser safety information

IBM servers can use I/O cards or features that are fiber-optic based and that utilize lasers or LEDs.

Laser compliance

IBM servers may be installed inside or outside of an IT equipment rack.

DANGER: When working on or around the system, observe the following precautions:

Electrical voltage and current from power, telephone, and communication cables are hazardous. To avoid a shock hazard: If IBM supplied the power cord(s), connect power to this unit only with the IBM provided power cord. Do not use the IBM provided power cord for any other product. Do not open or service any power supply assembly. Do not connect or disconnect any cables or perform installation, maintenance, or reconfiguration of this product during an electrical storm.

- 
The product might be equipped with multiple power cords. To remove all hazardous voltages, disconnect all power cords. For AC power, disconnect all power cords from their AC power source. For racks with a DC power distribution panel (PDP), disconnect the customer's DC power source to the PDP.
- When connecting power to the product ensure all power cables are properly connected. For racks with AC power, connect all power cords to a properly wired and grounded electrical outlet. Ensure that the outlet supplies proper voltage and phase rotation according to the system rating plate. For racks with a DC power distribution panel (PDP), connect the customer's DC power source to the PDP. Ensure that the proper polarity is used when attaching the DC power and DC power return wiring.
- Connect any equipment that will be attached to this product to properly wired outlets.

- When possible, use one hand only to connect or disconnect signal cables.
- Never turn on any equipment when there is evidence of fire, water, or structural damage.
- Do not attempt to switch on power to the machine until all possible unsafe conditions are corrected.
- When performing a machine inspection: Assume that an electrical safety hazard is present. Perform all continuity, grounding, and power checks specified during the subsystem installation procedures to ensure that the machine meets safety requirements. Do not attempt to switch power to the machine until all possible unsafe conditions are corrected. Before you open the device covers, unless instructed otherwise in the installation and configuration procedures: Disconnect the attached AC power cords, turn off the applicable circuit breakers located in the rack power distribution panel (PDP), and disconnect any telecommunications systems, networks, and modems.
- Connect and disconnect cables as described in the following procedures when installing, moving, or opening covers on this product or attached devices.

  To Disconnect: 1) Turn off everything (unless instructed otherwise). 2) For AC power, remove the power cords from the outlets. 3) For racks with a DC power distribution panel (PDP), turn off the circuit breakers located in the PDP and remove the power from the Customer's DC power source. 4) Remove the signal cables from the connectors. 5) Remove all cables from the devices.

  To Connect: 1) Turn off everything (unless instructed otherwise). 2) Attach all cables to the devices. 3) Attach the signal cables to the connectors. 4) For AC power, attach the power cords to the outlets. 5) For racks with a DC power distribution panel (PDP), restore the power from the Customer's DC power source and turn on the circuit breakers located in the PDP. 6) Turn on the devices.
-  Sharp edges, corners and joints may be present in and around the system. Use care when handling equipment to avoid cuts, scrapes and pinching. (D005)

(R001 part 1 of 2):

DANGER: Observe the following precautions when working on or around your IT rack system:

- Heavy equipment–personal injury or equipment damage might result if mishandled.
- Always lower the leveling pads on the rack cabinet.
- Always install stabilizer brackets on the rack cabinet if provided, unless the earthquake option is to be installed.
- To avoid hazardous conditions due to uneven mechanical loading, always install the heaviest devices in the bottom of the rack cabinet. Always install servers and optional devices starting from the bottom of the rack cabinet.
- Rack-mounted devices are not to be used as shelves or work spaces. Do not place objects on top of rack-mounted devices. In addition, do not lean on rack mounted devices and do not use them to stabilize your body position (for example, when working from a ladder).

  
- Stability hazard:
  - The rack may tip over causing serious personal injury.
  - Before extending the rack to the installation position, read the installation instructions.
  - Do not put any load on the slide-rail mounted equipment mounted in the installation position.
  - Do not leave the slide-rail mounted equipment in the installation position.
- Each rack cabinet might have more than one power cord.
  - For AC powered racks, be sure to disconnect all power cords in the rack cabinet when directed to disconnect power during servicing.

  - For racks with a DC power distribution panel (PDP), turn off the circuit breaker that controls the power to the system unit(s), or disconnect the customer's DC power source, when directed to disconnect power during servicing.
- Connect all devices installed in a rack cabinet to power devices installed in the same rack cabinet. Do not plug a power cord from a device installed in one rack cabinet into a power device installed in a different rack cabinet.
- An electrical outlet that is not correctly wired could place hazardous voltage on the metal parts of the system or the devices that attach to the system. It is the responsibility of the customer to ensure that the outlet is correctly wired and grounded to prevent an electrical shock. (R001 part 1 of 2)

(R001 part 2 of 2):

CAUTION:

- Do not install a unit in a rack where the internal rack ambient temperatures will exceed the manufacturer's recommended ambient temperature for all your rack-mounted devices.
- Do not install a unit in a rack where the air flow is compromised. Ensure that air flow is not blocked or reduced on any side, front, or back of a unit used for air flow through the unit.
- Consideration should be given to the connection of the equipment to the supply circuit so that overloading of the circuits does not compromise the supply wiring or overcurrent protection. To provide the correct power connection to a rack, refer to the rating labels located on the equipment in the rack to determine the total power requirement of the supply circuit.
- *(For sliding drawers.)* Do not pull out or install any drawer or feature if the rack stabilizer brackets are not attached to the rack or if the rack is not bolted to the floor. Do not pull out more than one drawer at a time. The rack might become unstable if you pull out more than one drawer at a time.

- *(For fixed drawers.)* This drawer is a fixed drawer and must not be moved for servicing unless specified by the manufacturer. Attempting to move the drawer partially or completely out of the rack might cause the rack to become unstable or cause the drawer to fall out of the rack. (R001 part 2 of 2)

CAUTION: Removing components from the upper positions in the rack cabinet improves rack stability during relocation. Follow these general guidelines whenever you relocate a populated rack cabinet within a room or building.

- Reduce the weight of the rack cabinet by removing equipment starting at the top of the rack cabinet. When possible, restore the rack cabinet to the configuration of the rack cabinet as you received it. If this configuration is not known, you must observe the following precautions:
  - Remove all devices in the 32U position and above.
  - Ensure that the heaviest devices are installed in the bottom of the rack cabinet.

  - Ensure that there are little-to-no empty U-levels between devices installed in the rack cabinet below the 32U level, unless the received configuration specifically allowed it.
- If the rack cabinet you are relocating is part of a suite of rack cabinets, detach the rack cabinet from the suite.
- If the rack cabinet you are relocating was supplied with removable outriggers they must be reinstalled before the cabinet is relocated.
- Inspect the route that you plan to take to eliminate potential hazards.
- Verify that the route that you choose can support the weight of the loaded rack cabinet. Refer to the documentation that comes with your rack cabinet for the weight of a loaded rack cabinet.
- Verify that all door openings are at least 760 x 2083 mm (30 x 82 in.).
- Ensure that all devices, shelves, drawers, doors, and cables are secure.
- Ensure that the four leveling pads are raised to their highest position.
- Ensure that there is no stabilizer bracket installed on the rack cabinet during movement.
- Do not use a ramp inclined at more than 10 degrees.
- When the rack cabinet is in the new location, complete the following steps:
  - Lower the four leveling pads.
  - Install stabilizer brackets on the rack cabinet or in an earthquake environment bolt the rack to the floor.
  - If you removed any devices from the rack cabinet, repopulate the rack cabinet from the lowest position to the highest position.
- If a long-distance relocation is required, restore the rack cabinet to the configuration of the rack cabinet as you received it. Pack the rack cabinet in the original packaging material, or equivalent. Also lower the leveling pads to raise the casters off of the pallet and bolt the rack cabinet to the pallet.

(R002)

(L001)

DANGER: Hazardous voltage, current, or energy levels are present inside any component that has this label attached. Do not open any cover or barrier that contains this label. (L001)

(L002)

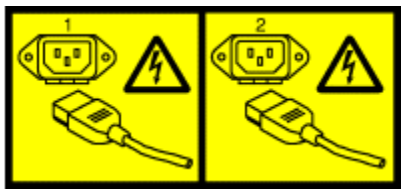
DANGER: Rack-mounted devices are not to be used as shelves or work spaces. Do not place objects on top of rack-mounted devices. In addition, do not lean on rack-mounted devices and do not use them to stabilize your body position (for example, when working from a ladder). Stability hazard:

- The rack may tip over causing serious personal injury.
- Before extending the rack to the installation position, read the installation instructions.

- Do not put any load on the slide-rail mounted equipment mounted in the installation position.
- Do not leave the slide-rail mounted equipment in the installation position.

(L002)

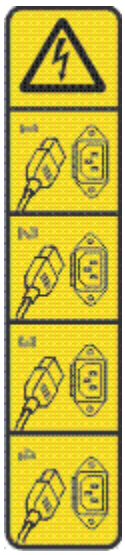
(L003)



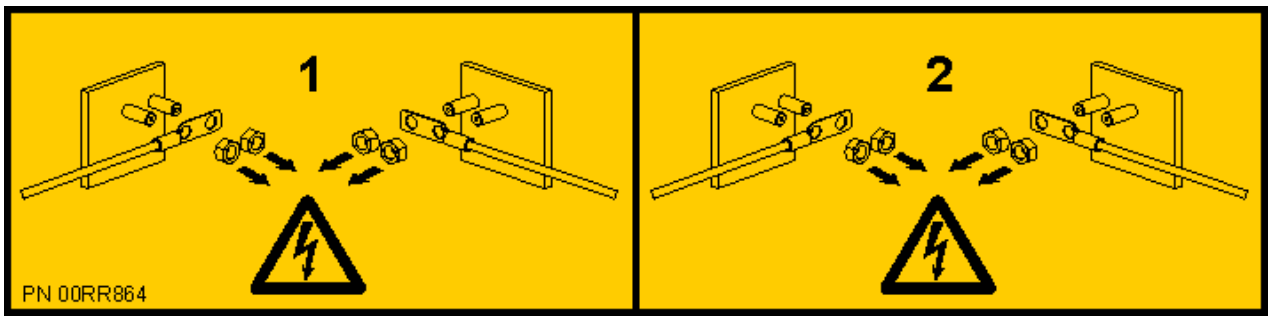
or

or

or



or



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

(L007)

CAUTION: A hot surface nearby. (L007)

(L008)

CAUTION: Hazardous moving parts nearby. (L008)

All lasers are certified in the U.S. to conform to the requirements of DHHS 21 CFR Subchapter J for class 1 laser products. Outside the U.S., they are certified to be in compliance with IEC 60825 as a class 1 laser product. Consult the label on each part for laser certification numbers and approval information.

CAUTION: This product might contain one or more of the following devices: CD-ROM drive, DVD-ROM drive, DVD-RAM drive, or laser module, which are Class 1 laser products. Note the following information:

- Do not remove the covers. Removing the covers of the laser product could result in exposure to hazardous laser radiation. There are no serviceable parts inside the device.
- Use of the controls or adjustments or performance of procedures other than those specified herein might result in hazardous radiation exposure.

(C026)

CAUTION: Data processing environments can contain equipment transmitting on system links with laser modules that operate at greater than Class 1 power levels. For this reason, never look into the end of an optical fiber cable or open receptacle. Although shining light into one end and looking into the other end of a disconnected optical fiber to verify the continuity of optic fibers may not injure the eye, this procedure is potentially dangerous. Therefore, verifying the continuity of optical fibers by shining light into one end and looking at the other end is not recommended. To verify continuity of a fiber optic cable, use an optical light source and power meter. (C027)

CAUTION: This product contains a Class 1M laser. Do not view directly with optical instruments. (C028)

CAUTION: Some laser products contain an embedded Class 3A or Class 3B laser diode. Note the following information:

- Laser radiation when open.
- Do not stare into the beam, do not view directly with optical instruments, and avoid direct exposure to the beam. (C030)

(C030)

CAUTION: The battery contains lithium. To avoid possible explosion, do not burn or charge the battery.

Do Not:

- Throw or immerse into water
- Heat to more than 100 degrees C (212 degrees F)
- Repair or disassemble

Exchange only with the IBM-approved part. Recycle or discard the battery as instructed by local regulations. In the United States, IBM has a process for the collection of this battery. For information, call 1-800-426-4333. Have the IBM part number for the battery unit available when you call. (C003)

CAUTION: Regarding IBM provided VENDOR LIFT TOOL:

- Operation of LIFT TOOL by authorized personnel only.
- LIFT TOOL intended for use to assist, lift, install, remove units (load) up into rack elevations. It is not to be used loaded transporting over major ramps nor as a replacement for such designated tools like pallet jacks, walkies, fork trucks and such related relocation practices. When this is not practicable, specially trained persons or services must be used (for instance, riggers or movers).
- Read and completely understand the contents of LIFT TOOL operator's manual before using. Failure to read, understand, obey safety rules, and follow instructions may result in property damage and/or personal injury. If there are questions, contact the vendor's service and support. Local paper manual must remain with machine in provided storage sleeve area. Latest revision manual available on vendor's web site.
- Test verify stabilizer brake function before each use. Do not over-force moving or rolling the LIFT TOOL with stabilizer brake engaged.
- Do not raise, lower or slide platform load shelf unless stabilizer (brake pedal jack) is fully engaged. Keep stabilizer brake engaged when not in use or motion.
- Do not move LIFT TOOL while platform is raised, except for minor positioning.
- Do not exceed rated load capacity. See LOAD CAPACITY CHART regarding maximum loads at center versus edge of extended platform.
- Only raise load if properly centered on platform. Do not place more than 200 lb (91 kg) on edge of sliding platform shelf also considering the load's center of mass/gravity (CoG).
- Do not corner load the platforms, tilt riser, angled unit install wedge or other such accessory options. Secure such platforms -- riser tilt, wedge, etc options to main lift shelf or forks in all four (4x or all other provisioned mounting) locations with provided hardware only, prior to use. Load objects are designed to slide on/off smooth platforms without appreciable force, so take care not

to push or lean. Keep riser tilt [adjustable angling platform] option flat at all times except for final minor angle adjustment when needed.

- Do not stand under overhanging load.
- Do not use on uneven surface, incline or decline (major ramps).
- Do not stack loads.
- Do not operate while under the influence of drugs or alcohol.
- Do not support ladder against LIFT TOOL (unless the specific allowance is provided for one following qualified procedures for working at elevations with this TOOL).
- Tipping hazard. Do not push or lean against load with raised platform.
- Do not use as a personnel lifting platform or step. No riders.
- Do not stand on any part of lift. Not a step.
- Do not climb on mast.
- Do not operate a damaged or malfunctioning LIFT TOOL machine.
- Crush and pinch point hazard below platform. Only lower load in areas clear of personnel and obstructions. Keep hands and feet clear during operation.
- No Forks. Never lift or move bare LIFT TOOL MACHINE with pallet truck, jack or fork lift.
- Mast extends higher than platform. Be aware of ceiling height, cable trays, sprinklers, lights, and other overhead objects.
- Do not leave LIFT TOOL machine unattended with an elevated load.
- Watch and keep hands, fingers, and clothing clear when equipment is in motion.
- Turn Winch with hand power only. If winch handle cannot be cranked easily with one hand, it is probably over-loaded. Do not continue to turn winch past top or bottom of platform travel. Excessive unwinding will detach handle and damage cable. Always hold handle when lowering, unwinding. Always assure self that winch is holding load before releasing winch handle.
- A winch accident could cause serious injury. Not for moving humans. Make certain clicking sound is heard as the equipment is being raised. Be sure winch is locked in position before releasing handle. Read instruction page before operating this winch. Never allow winch to unwind freely. Freewheeling will cause uneven cable wrapping around winch drum, damage cable, and may cause serious injury.
- This TOOL must be maintained correctly for IBM Service personnel to use it. IBM shall inspect condition and verify maintenance history before operation. Personnel reserve the right not to use TOOL if inadequate. (C048)

Power and cabling information for NEBS (Network Equipment-Building System) GR-1089-CORE

The following comments apply to the IBM servers that have been designated as conforming to NEBS (Network Equipment-Building System) GR-1089-CORE:

The equipment is suitable for installation in the following:

- Network telecommunications facilities
- Locations where the NEC (National Electrical Code) applies

The intrabuilding ports of this equipment are suitable for connection to intrabuilding or unexposed wiring or cabling only. The intrabuilding ports of this equipment *must not* be metallically connected to the interfaces that connect to the OSP (outside plant) or its wiring. These interfaces are designed for use as intrabuilding interfaces only (Type 2 or Type 4 ports as described in GR-1089-CORE) and require isolation from the exposed OSP cabling. The addition of primary protectors is not sufficient protection to connect these interfaces metallically to OSP wiring.

Note: All Ethernet cables must be shielded and grounded at both ends.

The ac-powered system does not require the use of an external surge protection device (SPD).

The dc-powered system employs an isolated DC return (DC-I) design. The DC battery return terminal *shall not* be connected to the chassis or frame ground.

The dc-powered system is intended to be installed in a common bonding network (CBN) as described in GR-1089-CORE.

Managing adapters

Find information about using and managing the adapters that are supported for the 5105-22E, IBM Power® System L922 (9008-22L), IBM Power System S922 (9009-22A and 9009-22G), IBM Power System H922 (9223-22H), IBM Power System H922S (9223-22S), IBM Power System S914 (9009-41A and 9009-41G), IBM Power System S924 (9009-42A and 9009-42G), IBM Power System H924 (9223-42H), or IBM Power System H924S (9223-42S) server, and EMX0 PCIe3 expansion drawers.

Overview of managing adapters

Find information about using and managing adapters.

PCI Express

Learn about PCI Express (PCIe) adapters and slots.

Note: Although PCI-X adapters are not supported on POWER9 processor-based systems, the following information and figure is for informational purposes.

PCI Express (PCIe) adapters use a different type of slot than Peripheral Component Interconnect (PCI) and Peripheral Component Interconnect-X (PCI-X) adapters. If you attempt to force an adapter into the wrong type of slot, you might damage the adapter or the slot. A PCI adapter can be installed in a PCI-X slot, and a PCI-X adapter can be installed in a PCI adapter slot. A PCIe adapter cannot be installed in a PCI or PCI-X adapter slot, and a PCI or PCI-X adapter cannot be installed in a PCIe slot. The following illustration shows an example of a PCI-X adapter **(A)** next to a PCIe 4x **(B)** adapter.

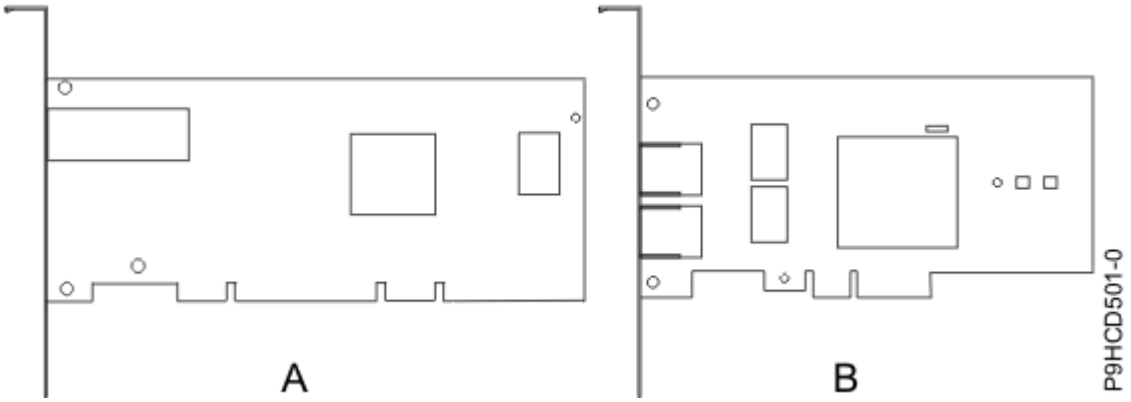


Figure 1. PCI-X adapter and PCIe 4x adapter

PCIe adapters and slots come in 4 different sizes: 1x, 4x, 8x, and 16x. Smaller size adapters do fit in larger slots, but larger size adapters do not fit in smaller slots. Table 1 on page 1 shows PCIe slot compatibility.

Table 1. PCIe slot compatibility

	1x slot	**4x slot**	**8x slot**	**16x slot**
1x adapter	Supported	Supported	Supported	Supported
4x adapter	Not supported	Supported	Supported	Supported
8x adapter	Not supported	Not supported	Supported	Supported
16x adapter	Not supported	Not supported	Not supported	Supported

Partitioning with multi-adapter configurations

Find information about partitioning considerations with dual-slot and multi-adapter configurations.

Logical partitions can own physical I/O resources. Physical I/O resources are assigned to logical partitions at the slot level. Assigning a slot to a logical partition enables the operating system that runs in the logical partition to control the functions of the I/O resource and power for that slot. When the operating system powers a slot on or off, the physical I/O resource is powered on or off.

Adapter pairs are used to create multi-initiator and high availability configurations.

Multi-initiator and high availability

The terms multi-initiator and high availability (HA) refer to connecting multiple adapters (typically two adapters) to a common set of disk expansion drawers for increasing availability. This configuration is also referred to as Dual Storage IOA configuration. This type of connection is commonly done in either of the following configurations.

HA two-system configuration

An HA two-system configuration provides a high-availability environment for system storage by enabling two systems or partitions to have access to the same set of disks and disk arrays. This feature is typically used with the IBM PowerHA® SystemMirror®. The IBMPowerHA SystemMirror software provides a commercial computing environment that ensures that mission-critical applications can recover quickly from hardware and software failures. The support for this configuration is operating system dependent.

HA single system configuration

An HA single system configuration provides for redundant adapters from a single system to the same set of disks and disk arrays. This feature is typically referred to as Multi-Path I/O (MPIO). MPIO support is part of the operating system support and can be used to provide a redundant IBM SAS RAID controller configuration with RAID protected disks.

For more information about the PCIe3 SAS RAID controllers, see the following topics:

- SAS RAID controllers for AIX®
- SAS RAID controllers for IBM i
- SAS RAID controllers for Linux®
- SAS subsystem for the 9040-MR9

Handling static-sensitive devices

Find information about precautions you must take to prevent damage to electronic components from static electricity discharge.

Electronic boards, adapters, media drives, and disk drives are sensitive to static electricity discharge. These devices are wrapped in antistatic bags to prevent this damage. Take the following precautions to prevent damage to these devices from static electricity discharge.

- Attach a wrist strap to an unpainted metal surface of your hardware to prevent electrostatic discharge from damaging your hardware.
- When you are using a wrist strap, follow all electrical safety procedures. A wrist strap is for static control. It does not increase or decrease your risk of receiving electric shock when you are using or working on electrical equipment.
- If you do not have a wrist strap, before you remove the product from ESD packaging and installing or replacing hardware, touch an unpainted metal surface of the system for a minimum of 5 seconds.
- Do not remove the device from the antistatic bag until you are ready to install the device in the system.
- With the device still in its antistatic bag, touch it to the metal frame of the system.
- Grasp cards and boards by the edges. Avoid touching the components and gold connectors on the adapter.

- If you need to lay the device down while it is out of the antistatic bag, lay it on the antistatic bag. Before you pick it up again, touch the antistatic bag and the metal frame of the system at the same time.
- Handle the devices carefully to prevent permanent damage.

Adapters for IBM Power Systems servers

Find information about the adapters that can be used for your specific system.

Managing adapters for the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9223-22H, or 9223-22S system

Find information about using and managing the adapters for the 5105-22E, IBM Power System L922 (9008-22L), IBM Power System S922 (9009-22A and 9009-22G), IBM Power System H922 (9223-22H), or IBM Power System H922S (9223-22S) system. Also, find information about specifications and installation notes for specific adapters.

Overview of managing adapters for the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9223-22H, or 9223-22S system

Find information about using and managing adapters.

The following features are electromagnetic compatibility (EMC) Class B features. See the Class B Notices in the Hardware Notices section.

Table 2. Electromagnetic compatibility (EMC) Class B features

Feature	Description
5269	POWER® GXT145 PCI Express Graphics Accelerator

The adapter information that is shown here is used during non-directed service activities. The information can be used to:

- Identify an adapter
- Find specific technical information about an adapter
- Where applicable, show special installation or cabling instructions
- Show signal names for the output-pins of the adapter connectors
- Where applicable, show the settings for switches or jumpers

Adapters can be identified by their feature code (FC) or their custom-card identification number (CCIN). Normally, the CCIN number is labeled on the adapter. The field replaceable unit (FRU) part number (P/N) of your adapter might not match the FRU P/N listed in this information. If the part numbers do not match, verify that the CCIN is the same. If the CCIN is same, the adapter has the same function and can be used in the same way.

Adapters must be placed in specific slots to function correctly or optimally.

PCIe3 SAS RAID internal adapters and controllers for the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9223-22H, or 9223-22S system

Find information about the PCIe3 SAS RAID internal adapters and controllers that are installed and supported in the system.

Table 3 on page 4 provides information about the PCIe3 SAS RAID internal adapters and controllers that are supported for the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9223-22H, or 9223-22S system.

Table 3. PCIe3 SAS RAID internal adapters and controllers for the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9223-22H, or 9223-22S system		
Feature Code	**Description**	**Function**
EJ1G	PCIe3 x8 cache SAS RAID Internal adapter 6 Gb (FC EJ1G and EL67; CCIN 57DC); Adapter part number: 01JC780	FC EJ1G is used to support up to 8 small form-factor disk drives or solid-state drives. It provides SAS RAID 0, 5, 6, 10, 5T2, 6T2, and 10T2 functions. It also provides an external SAS port that can be used to connect one external FC ESLS or ESLL. **Note:** The SAS YO cable that is used to attach a FC ESLS or ESLL disk drive enclosure to the rear SAS port must not exceed the maximum supported length of 3 meters.
EJ1F	Single - PCIe3 x8 SAS RAID Internal Adapter 6 Gb (FC EJ1F; CCIN 57D7); Adapter FRU number: 01LK399	FC EJ1F provides just a bunch of disks (JBOD) or RAID 0, 5, 6, and 10, functions for the attached disk drives in the base function.
EJ1H	Split Disk - PCIe3 x8 SAS RAID Internal Adapter 6 Gb (FC EJ1H; CCIN 57D7); Adapter FRU number: 01LK399	FC EJ1H is used to split the disk backplane into two sets of four disks. It provides JBOD or SAS RAID 0, 5, 6, and 10, functions for the attached disk drives in the base function.

For more information about the PCIe3 SAS RAID controllers, see the following topics:

- SAS RAID controllers for AIX
- SAS RAID controllers for IBM i
- SAS RAID controllers for Linux
- SAS subsystem for the 9040-MR9

Managing adapters for the 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9223-42H, or 9223-42S system

Find information about using and managing the adapters that are supported for the IBM Power System S914 (9009-41A and 9009-41G), IBM Power System S924 (9009-42A and 9009-42G), IBM Power System H924 (9223-42H), or IBM Power System H924S (9223-42S) system. Also, find information about specifications and installation notes for specific adapters.

Overview of managing adapters for the 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9223-42H, or 9223-42S system

Find information about using and managing adapters.

The following features are electromagnetic compatibility (EMC) Class B features. See the Class B Notices in the Hardware Notices section.

Table 4. Electromagnetic compatibility (EMC) Class B features	
Feature	**Description**
5748	POWER GXT145 PCI Express Graphics Accelerator
5785	4 Port Async EIA-232 PCIe Adapter
EN0W	PCIe2 2-port 10 GbE BaseT RJ45 Adapter

The adapter information that is shown here is used during non-directed service activities. The information can be used to:

- Identify an adapter
- Find specific technical information about an adapter
- Where applicable, show special installation or cabling instructions
- Show signal names for the output-pins of the adapter connectors
- Where applicable, show the settings for switches or jumpers

Adapters can be identified by their feature code (FC) or their custom-card identification number (CCIN). Normally, the CCIN number is labeled on the adapter. The field replaceable unit (FRU) part number (P/N) of your adapter might not match the FRU P/N listed in this information. If the part numbers do not match, verify that the CCIN is the same. If the CCIN is same, the adapter has the same function and can be used in the same way.

Adapters must be placed in specific slots to function correctly or optimally.

SAS RAID internal adapters and controllers for the 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9223-42H, or 9223-42S system

Find information about the PCIe3 SAS RAID internal adapters and controllers that are installed and supported in the system.

Table 5 on page 5 provides information about the SAS RAID cards that are supported for the 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9223-42H, or 9223-42S system.

Table 5. SAS RAID Controllers supported for the 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9223-42H, or 9223-42S system

Feature Code	Description	Function
EJ1C	Single - PCIe3 x8 SAS RAID Internal Adapter 6 Gb (FC EJ1C; CCIN 57D7); Adapter FRU number: 01LK399	Storage backplane with integrated SAS controller for SAS bays and DVD in the system unit. SAS bays are 2.5-inches or Small Form Factor (SFF) and use drives that are mounted on a carrier/tray specific to the system unit (SFF-3). The high-performance SAS controller provides RAID-0, RAID-5, RAID-6 and RAID-10 support for either HDD or SSD. JBOD support for HDD is also supported. Controller has no write cache.
EJ1E	Split Disk - PCIe3 x8 SAS RAID Internal Adapter 6 Gb (FC EJ1E; CCIN 57D7); Adapter FRU number: 01LK399	The high-performance SAS controllers each provides RAID-0, RAID-5, RAID-6 and RAID-10 support. JBOD support for HDD is also supported. There is no write cache on either controller.

Table 5. SAS RAID Controllers supported for the 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9223-42H, or 9223-42S system (continued)		
Feature Code	**Description**	**Function**
EJ1D	18 SFF - PCIe3 x8 cache SAS RAID internal adapter 6 Gb (FC EJ1D; CCIN 57D8); Adapter FRU number: 01JC773	Storage backplane with dual integrated SAS controllers with write cache. High-performance controllers run SFF-3 SAS bays, 1.8-inch SSD cage bays if supported, and DVD bay in the system unit. Dual controllers (also called dual I/O adapters or paired controllers) and their write cache are placed in integrated slots and do not use PCIe slots. The high-performance SAS controllers provide RAID-0, RAID-5, RAID-6, RAID-10, RAID-5T2, RAID-6T2, and RAID-10T2 support. Patented Active/Active configurations with at least two arrays is supported.
EJ1M	12 SFF with RDX - PCIe3 x8 cache SAS RAID internal adapter 6 Gb (FC EJ1M; CCIN 57D8); Adapter FRU number: 01JC773	Storage backplane with dual integrated SAS controllers with write cache. High-performance controllers run SFF-3 SAS bays, 1.8-inch SSD cage bays if supported, and DVD bay in the system unit. Dual controllers (also called dual I/O adapters or paired controllers) and their write cache are placed in integrated slots and do not use PCIe slots. The high-performance SAS controllers provide RAID-0, RAID-5, RAID-6, RAID-10, RAID-5T2, RAID-6T2, and RAID-10T2 support. Patented Active/Active configurations with at least two arrays is supported.

For more information about the PCIe3 SAS RAID controllers, see the following topics:

- SAS RAID controllers for AIX
- SAS RAID controllers for IBM i
- SAS RAID controllers for Linux
- SAS subsystem for the 9040-MR9

Managing adapters for the 9040-MR9 system

Find information about using and managing the adapters that are supported for the IBM Power System E950 (9040-MR9) server. Also, find information about specifications and installation notes for specific adapters.

Overview of managing adapters for the 9040-MR9 system

Find information about using and managing adapters.

The following features are electromagnetic compatibility (EMC) Class B features. See the Class B Notices in the Hardware Notices section.

Table 6. Electromagnetic compatibility (EMC) Class B features	
Feature	**Description**
5748	POWER GXT145 PCI Express Graphics Accelerator

Table 6. Electromagnetic compatibility (EMC) Class B features (continued)	
Feature	**Description**
5785	4 Port Async EIA-232 PCIe Adapter
EN0W	PCIe2 2-port 10 GbE BaseT RJ45 Adapter

The adapter information that is shown here is used during non-directed service activities. The information can be used to:

- Identify an adapter
- Find specific technical information about an adapter
- Where applicable, show special installation or cabling instructions
- Show signal names for the output-pins of the adapter connectors
- Where applicable, show the settings for switches or jumpers

Adapters can be identified by their feature code (FC) or their custom-card identification number (CCIN). Normally, the CCIN number is labeled on the adapter. The field replaceable unit (FRU) part number (P/N) of your adapter might not match the FRU P/N listed in this information. If the part numbers do not match, verify that the CCIN is the same. If the CCIN is same, the adapter has the same function and can be used in the same way.

Adapters must be placed in specific slots to function correctly or optimally.

SAS RAID adapters and controllers used for internal storage features in the 9040-MR9 system

Find information about PCIe3 SAS RAID adapters and controllers that are installed and supported for internal storage features in the system.

The following table provides information about the SAS RAID cards that are supported for internal storage features in a 9040-MR9 system.

Table 7. SAS RAID controllers supported for the 9040-MR9 system		
Feature Code	**Description**	**Function**
EJ0K	PCIe3 SAS RAID quad port 6 Gb x8, low-profile capable adapter (FC EJ0K; CCIN 57B4); Adapter FRU number: 02DE906	• FC EJ0K adapter is used in the base function disk drive backplane configuration (EJBB) that supports 8x SFF (2.5") bays. The SAS controller provides RAID 0, 5, 6, and 10 support for disk arrays. It also supports one SAS AZ cable for internal SAS connection with two external mini SAS HD connectors. This adapter must be installed in slot C12. • Two FC EJ0K adapters are used in the split DASD disk drive backplane configuration (EJSB) that supports 8x SFF (2.5") bays. Each EJ0K adapter controls four disk drive bays. The SAS controllers provide RAID 0, 5, 6, and 10 support for disk arrays. It also supports one SAS AZ cable for internal SAS connection with two external mini SAS HD connectors. These adapters must be installed in C09 and C12 slots.

Table 7. SAS RAID controllers supported for the 9040-MR9 system (continued)		
Feature Code	**Description**	**Function**
EJ14	PCIe3 12 GB Cache RAID PLUS SAS adapter quad-port 6 Gb x8 (FC EJ14; CCIN 57B1); Adapter part number 02DE340	Two FC EJ14 adapters are used with the expanded function disk drive backplane configuration (EJ0C) that supports 8x SFF (2.5") bays. The SAS controllers provide RAID 0, 5, 6, 10, 5T2, 6T2, and 10T2 support for disk arrays. JBOD is not supported under dual adapter configurations. It also supports one SAS AZ4 cable for internal SAS connection with four external mini SAS HD connectors and two AA cables for adapter-to-adapter communication. These adapters must be installed in C09 and C12 slots.
EJBB	Storage backplane that uses a PCIe3 SAS RAID quad port 6 Gb x8 adapter for SAS bays in the system unit	The base function storage configuration includes: • One FC EJ0K adapter installed in C12 slot • One base function disk drive backplane with 8x SFF (2.5") bays • One SAS AZ cable SAS bays are 2.5-inch or Small Form Factor (SFF) and used drives that are mounted on a carrier or tray specific to the system unit (SFF-3). The high-performance SAS controller provides RAID 0, 5, 6, and 10 support for either HDD or SSD connectors. JBOD for HDD is also supported. The SAS controller has no write cache.
EJSB	Storage backplane that uses two PCIe3 SAS RAID quad port 6 Gb x8 adapters for SAS bays in the system unit	Base function storage configuration with split-disk feature includes: • Two FC EJ0K adapters that are installed in C09 and C12 slots • One base function disk drive backplane with 8x SFF (2.5") bays that are split into 4+4 • One SAS AZ cable SAS bays are 2.5-inch or Small Form Factor (SFF) and used drives that are mounted on a carrier or tray specific to the system unit (SFF-3). The storage bays are split into four storage bays each per adapter. The high-performance SAS controllers provide RAID 0, 5, 6, and 10 support for the HDD or SSD connectors. JBOD for HDD is also supported. The SAS controllers have no write cache.

Table 7. SAS RAID controllers supported for the 9040-MR9 system (continued)		
Feature Code	**Description**	**Function**
EJ0C	Expanded function storage backplane that uses dual PCIe3 12 GB Cache RAID Plus SAS adapters	Expanded function storage configuration with dual SAS Raid adapters includes: • Two FC EJ14 adapters that are installed in C09 and C12 slots • One expanded function disk drive backplane with 8x SFF (2.5") bays • One SAS AZ4 cable • Two A12 SAS cables for adapter-to-adapter attachment All eight SSF-3 SAS disk bays are used by both controllers. The high-performance SAS controllers provide RAID 0, 5, 6, 10, 5T2, 6T2, and 10T2 support. JBOD is not supported for dual controller configurations.

For more information about the PCIe3 SAS RAID controllers, see the following topics:

- SAS RAID controllers for AIX
- SAS RAID controllers for IBM i
- SAS RAID controllers for Linux
- SAS subsystem for the 9040-MR9

Managing adapters for the 9080-M9S system

Find information about using and managing the adapters that are supported for the 9080-M9S system. Also, find information about specifications and installation notes for specific adapters.

Overview of managing adapters for the 9080-M9S system

Find information about using and managing adapters.

The following features are electromagnetic compatibility (EMC) Class B features. See the Class B Notices in the Hardware Notices section.

Table 8. Electromagnetic compatibility (EMC) Class B features	
Feature	**Description**
5748	POWER GXT145 PCI Express Graphics Accelerator
5785	4 Port Async EIA-232 PCIe Adapter
EN0W	PCIe2 2-port 10 GbE BaseT RJ45 Adapter

The adapter information that is shown here is used during non-directed service activities. The information can be used to:

- Identify an adapter
- Find specific technical information about an adapter
- Where applicable, show special installation or cabling instructions
- Show signal names for the output-pins of the adapter connectors
- Where applicable, show the settings for switches or jumpers

Adapters can be identified by their feature code (FC) or their custom-card identification number (CCIN). Normally, the CCIN number is labeled on the adapter. The field replaceable unit (FRU) part number (P/N) of your adapter might not match the FRU P/N listed in this information. If the part numbers do not match, verify that the CCIN is the same. If the CCIN is same, the adapter has the same function and can be used in the same way.

Adapters must be placed in specific slots to function correctly or optimally.

SAS RAID internal adapters and controllers for the 9080-M9S system

Find information about the PCIe3 SAS RAID internal adapters and controllers that are installed and supported in the system.

Table 9 on page 10 provides information about the SAS RAID cards that are supported for the 9080-M9S system.

Table 9. SAS RAID controllers supported for the 9080-M9S system

Feature Code	Description	Function
EJ1C	Single - PCIe3 x8 SAS RAID Internal Adapter 6 Gb (FC EJ1C; CCIN 57D7); Adapter FRU number: 00MH906	Storage backplane with integrated SAS controller for SAS bays and DVD in the system unit. SAS bays are 2.5-inch or Small Form Factor (SFF) and used drives that are mounted on a carrier/tray specific to the system unit (SFF-3). The high-performance SAS controller provides RAID-0, RAID-5, RAID-6 and RAID-10 support for either HDD or SSD. JBOD support for HDD is also supported. Controller has no write cache.
EJ1E	Split Disk - PCIe3 x8 SAS RAID Internal Adapter 6 Gb (FC EJ1E; CCIN 57D7); Adapter FRU number: 00MH906	The high-performance SAS controllers each provides RAID-0, RAID-5, RAID-6 and RAID-10 support. JBOD support for HDD is also supported. There is no write cache on either controller.
EJ1D and EJ1M	18 SFF - PCIe3 x8 cache SAS RAID internal adapter 6 Gb (FC EJ1D; CCIN 57D8); Adapter FRU number: 00MA025	Storage backplane with dual integrated SAS controllers with write cache. High-performance controllers run SFF-3 SAS bays, 1.8-inch SSD cage bays if supported, and DVD bay in the system unit. Dual controllers (also called dual I/O adapters or paired controllers) and their write cache are placed in integrated slots and do not use PCIe slots. The high-performance SAS controllers provide RAID-0, RAID-5, RAID-6, RAID-10, RAID-5T2, RAID-6T2, and RAID-10T2 support. Patented Active/Active configurations with at least two arrays is supported.

Table 9. SAS RAID controllers supported for the 9080-M9S system (continued)		
Feature Code	**Description**	**Function**
EJ1M	12 SFF with RDX - PCIe3 x8 cache SAS RAID internal adapter 6 Gb (FC EJ1M; CCIN 57D8); Adapter FRU number: 00MA025	Storage backplane with dual integrated SAS controllers with write cache. High-performance controllers run SFF-3 SAS bays, 1.8-inch SSD cage bays if supported, and DVD bay in the system unit. Dual controllers (also called dual I/O adapters or paired controllers) and their write cache are placed in integrated slots and do not use PCIe slots. The high-performance SAS controllers provide RAID-0, RAID-5, RAID-6, RAID-10, RAID-5T2, RAID-6T2, and RAID-10T2 support. Patented Active/Active configurations with at least two arrays is supported.

For more information about the PCIe3 SAS RAID controllers, see the following topics:

- SAS RAID controllers for AIX
- SAS RAID controllers for IBM i
- SAS RAID controllers for Linux
- SAS subsystem for the 9040-MR9

Adapter information by feature code for the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers

Find information about the adapters that are supported for systems that contain the POWER9 processor.

The table shows the available adapters by feature code (FC), description, customer card identification number (CCIN), adapter FRU number, and provides a link to more details for each adapter.

Important:

- This document does not replace the latest sales and marketing publications and tools that document supported features.
- If you are installing a new feature, ensure that you have the software required to support the new feature and determine whether you must install any existing program temporary fix (PTF) prerequisites. To do this, use the Power Systems Prerequisites website (www14.software.ibm.com/support/customercare/iprt/home).

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers

Feature code	**Description**	**Supported on the following systems**						
2893	PCIe 2-line WAN with modem (FC 2893, 2894, EN13, EN14; CCIN 576C); Part number: 44V5323			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S			EMX0
2893 or 2894	PCIe 2-line WAN with modem (FC 2893, 2894, EN13, EN14; CCIN 576C); Part number: 44V5323			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S			EMX0
5260	PCIe2 4-port 1 GbE adapter (FC 5260, 5899, EL4L, and EL4M; CCIN 576F); Adapter part number: 74Y4064	9008-22L (FC EL4M)	9009-22A, 9009-22G, 9223-22H, or 9223-22S				9080-M9S	

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
5269	POWER GXT145 PCI Express Graphics Accelerator (FC 5269; CCIN 5269); Adapter part number: 74Y3227	9008-22L	9009-22A, 9009-22G, 9223-22H, or 9223-22S				9080-M9S	
5273	PCIe2 8 Gb dual-port Fibre Channel adapter (FC 5273, 5735, EL2N, and EL58); CCIN 577D); Adapter part number: 10N9824	9008-22L (EL2N)	9009-22A, 9009-22G, 9223-22H, or 9223-22S				9080-M9S	
5277	4-port Async EIA-232 PCIe 1X adapter (FC 5277 and 5785; CCIN 57D2); Adapter FRU number 46K6734	9008-22L	9009-22A, 9009-22G, 9223-22H, or 9223-22S				9080-M9S	

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
5729	PCIe2 FH 4-port 8 Gb Fibre Channel adapter (FC 5729; CCIN 5729); Adapter part number: 74Y3467			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		EMX0
5735	8 Gb PCI Express dual-port Fibre Channel adapter (FC 5273, 5735, EL2N, and EL58); CCIN 577D); Adapter part number: 10N9824			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		EMX0 (FC EL58)
5748	POWER GXT145 PCI Express Graphics Accelerator (FC 5748; CCIN 5269); Adapter part number: 10N7756			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
5785	4-port Async EIA-232 PCIe 1X adapter (FC 5277 and 5785; CCIN 57D2); Adapter part number: 46K6734			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		EMX0
5899	PCIe2 4-port 1 GbE adapter (FC 5260, 5899, EL4L, and EL4M; CCIN 576F); Adapter part number: 74Y4064			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		EMX0 (FC EL4L)

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	**Description**	**Supported on the following systems**						
EC2M	PCIe3 2-port 10 GbE NIC & RoCE SR adapter (FC EC2M, EC2N, and EL54; CCIN 57BE); Adapter part number: full-height tailstock: 00RX875, low-profile tailstock: 00RX872						9080-M9S	
EC2N	PCIe3 2-port 10 GbE NIC & RoCE SR adapter (FC EC2M, EC2N, and EL54; CCIN 57BE); Adapter part number: full-height tailstock: 00RX875, low-profile tailstock: 00RX872					9040-MR9		EMX0 (EL54)

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
EC2R	PCIe3 2-port 10 Gb NIC & RoCE SR/Cu adapter (FC EC2R and EC2S; CCIN 58FA); Adapter part number: 01FT759	9008-22L	9009-22A, 9009-22G, 9223-22H, or 9223-22S				9080-M9S	
EC2S	PCIe3 2-port 10 Gb NIC & RoCE SR/Cu adapter (FC EC2R and EC2S; CCIN 58FA); Adapter part number: 01FT759			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		EMX0
EC2T	PCIe3 2-port 25/10 Gb NIC & RoCE SFP28 adapter (FC EC2T and EC2U; CCIN 58FB); Adapter part number: 01FT753	9008-22L	5105-22E, 9009-22A, 9009-22G, 9223-22H, or 9223-22S				9080-M9S	

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
EC2U	PCIe3 2-port 25/10 Gb NIC & RoCE SFP28 adapter (FC EC2T and EC2U; CCIN 58FB); Adapter part number: 01FT753			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		EMX0
EC37	PCIe3 LP 2-port 10 GbE NIC & RoCE SFP+ Copper adapter (FC EC37, EC38, EL3X, and EL53; CCIN 57BC); Adapter part number: 00RX859	9008-22L (EL3X)	9009-22A, 9009-22G, 9223-22H, or 9223-22S				9080-M9S	
EC38	PCIe3 2-port 10 GbE NIC & RoCE SFP+ Copper adapter (FC EC37, EC38, EL3X, and EL53; CCIN 57BC); Adapter part number: 00RX859			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		EMX0 (EL53)

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	**Description**	**Supported on the following systems**						
EC3A	PCIe3 LP 2-Port 40 GbE NIC RoCE QSFP+ adapter (FC EC3A and EC3B; CCIN 57BD); Adapter part number: 00FW105	9008-22L	9009-22A, 9009-22G, 9223-22H, or 9223-22S				9080-M9S	
EC3B	PCIe3 2-Port 40 GbE NIC RoCE QSFP+ adapter (FC EC3A and EC3B; CCIN 57BD); Adapter part number: 00FW105			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		EMX0
EC3E	PCIe3 2-port 100 Gb EDR InfiniBand adapter x16 (FC EC3E and EC3F; CCIN 2CEA); Adapter part number: 00WT075	9008-22L	9009-22A, 9009-22G, 9223-22H, or 9223-22S					

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
EC3F	PCIe3 2-port 100 Gb EDR InfiniBand adapter x16 (FC EC3E and EC3F; CCIN 2CEA); Adapter part number: 00WT075			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S			
EC3L	PCIe3 2-port 100 GbE NIC & RoCE QSFP28 adapter (FC EC3L and EC3M; CCIN 2CEC); Adapter part number: 00WT078	9008-22L	9009-22A, 9009-22G, 9223-22H, or 9223-22S				9080-M9S	
EC3M	PCIe3 2-port 100 GbE NIC & RoCE QSFP28 adapter (FC EC3L and EC3M; CCIN 2CEC); Adapter part number: 00WT078			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
EC3T	PCIe3 1-port 100 Gb EDR InfiniBand adapter x16 (FC EC3T and EC3U; CCIN 2CEB) Adapter part number: 00WT013	9008-22L	9009-22A, 9009-22G, 9223-22H, or 9223-22S				9080-M9S	
EC3U	PCIe3 1-port 100 Gb EDR InfiniBand adapter x16 (FC EC3U; CCIN 2CEB) Adapter part number: 00WT013			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S			
EC42	PCIe2 3D Graphics adapter x1 (FC EC42); Adapter part number: 00E3980			9009-41A	9009-42A or 9223-42H			EMX0
EC45	PCIe2 4-port USB 3.0 adapter (FC EC45 and EC46; CCIN 58F9); Adapter part number: 00E2932	9008-22L	9009-22A, 9009-22G, 9223-22H, or 9223-22S				9080-M9S	

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	**Description**	**Supported on the following systems**						
EC46	PCIe2 4-port USB 3.0 adapter (FC EC45 and EC46; CCIN 58F9); Adapter part number: 00E2932			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		EMX0
EC51	PCIe2 LP 3D Graphics adapter x16 (FC EC51); Adapter part number: 00WT180	9008-22L	9009-22A, 9009-22G, 9223-22H, or 9223-22S				9080-M9S	
EC59	PCIe3 2x4 NVMe M.2 internal carrier adapter (FC EC59); Adapter part number: 01DH181	9008-22L	9009-22A or 9223-22H	9009-41A	9009-42A or 9223-42H			

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
EC5B	PCIe3 x8 Non-Volatile Memory 1.6 TB SSD NVMe adapter (FC EC5A, EC5B, EC5G, EC6U, and EC6V; CCIN 58FC); Adapter part number: 01DH570			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		
EC5C	PCIe3 x8 Non-Volatile Memory 3.2 TB SSD NVMe adapter (FC EC5C, EC5D, EC6W, and EC6X; CCIN 58FD); Adapter part number: 01LK431	9008-22L	9009-22A, 9009-22G, 9223-22H, or 9223-22S				9080-M9S	

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
EC5D	PCIe3 x8 Non-Volatile Memory 3.2 TB SSD NVMe adapter (FC EC5C, EC5D, EC6W, and EC6X; CCIN 58FD); Adapter part number: 01LK431			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		
EC5E	PCIe3 x8 Non-Volatile Memory 6.4 TB SSD NVMe adapter (FC EC5E, EC5F, EC6Y, and EC6Z; CCIN 58FE); Adapter part number: 01LK435	9008-22L	9009-22A, 9009-22G, 9223-22H, or 9223-22S				9080-M9S	

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	**Description**	**Supported on the following systems**						
EC5F	PCIe3 x8 Non-Volatile Memory 6.4 TB SSD NVMe adapter (FC EC5E, EC5F, EC6Y, and EC6Z; CCIN 58FE); Adapter part number: 01LK435			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		
EC5G	PCIe3 x8 Non-Volatile Memory 1.6 TB SSD NVMe adapter (FC EC5A, EC5B, EC5G, EC6U, and EC6V; CCIN 58FC); Adapter part number: 01DH570	9008-22L	9009-22A, 9009-22G, 9223-22H, or 9223-22S				9080-M9S	

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
EC62	PCIe4 x16 1-Port EDR 100 GB InfiniBand ConnectX-5 CAPI-capable adapter (FC EC62 and EC63; CCIN 2CF1); Adapter part number: 00WT179	9008-22L	9009-22A, 9009-22G, 9223-22H, or 9223-22S				9080-M9S	
EC63	PCIe4 x16 1-Port EDR 100 GB InfiniBand ConnectX-5 CAPI-capable adapter (FC EC62 and EC63; CCIN 2CF1); Adapter part number: 00WT179			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
EC64	PCIe4 x16 2-port EDR 100 GB InfiniBand ConnectX-5 CAPI Capable adapter (FC EC64 and EC65; CCIN 2CF2); Adapter part number: 00WT176	9008-22L	5105-22E, 9009-22A, 9009-22G, 9223-22H, or 9223-22S					
EC65	PCIe4 x16 2-port EDR 100 GB InfiniBand ConnectX-5 CAPI Capable adapter (FC EC64 and EC65; CCIN 2CF2); Adapter part number: 00WT176			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
EC66	PCIe4 x16, 2-port 100 GB RoCE En ConnectX-5 adapter (FC EC66 and EC67; CCIN 2CF3); Adapter part number: 01FT742			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		
EC67	PCIe4 x16, 2-port 100 GB RoCE En ConnectX-5 adapter (FC EC66 and EC67; CCIN 2CF3); Adapter part number: 01FT742	9008-22L	5105-22E, 9009-22A, 9009-22G, 9223-22H, or 9223-22S				9080-M9S	
EC6G	PCIe4 x16, 2-port HDR 100 Gb InfiniBand ConnectX-6 adapter (FC EC6G; CCIN 590E); Adapter part number: 02CM912		5105-22E					

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
EC6J	PCIe2 LP 2-Port USB 3.0 Adapter (FC EC6J and FC EC6K; CCIN 590F); Adapter part number: 02JD518	9008-22L	9009-22A, 9009-22G, 9223-22H, or 9223-22S				9080-M9S	
EC6K	PCIe2 LP 2-Port USB 3.0 Adapter (FC EC6J and FC EC6K; CCIN 590F); Adapter part number: 02JD518			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		EMX0
EC6U	PCIe3 x8 Non-Volatile Memory 1.6 TB SSD NVMe adapter (FC EC5A, EC5B, EC5G, EC6U, and EC6V; CCIN 58FC); Adapter part number: 01DH570						9080-M9S	

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
EC6V	PCIe3 x8 Non-Volatile Memory 1.6 TB SSD NVMe adapter (FC EC5A, EC5B, EC5G, EC6U, and EC6V; CCIN 58FC); Adapter part number: 01DH570			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S			
EC6W	PCIe3 x8 Non-Volatile Memory 3.2 TB SSD NVMe adapter (FC EC5C, EC5D, EC6W, and EC6X; CCIN 58FD); Adapter part number: 01LK431						9080-M9S	

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	**Description**	**Supported on the following systems**						
EC6X	PCIe3 x8 Non-Volatile Memory 3.2 TB SSD NVMe adapter (FC EC5C, EC5D, EC6W, and EC6X; CCIN 58FD); Adapter part number: 01LK431			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S			
EC6Y	PCIe3 x8 Non-Volatile Memory 6.4 TB SSD NVMe adapter (FC EC5E, EC5F, EC6Y, and EC6Z; CCIN 58FE); Adapter part number: 01LK435						9080-M9S	

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
EC6Z	PCIe3 x8 Non-Volatile Memory 6.4 TB SSD NVMe adapter (FC EC5E, EC5F, EC6Y, and EC6Z; CCIN 58FE); Adapter part number: 01LK435			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S			
EC75	PCIe4 2-port 100 GbE RoCE x16 adapter (FC EC75 and FC EC76; CCIN 2CFB); Adapter part number: 02CM921	9008-22L	9009-22A, 9009-22G, 9223-22H, or 9223-22S				9080-M9S	
EC76	PCIe4 2-port 100 GbE RoCE x16 adapter (FC EC75 and FC EC76; CCIN 2CFB); Adapter part number: 02CM921			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
EC77	PCIe4 2-port 100 GbE RoCE with Crypto x16 adapter (FC EC77 and FC EC78; CCIN 2CFA); Adapter part number: 02CM993		9009-22G				9080-M9S	
EC78	PCIe4 2-port 100 GbE RoCE with Crypto x16 adapter (FC EC77 and FC EC78; CCIN 2CFA); Adapter part number: 02CM993			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S			
EC7A	PCIe4 x8 NVMe 1.6 TB Flash Adapter (FC EC7A, EC7B, EC7J, and EC7K; CCIN 594A); Adapter part number: 02DE956	9008-22L	9009-22A, 9009-22G, 9223-22H, or 9223-22S				9080-M9S	

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
EC7B	PCIe4 x8 NVMe 1.6 TB Flash Adapter (FC EC7A, EC7B, EC7J, and EC7K; CCIN 594A); Adapter part number: 02DE956			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		
EC7C	PCIe4 x8 NVMe 3.2 TB Flash Adapter (FC EC7C, EC7D, EC7L, and EC7M; CCIN 594B); Adapter part number: 02DE960	9008-22L	9009-22A, 9009-22G, 9223-22H, or 9223-22S				9080-M9S	
EC7D	PCIe4 x8 NVMe 3.2 TB Flash Adapter (FC EC7C, EC7D, EC7L, and EC7M; CCIN 594B); Adapter part number: 02DE960			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
EC7E	PCIe4 x8 NVMe 6.4 TB Flash Adapter (FC EC7E, EC7F, EC7N, and EC7P; CCIN 594C); Adapter part number: 02DE964	9008-22L	9009-22A, 9009-22G, 9223-22H, or 9223-22S				9080-M9S	
EC7F	PCIe4 x8 NVMe 6.4 TB Flash Adapter (FC EC7E, EC7F, EC7N, and EC7P; CCIN 594C); Adapter part number: 02DE964			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		
EC7J	PCIe4 x8 NVMe 1.6 TB Flash Adapter (FC EC7A, EC7B, EC7J, and EC7K; CCIN 594A); Adapter part number: 02DE956						9080-M9S	

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
EC7K	PCIe4 x8 NVMe 1.6 TB Flash Adapter (FC EC7A, EC7B, EC7J, and EC7K; CCIN 594A); Adapter part number: 02DE956			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S			
EC7L	PCIe4 x8 NVMe 3.2 TB Flash Adapter (FC EC7C, EC7D, EC7L, and EC7M; CCIN 594B); Adapter part number: 02DE960						9080-M9S	
EC7M	PCIe4 x8 NVMe 3.2 TB Flash Adapter (FC EC7C, EC7D, EC7L, and EC7M; CCIN 594B); Adapter part number: 02DE960			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S			

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
EC7N	PCIe4 x8 NVMe 6.4 TB Flash Adapter (FC EC7E, EC7F, EC7N, and EC7P; CCIN 594C); Adapter part number: 02DE964						9080-M9S	
EC7P	PCIe4 x8 NVMe 6.4 TB Flash Adapter (FC EC7E, EC7F, EC7N, and EC7P; CCIN 594C); Adapter part number: 02DE964			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S			
EJ05	PCIe3 cable adapter for the EMX0 PCIe Gen3 I/O expansion drawer (FC EJ05; CCIN 2B1C); Adapter part number: 00RR809	9008-22L	9009-22A, 9009-22G, 9223-22H, or 9223-22S					

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
EJ07	PCIe3 cable adapter for the EMX0 PCIe3 expansion drawer (FC EJ07; CCIN 6B52); Adapter part number: 00TK704						9080-M9S	
EJ08	PCIe3 cable adapter for the EMX0 PCIe3 expansion drawer (FC EJ08; CCIN 2CE2); Adapter part number: 41T9901			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		
EJ0J	PCIe3 SAS RAID quad-port 6 Gb adapter (FC EJ0J and EL59); CCIN 57B4); Adapter part number: 00FX846			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		EMX0 (FC EJ0J and FC EL59)

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
EJ0K	PCIe3 SAS RAID quad port 6 Gb x8, low-profile capable adapter (FC EJ0K; CCIN 57B4)					9040-MR9		
EJ0L	PCIe3 12 GB Cache SAS RAID quad-port 6 Gb adapter (FC EJ0L; CCIN 57CE); Adapter part number: 00FX840			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		EMX0
EJ0M	PCIe3 SAS RAID quad-port 6 Gb LP adapter (FC EJ0M and EL3B; CCIN 57B4); Adapter part number: 00MH910	9008-22L (FC EL3B)	9009-22A, 9009-22G, 9223-22H, or 9223-22S				9080-M9S	

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
EJ10	PCIe3 4 x8 SAS Port adapter (FC EL60, EL65, EJ10, and EJ11; CCIN 57B4); Adapter part number: 00MH959			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		EMX0
EJ11	PCIe3 4 x8 SAS Port adapter (FC EL60, EL65, EJ10, and EJ11; CCIN 57B4); Adapter part number: 00MH959	9008-22L (FC EL60)	9009-22A, 9009-22G, 9223-22H, or 9223-22S				9080-M9S	
EJ14	PCIe3 12 GB Cache RAID PLUS SAS adapter quad-port 6 Gb x8 (FC EJ14; CCIN 57B1); Adapter part number 01DH742			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		EMX0

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
EJ19	PCIe3 cable adapter for the EMX0 PCIe Gen3 I/O expansion drawer (FC EJ19; CCIN 6B53); Adapter part number: 02AE929						9080-M9S	
EJ1C	PCIe3 x8 SAS RAID Internal adapter 6 Gb (FC EJ1C and EJ1E; CCIN 57D7); Adapter part number: 01LK399			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S			
EJ1D and EJ1M	PCIe3 x8 cache SAS RAID internal adapter 6 Gb (FC EJ1D and EJ1M; CCIN 57D8); Adapter part number: 01JC773			9009-41A	9009-42A and 9223-42H			

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
EJ1E	PCIe3 x8 SAS RAID Internal adapter 6 Gb (FC EJ1C and EJ1E; CCIN 57D7); Adapter part number: 01LK399			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S			
EJ1F and EJ1H	PCIe3 x8 SAS RAID Internal adapter 6 Gb (FC EJ1F, EJ1H, EL66, EL68; CCIN 57D7); Adapter part number: 01LK399	9008-22L (FC EL66 and EL68)	9009-22A and 9223-22H					
EJ1G	PCIe3 x8 cache SAS RAID Internal adapter 6 Gb (FC EJ1G and EL67; CCIN 57DC); Adapter part number: 01JC780	9008-22L (FC EL67)	9009-22A and 9223-22H					

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
EJ1N	PCIe1 SAS Tape/DVD dual-port 3 Gb x8 adapter (FC EJ1N and EJ1P; CCIN 57B3); Adapter part number: 44V4852	9008-22L	9009-22A, 9009-22G, 9223-22H, or 9223-22S				9080-M9S	
EJ1P	PCIe1 SAS Tape/DVD dual-port 3 Gb x8 adapter (FC EJ1N and EJ1P; CCIN 57B3); Adapter part number: 44V4852			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		EMX0
EJ1R	PCIe3 cable adapter for the EMX0 PCIe Gen3 I/O expansion drawer (FC EJ1R; CCIN 58FF); Adapter part number: 02AE884	9008-22L	9009-22A, 9009-22G, 9223-22H, or 9223-22S					

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
EJ20	PCIe3 cable adapter for the EMX0 PCIe Gen3 I/O expansion drawer (FC EJ20; CCIN 2CF5); Adapter part number: 02WF001			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		
EJ27	PCIe Cryptographic Coprocessor (FC EJ27 and EJ28; CCIN 476A); Adapter part number: 45D7948					9040-MR9		
EJ28	PCIe Cryptographic Coprocessor (FC EJ27 and EJ28; CCIN 476A); Adapter part number: 45D7948					9040-MR9		EMX0

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
EJ32	4767-001 Cryptographic Coprocessor (FC EJ32 and EJ33; CCIN 4767); Adapter part number: 00LV501			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		
EJ33	4767-001 Cryptographic Coprocessor (FC EJ32 and EJ33; CCIN 4767); Adapter part number: 00LV501			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		EMX0
EJ35	4769-001 Cryptographic Coprocessor (FC EJ35 and EJ37 for BSC; CCIN C0AF); Adapter part number: 02JD572			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
EJ37	4769-001 Cryptographic Coprocessor (FC EJ35 and EJ37 for BSC; CCIN C0AF); Adapter part number: 02JD572			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		EMX0
EN0A	PCIe3 16 Gb 2-port Fibre Channel adapter (FC EL43, EL5B, EN0A, and EN0B; CCIN 577F); Adapter part number: 00E3496			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		EMX0 (FC EL5B and FC EN0A)
EN0B	PCIe3 16 Gb 2-port Fibre Channel adapter (FC EL43, EL5B, EN0A, and EN0B; CCIN 577F); Adapter part number: 00E9283	9008-22L	9009-22A, 9009-22G, 9223-22H, or 9223-22S				9080-M9S	

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
EN0F	PCIe2 8Gb 2-Port Fibre Channel adapter (FC EL5Y, EL5Z, EN0F, and EN0G; CCIN 578D); Adapter part number: 00WT111	9008-22L (FC EL5Y)	9009-22A, 9009-22G, 9223-22H, or 9223-22S				9080-M9S	
EN0G	PCIe2 8Gb 2-Port Fibre Channel adapter (FC EL5Y, EL5Z, EN0F, and EN0G; CCIN 578D); Adapter part number: 00WT111			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		EMX0
EN0H	PCIe3 4-port (10 Gb FCoE and 1 GbE) (FC EL38, FC EL56, FC EN0H, and FC EN0J; CCIN 2B93); Adapter part number: 00E3498			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		EMX0 (FC EL56 and FC EN0H)

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
EN0J	PCIe3 4-port (10 Gb FCoE and 1 GbE) (FC EL38, FC EL56, FC EN0H, and FC EN0J; CCIN 2B93); Adapter part number: 00E3498	9008-22L (FC EL38)	9009-22A, 9009-22G, 9223-22H, or 9223-22S				9080-M9S	
EN0K	PCIe3 4-port (10 Gb FCoE and 1 GbE) copper and RJ45 adapter (FC EL3C, EL57, EN0K, and EN0L; CCIN 2CC1); Adapter part number: 00E8140 (FC EN0K) and 00E3502 (FC EN0L)			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		EMX0

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
EN0L	PCIe3 4-port (10 Gb FCoE and 1 GbE) copper and RJ45 adapter (FC EL3C, EL57, EN0K, and EN0L; CCIN 2CC1); Adapter part number: 00E8140 (FC EN0K) and 00E3502 (FC EN0L)	9008-22L (FC EL3C)	9009-22A, 9009-22G, 9223-22H, or 9223-22S				9080-M9S	
EN0M	PCIe3 4-port (10 Gb FCoE and 1 GbE) LR and RJ45 adapter (FC EN0M and EN0N; CCIN 2CC0); Adapter part number: 00E8144					9040-MR9		EMX0

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
EN0N	PCIe3 4-port (10 Gb FCoE and 1 GbE) LR and RJ45 adapter (FC EN0M and EN0N; CCIN 2CC0); Adapter part number: 00E8143	9008-22L	9009-22A and 9223-22H				9080-M9S	
EN0S	PCIe2 4-port (10 Gb + 1 GbE) SR+RJ45 adapter (FC EN0S, FC EN0T, FC EN0U, and FC EN0V; CCIN 2CC3); Adapter part number: 00E2715			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		EMX0
EN0T	PCIe2 LP 4-port (10 Gb + 1 GbE) SR+RJ45 adapter (FC EN0T; CCIN 2CC3); Adapter part number: 00E2715	9008-22L	9009-22A, 9009-22G, 9223-22H, or 9223-22S				9080-M9S	

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
EN0U	PCIe2 4-port (10 Gb + 1 GbE) Copper SFP+RJ45 adapter (FC EN0U; CCIN 2CC3); Adapter part number: 00E2715; low-profile tailstock: 00E2720			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		EMX0
EN0V	PCIe2 LP 4-port (10 Gb + 1 GbE) copper SFP+RJ45 adapter (FC EN0V; CCIN 2CC3); Adapter part number: 00E2715	9008-22L	9009-22A, 9009-22G, 9223-22H, or 9223-22S				9080-M9S	

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
EN0W	PCIe2 2-port 10 GbE BaseT RJ45 adapter (FC EL3Z, FC EL55, FC EN0W, and FC EN0X; CCIN 2CC4); Adapter part number: Adapter part number: 00E2714			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		EMX0
EN0X	PCIe2 2-port 10 GbE BaseT RJ45 adapter (FC EL3Z, FC EL55, FC EN0W, and FC EN0X; CCIN 2CC4); Adapter part number: Adapter part number: 00E2714	9008-22L (FC EL3Z)	9009-22A, 9009-22G, 9223-22H, or 9223-22S				9080-M9S	

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
EN0Y	PCIe2 LP 8 Gb 4-port Fibre Channel adapter (FC EN0Y; CCIN EN0Y); Adapter part number: 74Y3923	9008-22L	9009-22A, 9009-22G, 9223-22H, or 9223-22S				9080-M9S	
EN12	PCIe2 FH 4-port 8 Gb Fibre Channel adapter (FC EN12; CCIN EN0Y); Adapter part number 00WT107			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		EMX0
EN13	PCIe 2-line WAN with modem (FC 2893, 2894, EN13, EN14; CCIN 576C); Part number: 44V5323			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S			EMX0

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
EN14	PCIe 2-line WAN with modem (FC 2893, 2894, EN13, EN14; CCIN 576C); Part number: 44V5323			9009-41A	9009-42A and 9223-42H			
EN15	PCIe3 4-port 10 GbE SR adapter (FC EN15 and EN16; CCIN 2CE3); Adapter part number: 00ND466			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		EMX0
EN16	PCIe3 4-port 10 GbE SR adapter (FC EN15 and EN16; CCIN 2CE3); Adapter part number: 00ND466						9080-M9S	

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
EN17	PCIe3 4-port 10 GbE SFP+ copper adapter (FC EN17 and EN18, CCIN 2CE4); Adapter part number: 00ND463					9040-MR9		EMX0
EN18	PCIe3 LPX 4-port 10 GbE SFP+ copper adapter (FC EN17 and EN18, CCIN 2CE4); Adapter part number: 00ND463						9080-M9S	
EN1A	PCIe3 x8 2-port Fibre Channel (32 Gb/s); (FC EL5U, EL5V, EN1A, and EN1B); CCIN 578F); Adapter part number: 01FT703			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		EMX0

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
EN1B	PCIe3 x8 2-port Fibre Channel (32 Gb/s); (FC EL5U, EL5V, EN1A, and EN1B); CCIN 578F); Adapter part number: 01FT703	9008-22L (FC EL5V)	9009-22A, 9009-22G, 9223-22H, or 9223-22S				9080-M9S	
EN1C	PCIe3 x8 4-port Fibre Channel (16 Gb/s); (FC EL5W, EL5X, EN1C, and EN1D; CCIN 578E); Adapter part number: 01FT698			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		EMX0
EN1D	PCIe3 x8 4-port Fibre Channel (16 Gb/s); (FC EL5W, EL5X, EN1C, and EN1D; CCIN 578E); Adapter part number: 01FT698	9008-22L (FC EL5X)	9009-22A, 9009-22G, 9223-22H, or 9223-22S				9080-M9S	

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
EN1E	PCIe3 x8 4-port Fibre Channel (16 Gb/s); (FC EN1E and EN1F; CCIN 579A); Adapter part number: 02JD586		9223-22S	9009-41G	9009-42G or 9223-42S	9040-MR9	9080-M9S	EMX0
EN1F	PCIe3 x8 4-port Fibre Channel (16 Gb/s); (FC EN1E and EN1F; CCIN 579A); Adapter part number: 02JD586		9009-22G or 9223-22S				9080-M9S	
EN1G	PCIe3 x8 2-port Fibre Channel (16 Gb/s) (EN1G and EN1H; CCIN 579B); Adapter part number: 02CM900 and 02CM903			9009-41A	9009-42A, 9009-42G, or 9223-42S	9040-MR9		EMX0

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	Description	Supported on the following systems						
EN1H	PCIe3 x8 2-port Fibre Channel (16 Gb/s) (EN1G and EN1H; CCIN 579B); Adapter part number: 02CM900 and 02CM903		9009-22A, 9009-22G, or 9223-22S				9080-M9S	
EN1J	PCIe4 x8 2-port Fibre Channel (32 Gb/s); (FC EN1J and EN1K; CCIN 579C); Adapter part number: 02CM909		9223-22S	9009-41G	9009-42G or 9223-42S	9040-MR9	9080-M9S	EMX0
EN1K	PCIe4 x8 2-port Fibre Channel (32 Gb/s); (FC EN1J and EN1K; CCIN 579C); Adapter part number: 02CM909		9009-22G or 9223-22S				9080-M9S	

Table 10. Adapters supported in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9040-MR9, 9080-M9S, 9223-22H, 9223-22S, 9223-42H, 9223-42S system and EMX0 PCIe3 expansion drawers (continued)

Feature code	**Description**	**Supported on the following systems**						
EN2A	PCIe3 16 Gb 2-port Fibre Channel adapter (FC EN2A and FC EN2B; CCIN 579D); Adapter part number: 02JD564			9009-41A or 9009-41G	9009-42A, 9009-42G, 9223-42H, or 9223-42S	9040-MR9		EMX0
EN2B	PCIe3 16 Gb 2-port Fibre Channel adapter (FC EN2A and FC EN2B; CCIN 579D); Adapter part number: 02JD564	9008-22L	9009-22A, 9009-22G, 9223-22H, or 9223-22S				9080-M9S	
ES14	NVMe 400 GB mainstream solid-state drive (FC ES14); Adapter part number: 00LY537	9008-22L	9009-22A or 9223-22H	9009-41A	9009-42A or 9223-42H			

Reference information for managing PCIe adapters

Learn how to install operating system device driver software, verify device driver software, and how to manage adapter battery packs.

Installing the AIX device driver software

Find information about how to install the AIX device driver software for a PCI adapter.

Before you begin

If you are installing the AIX operating system at this time, install the adapter before you install the operating system. When you install AIX, the adapter device driver is automatically installed and the following procedure does not apply to your situation.

About this task

If you are installing only the device driver for a PCI adapter, perform these steps:

Procedure

1. Log in to the system unit as root user.
2. Insert the media containing the device driver software (for example, the CD) into the media device.

   If your system does not have a CD-ROM drive, refer to your system documentation for performing a Network Installation Management (NIM) installation.
3. Type the following System Management Interface Tool (SMIT) fast path command: `smit devinst`.
4. Press **Enter**.

   The **Install Additional Device Software** window highlights the **INPUT device / directory for software** option.
5. Type the name of the input device that you are using, or press **F4** to select the input device from a list.
6. Press **Enter**.

   The **Install Additional Device Software** window highlights the **SOFTWARE to install** option.
7. Press **F4** to select List.
8. Type / to display the **Find** window.
9. Type the device package name, and press **Enter**.

   The system finds and highlights this device driver software.
10. Press **F7** to select the highlighted device driver software, and press **Enter**.

    The **INSTALL ADDITIONAL DEVICE SOFTWARE** window is displayed. The entry fields are automatically updated.
11. Press **Enter** to accept the information.

    The **ARE YOU SURE** window is displayed.
12. Press **Enter** to accept the information.

    The **COMMAND STATUS** window is displayed.

    - The message RUNNING is highlighted to indicate that the installation and configuration command is in progress.
    - When RUNNING changes to OK, scroll to the bottom of the page and locate the installation summary.
    - After a successful installation, SUCCESS displayed in the **Result** column of the installation summary at the bottom of the page.
13. Remove the installation media from the drive.
14. Press **F10** to exit SMIT.

What to do next

You can verify if the device driver has installed for the PCI adapter. For instructions, see "Verifying the AIX device driver software" on page 61.

Verifying the AIX device driver software

Find information about how to verify if whether the AIX device driver is installed for a PCI adapter.

About this task

To verify that the AIX device driver for an adapter is installed, do the following steps:

Procedure

1. If necessary, log in as root user.
2. At the command line, type `lslpp -l devices.`*xxxxxxxxxx* where *xxxxxxxxxx* is the device package name.
3. Press Enter.

Results

If the adapter device driver is installed, the following is an example of the data that is displayed on the window.

File set	Level	State	Description
Path: /usr/lib/objrepos devices.*xxxxxxxxxx*	5.3.8.0	COMMITTED	*Adapter name* software

Verify that the file sets are installed at the AIX version level you are running. Level 5.3.8.0 is an example. If no data is displayed on your screen, the adapter device driver was not installed correctly. Try reinstalling the driver.

Upgrading a SAS RAID storage adapter

Find information about upgrading the PCI-X and PCIe SAS RAID storage adapters with PCIe2 or PCIe3 SAS RAID storage adapters.

The PCIe2 and PCIe3 SAS RAID adapters add the industry standard T-10 Data Integrity Fields (DIF) for superior data protection. The T-10 DIF attaches three fields to each data block. During the operation, the DIFs can be checked at different points to detect data corruption or inappropriate use. When upgrading from PCI-X and PCIe SAS RAID storage adapters (which did not utilize the T-10 DIF fields) to PCIe2 or PCIe3 SAS RAID storage adapters, an automatic conversion process is performed to generate the T-10 DIFs on each data block. Once this conversion is performed, the devices are not usable on the previous PCI-X or PCIe SAS RAID storage adapters unless they are reformatted.

Adapter details

Find information about using and managing the adapters that are supported for the 5105-22E, IBM Power System L922 (9008-22L), IBM Power System S922 (9009-22A and 9009-22G), IBM Power System H922 (9223-22H), or IBM Power System H922S (9223-22S), and EMX0 PCIe Gen3 I/O expansion drawer. Also, find information about specifications and installation notes for specific adapters.

PCIe 2-line WAN with modem (FC 2893, FC 2894, FC EN13, and FC EN14; CCIN 576C)

Learn about the features of the PCIe 2-Line WAN with Modem.

This adapter is a 2-line per port WAN with modem PCIe adapter. Port 0 is the modem port and supports V.92 56K Async PPP, V.92 data modem, V.44 data compression, V.34 FAX modem and FAX functions, such as ECM and 2D/1D conversion. Port 0 does not provide Sync modem capabilities (SDLC and Sync PPP). Port 1 is the RVX port and supports multiple communications protocols, including synchronous operations.

2893 and EN13 is the non-CIM (Complex Impedance Matching) version offered in all countries and regions except Australia and New Zealand.

2894 and EN14 is the CIM (Complex Impedance Matching) version offered only in Australia and New Zealand.

Note: FC EN13 and EN14 are only supported with the IBM i operating system.

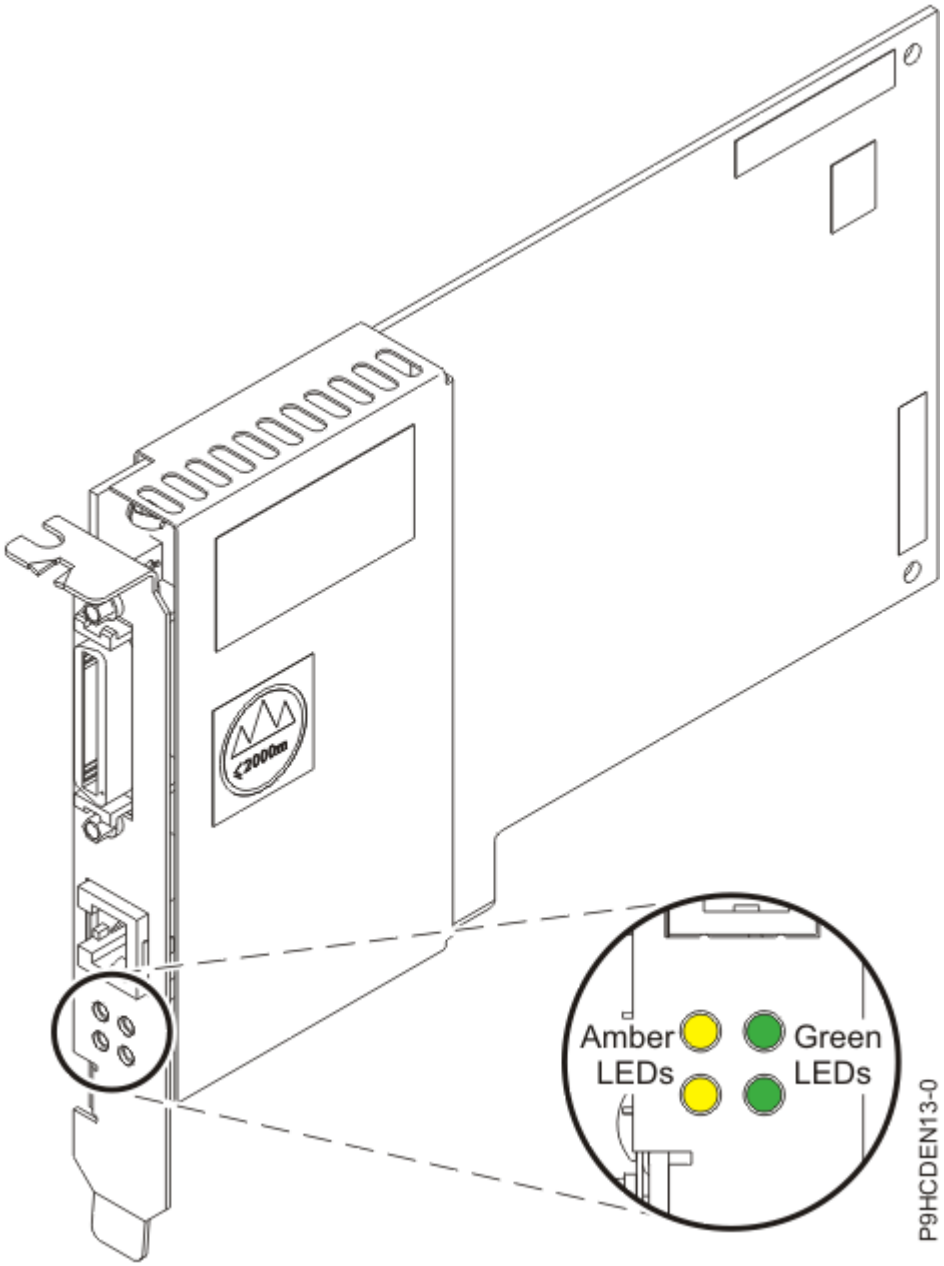


Figure 2. PCIe Binary Synchronous Adapter

Specifications

Item
Description

Adapter FRU number
44V5323

I/O bus architecture
PCIe2 x4

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
3.3 V

Form factor
Short, low-profile

Maximum number
For details about the maximum number of adapters that are supported, see Adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe2 4-port 1 GbE adapter (FC 5260, FC 5899, FC EL4L, and FC EL4M; CCIN 576F)

Learn about the specifications and operating system requirements for the feature code (FC) 5260, FC 5899, FC EL4L, and EL4M adapters.

Overview

FC 5260, FC EL4M, FC 5899, and FC EL4L are the same adapter with different feature codes. FC 5260 and EL4M are low-profile adapters and the FC 5899 and EL4L are full-height adapters.

These adapters provide four 1-Gb Ethernet ports that can be configured to run at 1000 megabits per second (Mbps) (or 1 gigabit per second (Gbps)), 100 Mbps, or 10 Mbps. The adapter connects to a network that uses unshielded twisted pair (UTP) cable for distances of up to 100 meters (328.08 feet). The adapter supports AIX Network Installation Management (NIM) boot capability. The adapter conforms

to the IEEE 802.3ab 1000Base-T standard. The adapter supports jumbo frames when running at the 1000 Mbps speed.

Each of the Ethernet ports can be connected by using:

- CAT5e (or later) UTP cables for 1000 Mbps network attachment
- CAT5 or CAT3 UTP cables for 100 Mbps or 10 Mbps network attachment

The cables are attached to the copper RJ45 connectors. Each port is independent of one another and supports full-duplex or half-duplex. The half-duplex mode does not support a speed of 1000 Mbps.

The adapter provides the following features:

- Supports interrupt moderation to deliver increased performance while significantly reducing processor utilization
- Supports dual port operation in almost any PCIe slot, except x1
- Supports auto-negotiation, full-duplex only
- Supports integrated media-access control (MAC) and physical layer (PHY)
- Supports Fast EtherChannel (FEC) with the existing software
- Supports gigabit EtherChannel (GEC) with the existing software
- Supports IEEE 802.3ad (Link Aggregation control protocol)
- Supports IEEE 802.1Q VLANs
- Supports IEEE 802.3 z, ab, u, x flow control support
- Supports IEEE 802.1p
- Supports IEEE 802.3ab for TX
- Supports TCP checksum offload transmission control protocol (TCP), user datagram protocol (UDP), Internet Protocol (IP) for IPv4 and IPv6
- Supports TCP segmentation or large send offload
- Supports EEPROM-SPI and single EEPROM
- Supports interrupt levels INTA and MSI
- Hardware certifications FCC B, UL, CE, VCCI, BSMI, CTICK, MIC
- Network Controller (MAC) Intel 82571EB

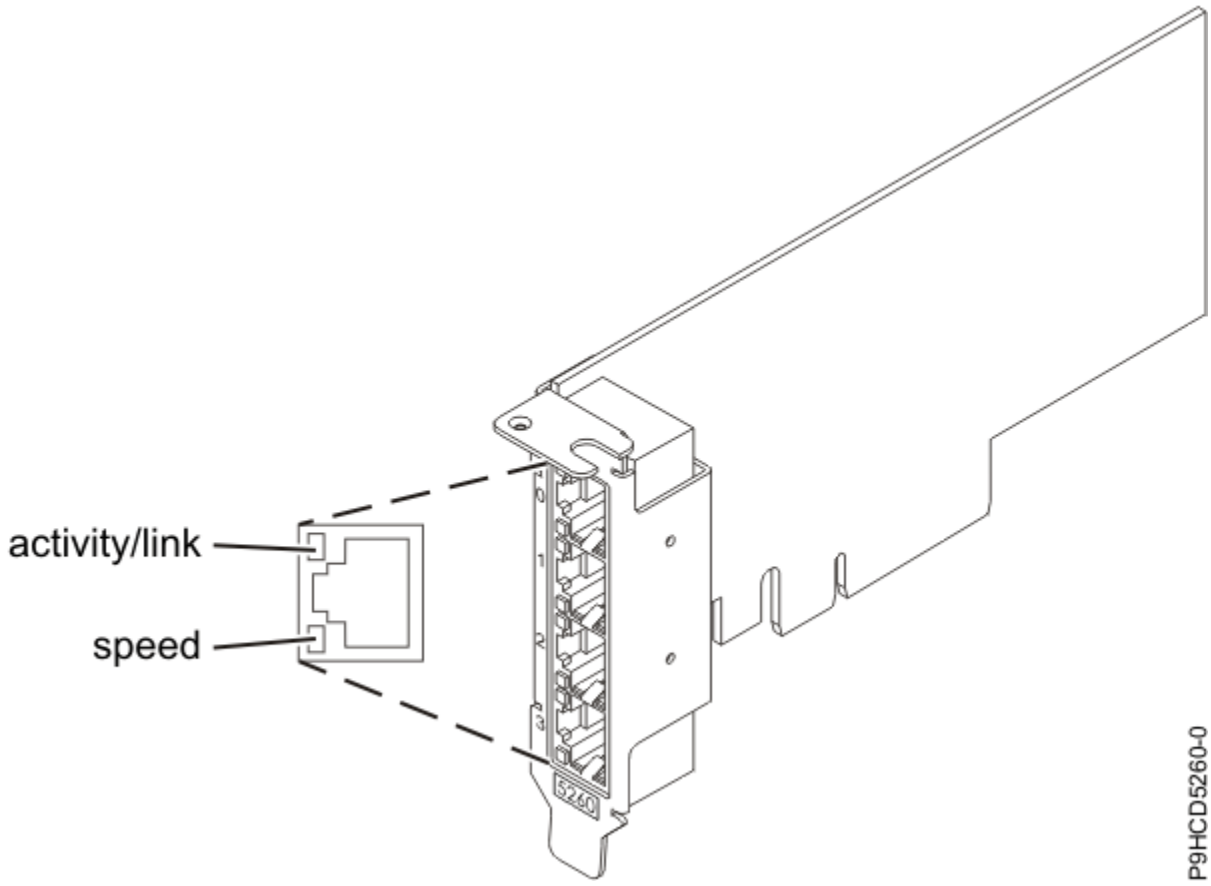


Figure 3. FC 5260 and FC EL4M PCIe2 4-port 1 GbE adapter

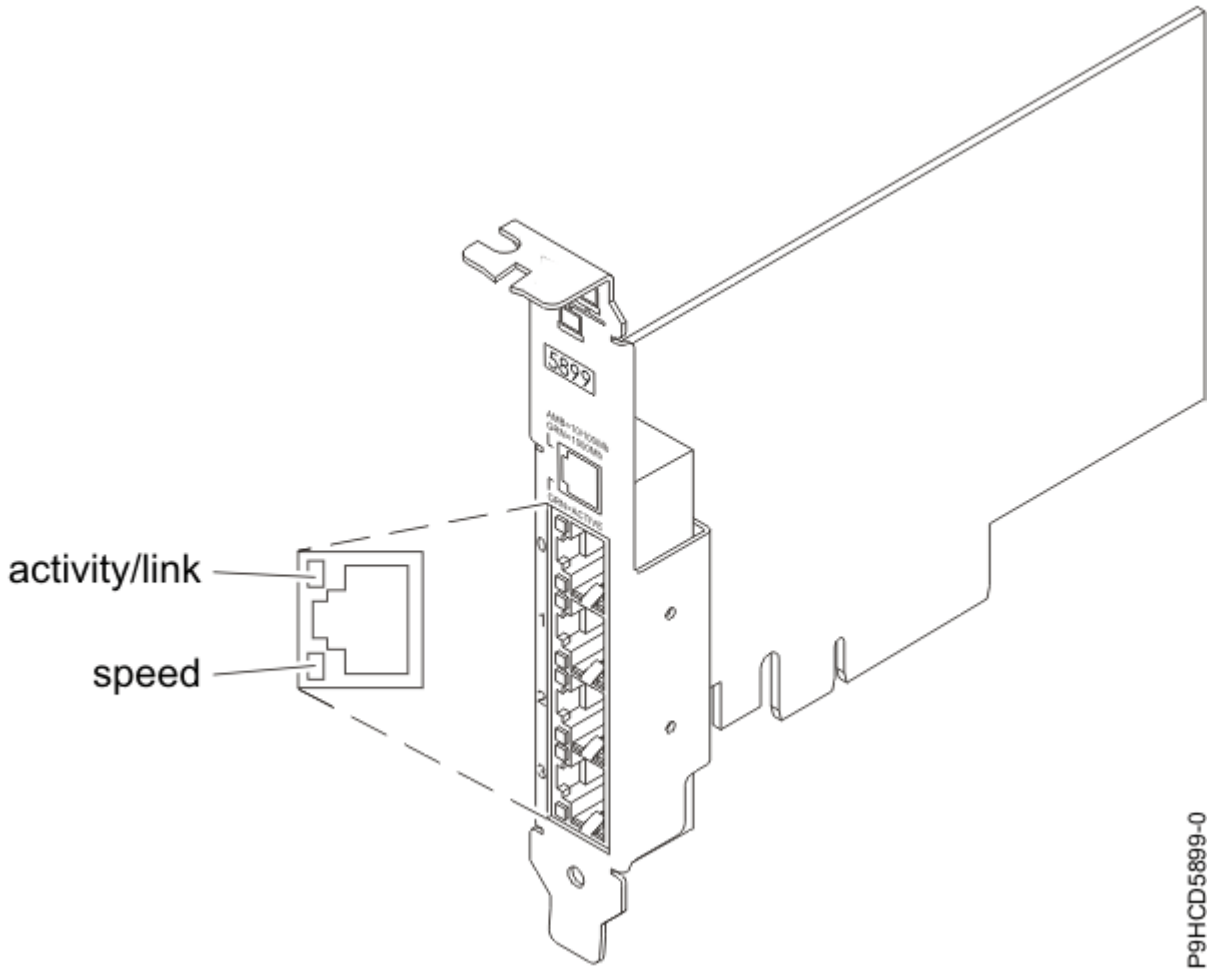


Figure 4. FC 5899 and FC EL4L PCIe2 4-port 1 GbE adapter

Specifications

Item
Description

Adapter FRU number
74Y4064

Wrap plug
10N7405

Note: Wrap plugs are not included with the card and cannot be purchased from IBM.

I/O bus architecture
PCIe2 x4

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
3.3 V

Form factor
short, low-profile

Connector information

- Two RJ-45 ports

- Two LED adapter status indicators per port, for link activity and speed

Cables

4-pair, CAT5e, UTP cables are connected to copper RJ45 connectors.

Attributes provided

- PCIe x4, generation-1 or generation-2
- 4-Port machine access code (MAC)
- High performance IPV4/IPV6 checksum offload
- Supports large send and large receive
- Multiple queues
- VIOS

Adapter LED states

The LEDs on the adapter provide information about the operation status of the adapter. The LEDs are visible through the mounting bracket. Figure 3 on page 65 shows the location of the LEDs. Table 11 on page 67 describes the different LED states and what those states indicate.

Table 11. Adapter LEDs and descriptions

LED	Light	Description
Speed	Yellow	10 Mbps or 100 Mbps
	Green	1000 Mbps or 1 Gbps
Activity/link	Green flashing	Active link or data activity
	Off	No link The absence of a link can indicate a defective cable, defective connector, or a configuration mismatch.

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe POWER GXT145 graphics accelerator adapter (FC 5269; CCIN 5269)

Learn about the features, requirements, installation notes, and troubleshooting tips for the PCIe POWER GXT145 graphics accelerator adapter.

Overview

The PCIe POWER GXT145 graphics accelerator adapter is a versatile 2D graphics accelerator and enhances the system unit video. This adapter supports both analog and digital monitors. The adapter requires a PCI Express slot. A short converter cable is included which adapts the 28-pin port on the adapter to dual DVI-I (analog/digital video) connectors. The adapter has no hardware switches to set. Mode selection is made through the software. The figures below show the adapters.

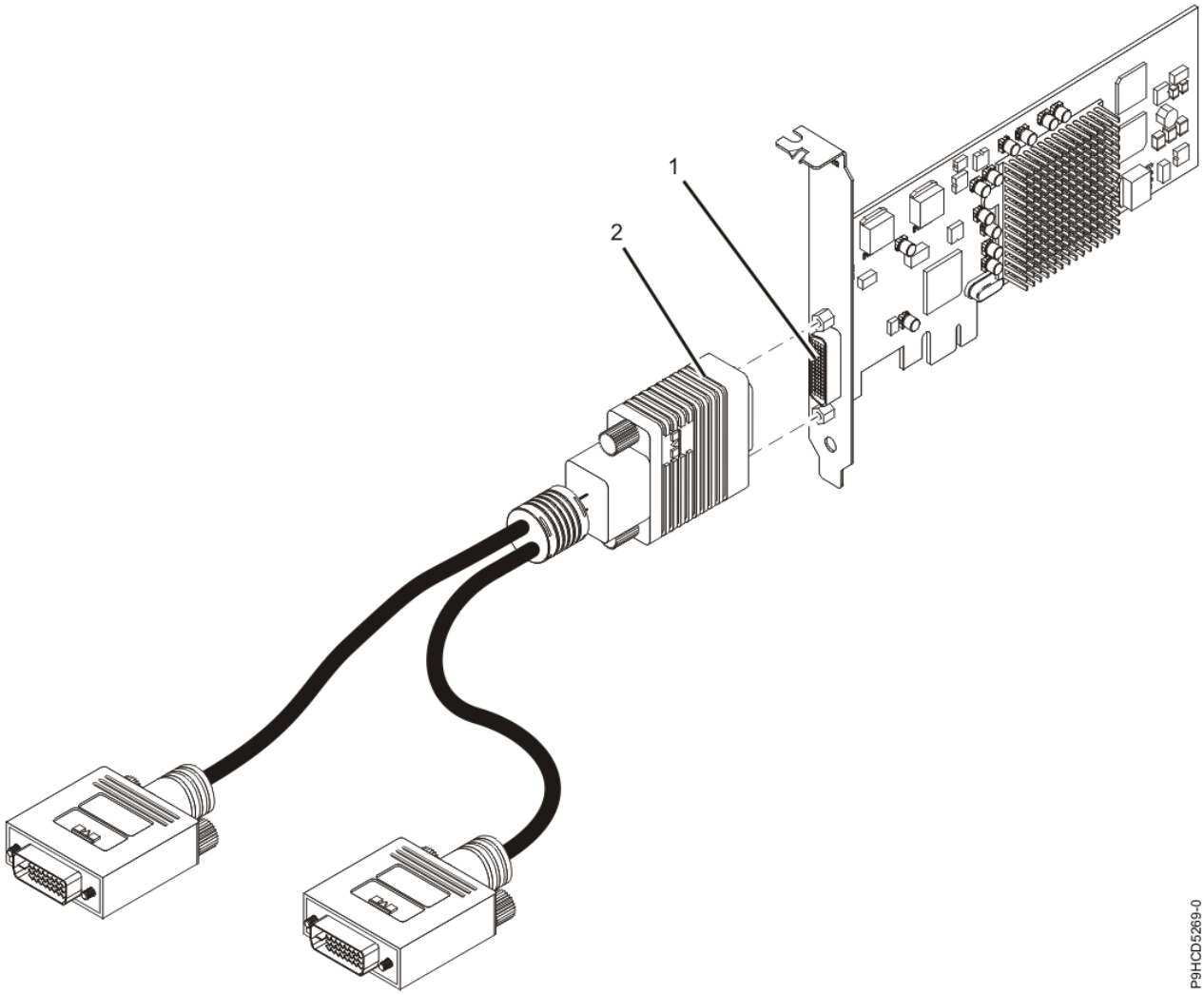


Figure 5. PCIe POWER GXT145 graphics accelerator adapter and converter cable (FC 5269)

1
DVI connector (28 pin), analog, or digital

2
Converter cable with dual DVI-I (analog/digital video) connectors

If your monitor has a DVI connector, connect it directly to the main DVI connector (labeled 1/3) of your converter cable.

If attaching a device that requires a 15 pin D-Shell receptacle for a VGA connection (that is, when the graphic adapter output is routed directly to a 7316-TF3 display or indirectly through a KVM switch), order

a VGA to DVI Connection Converter, feature number 4276 and connect it to the main DVI connector (labeled 1/3) of your converter cable.

If you're connecting only one monitor, use the main connector (labeled 1/3) of your converter cable.

In the system or logical partition that is running the AIX operating system, the video that is displayed on the secondary monitor is the same as the video displayed the primary monitor, and at the same resolution and refresh rate.

Specifications

Item
Description

Feature code
5269

Custom card identification number (CCIN)
5269

Adapter FRU number
74Y3227

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

This adapter provides the following features:

- 8-bit indexed or 24-bit true color.
- 32-MB SDRAM frame buffer.
- x1 PCIe bus interface.
- One DVI-I analog or digital connector.
- One monitor connected, analog, up to 2048 x 1536 resolution.
- One monitor connected, digital, up to 1280 x 1024 resolution.
- A second monitor supported at up to 1600 x 1200 analog or 1280 x 1024 digital.
  - For systems or logical partitions running the Linux operating system, a second monitor is supported at resolutions up to 1600 x 1200 analog or 1280 x 1024 digital.
  - For systems or logical partitions running the AIX operating system, when running with two monitors, both monitors must have an analog connection with the same resolution, up to 1600 x 1200. The image on the primary monitor is also displayed on the secondary monitor.
- Display power management: Video Electronics Standards Association (VESA), Display Power Management Signaling (DPMS)

Preparing for installation

If you are installing your operating system at this time, install your adapter before you install the operating system. If you are installing only the device driver for this adapter, install your device driver software before you install the adapter.

Installing the adapter

For instructions about installing PCIe adapters, see Installing, removing, or replacing PCIe adapters (http://www.ibm.com/support/knowledgecenter/POWER9/p9hak/pciadpters.htm) and select the system you are working on

Verifying the adapter installation

To verify that your system unit recognizes the PCI adapter, do the following steps:

1. If necessary, log in as root user.
2. At the command line, type: `lsdev -Cs pci`
3. Press Enter.

A list of PCI devices is displayed. If the adapter is installed correctly, the status of available for each port indicates that the adapter is installed and ready to use. If a message indicates that any of the ports are defined instead of available, shut down your server and verify that the adapter was installed correctly.

Troubleshooting

If you have video problems after the initial installation, follow these procedures to troubleshoot the problem:

- Check the cables.
- Check the device driver software installation.
- Check the console.
- Check the adapter installation.

Checking the cables

1. Ensure the monitor cables are connected to the correct adapter.
2. If you have more than one video adapter, be sure that each adapter is connected to a monitor.
3. Verify that the connections are secure.
4. If no log-in prompt appears, restart the system unit.

Checking the device driver software installation

Verify that the device driver for the PCIe POWER GXT145 graphics accelerator adapter is installed by typing the following command and then pressing Enter:

```
lslpp -l all | grep GXT145
```

If the GXT145 device driver is installed, the following table is an example of the data that appears if you are running AIX Version 5.2:

```
devices.pci.2b102725.X11 5.2.0.105 COMMITTED AIXwindows GXT145 Graphics
devices.pci.2b102725.diag 5.2.0.105 COMMITTED GXT145 Graphics Adapter
devices.pci.2b102725.rte   5.2.0.105  COMMITTED GXT145 Graphics Adapter
```

If the POWER GXT145 device driver did not fully install, reinstall the driver. For instructions, see Installing the AIX device driver software (www.ibm.com/support/knowledgecenter/POWER9/p9hak/pxhak_installing_devicedriver_aix.htm).

Checking the console

1. If you continue to experience problems, you can redirect the monitor to the new adapter using the **chdisp** command.
2. If you continue to experience problems after you have checked your cables and tried the **chdisp** command, run diagnostics.

Checking the adapter installation

Verify that the system unit recognizes the PCIe POWER GXT145 graphics accelerator adapter.

At the AIX command-line type `lsdev -Cs pci`. If the PCIe POWER GXT145 graphics accelerator adapter is correctly installed, the following is an example of the data that appears:

```
cor0 Available 0K-00 GXT145 Graphics Adapter
```

If the message indicates that the adapter is DEFINED instead of AVAILABLE, shut down the system unit and check the PCIe POWER GXT145 graphics accelerator adapter to ensure that it is installed correctly. If

you continue to experience problems after following the steps in this section, contact service and support for assistance.

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe 8 Gb 2-Port Fibre Channel adapter (FC 5273, FC 5735, FC EL2N, and FC EL58; CCIN 577D)

Learn about the specifications and operating system requirements for the feature code (FC) 5273, FC EL2N, FC 5735, and FC 5738 adapters.

Overview

FC 5273 and FC EL2N are low-profile adapters. FC 5735 and FC EL58 are full-height adapters.

The PCIe 8 Gb 2-Port Fibre Channel adapter is a high-performance adapter based on the Emulex e12002 PCIe Host Bus Adapter (HBA). Each port provides single initiator capability over a fiber link. The ports have LC type connectors that use shortwave laser optics. The adapter connects to Fibre Channel switches and direct attached storage devices, operating at link speeds of 2, 4, and 8 Gbps. The adapter automatically negotiates with the switch to the highest speed that the switch is capable of. LEDs on each port provide information about the status and link speed of the port.

N_Port ID Virtualization (NPIV) capability is supported through Virtual I/O Server (VIOS).

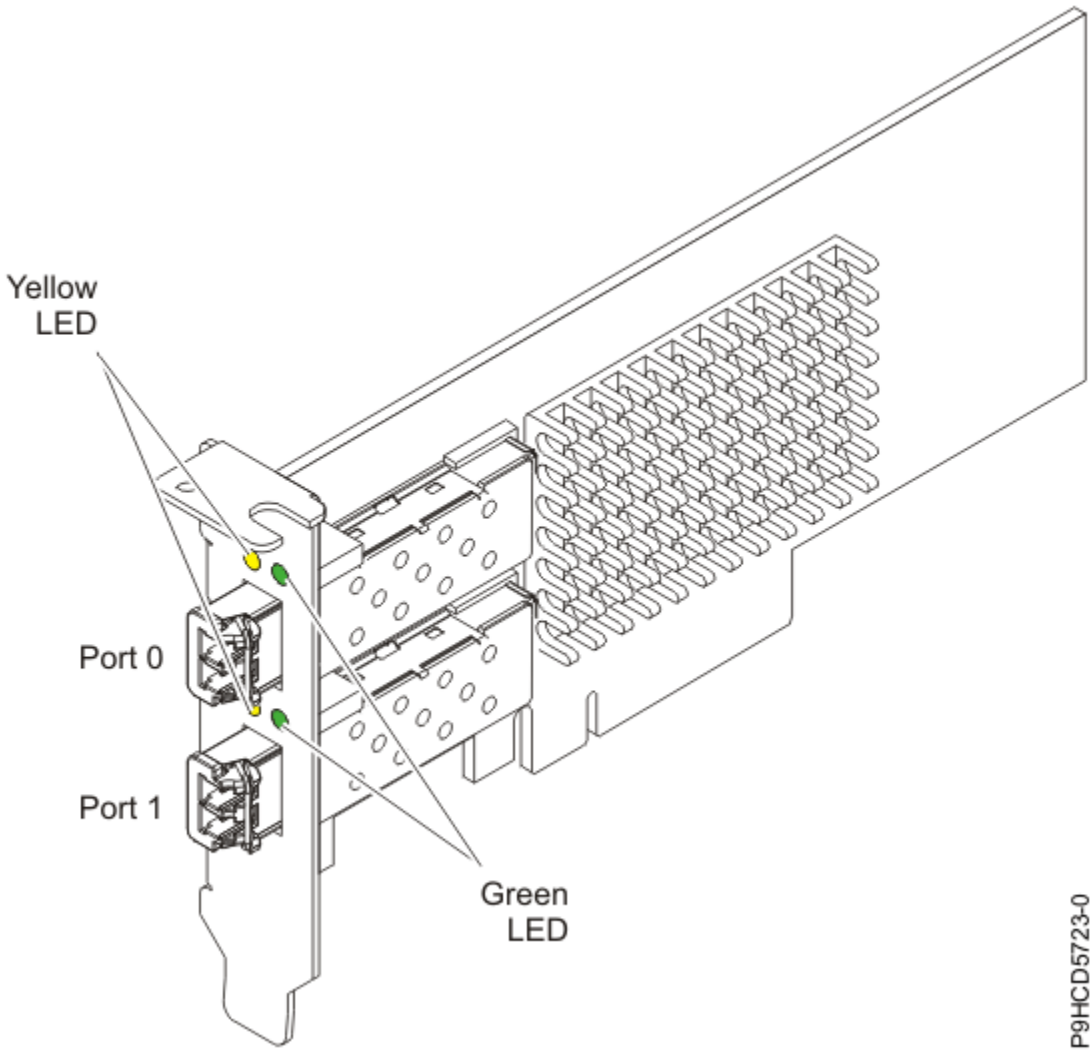


Figure 6. PCIe 8 Gb 2-Port Fibre Channel adapter (FC 5273 and FC EL2N)

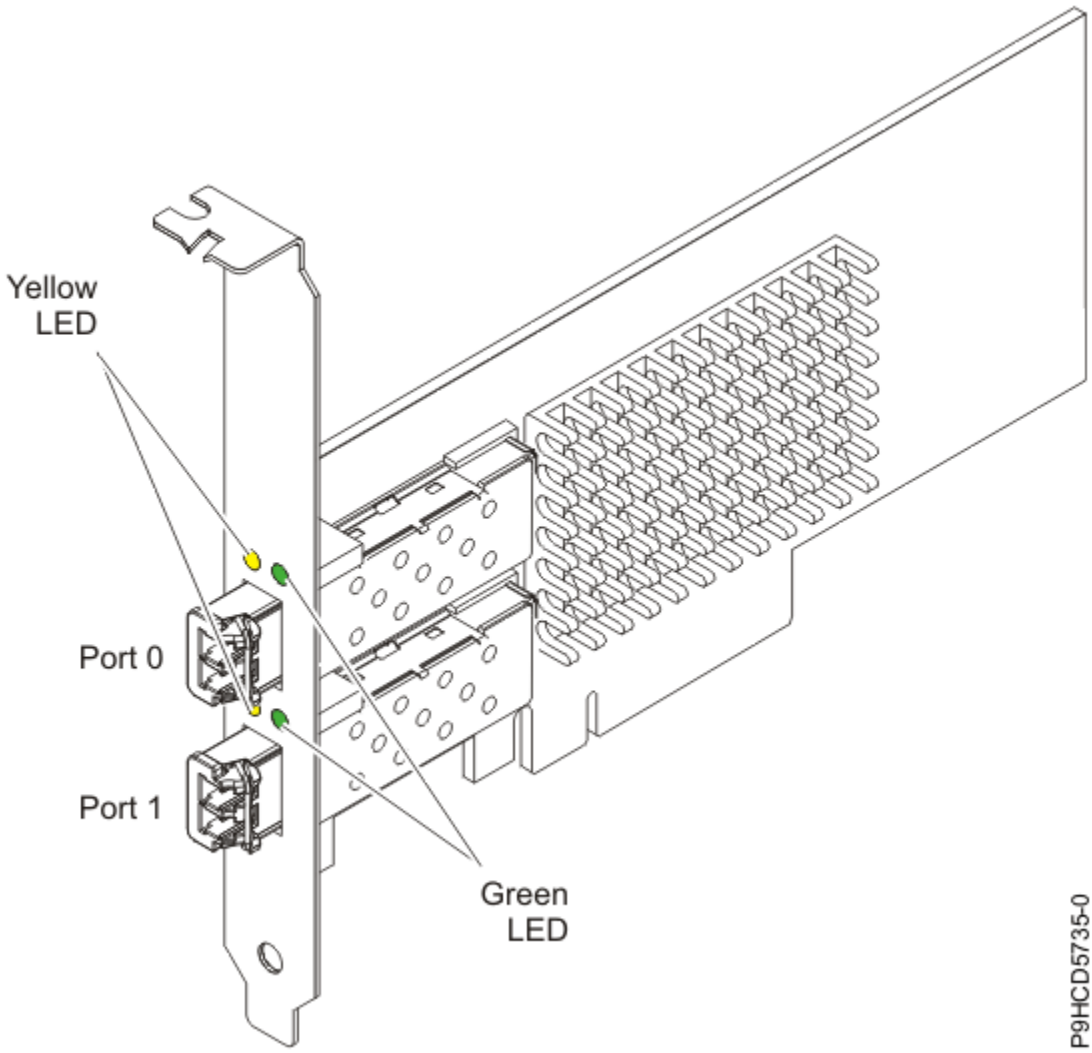


Figure 7. PCIe 8 Gb 2-Port Fibre Channel adapter (FC 5735 and FC 5738)

Adapter specifications

Item
Description

FRU number
10N9824

Wrap plug FRU number
12R9314

Note: The wrap plug is included with the card, and can also be purchased from IBM.

I/O bus architecture
PCI Express (PCIe) Base and Card Electromechanical (CEM) 2.0
x8 PCIe bus interface.

Slot requirement

For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
3.3 V.

Form factor
The FC 5273 and FC EL2N are short, low-profile adapters; the FC 5735 and FC EL58 are short, full-height adapters.

FC compatibility
2, 4, 8 Gigabit.

Cables
Cables are the responsibility of the customer.

Use multimode fiber optic cables with shortwave lasers that adhere to the following specifications:

- OM3: Multimode 50/125 micron fiber, 2000 MHz x km bandwidth
- OM2: Multimode 50/125 micron fiber, 500 MHz x km bandwidth
- OM1: Multimode 62.5/125 micron fiber, 200 MHz x km bandwidth

Because core sizes are different, OM1 cables can only be connected to other OM1 cables. For best results, OM2 cables should not be connected to OM3 cables. However, if an OM2 cable is connected to an OM3 cable, the characteristics of the OM2 cable apply to the entire length of the cables. The following table shows the supported distances for the different fiber optic cable types at different link speeds.

Table 12. Supported distances for multimode fiber optic cables

Header	**Cable Type and Distance**		
Rate	OM1	OM2	OM3
2.125 Gbps	0.5 meters to 150 meters (1.64 feet to 492.12 feet)	0.5 meters to 300 meters (1.64 feet to 984.25 feet)	0.5 meters to 500 meters (1.64 feet to 1640.41 feet)
4.25 Gbps	0.5 meters to 70 meters (1.64 feet to 229.65 feet)	0.5 meters to 150 meters (1.64 feet to 492.12 feet)	0.5 meters to 380 meters (1.64 feet to 1246.71 feet)
8.5 Gbps	0.5 meters to 21 meters (1.64 feet to 68.89 feet)	0.5 meters to 50 meters (1.64 feet to 164.04 feet)	0.5 meters to 150 meters (1.64 feet to 492.12 feet)

Adapter LED

Green and yellow LEDs can be seen through openings in the mounting bracket of the adapter. Green indicates firmware operation and yellow signifies port activity. Table 13 on page 74 summarizes the link rate conditions. There is a 1-second pause when the LED is off between each group of fast flashes (2, 3, or 4). Observe the LED sequence for several seconds to be sure that you have correctly identified the state.

Table 13. Normal LED states

Green LED	**Yellow LED**	**State**
Slow flash	Off	Normal, link inactive or not started
On	2 fast flashes	2 Gbps link rate - normal, link active
On	3 fast flashes	4 Gbps link rate - normal, link active
On	4 fast flashes	8 Gbps link rate - normal, link active

Power-on self test (POST) conditions and results are summarized in Table 14 on page 75. These states can be used to identify abnormal states or problems. Follow the action to be taken for each condition.

Table 14. POST conditions and results

Green LED	Yellow LED	State	Action to be taken
Off	Off	Wake-up failure (dead board)	Perform AIX, IBM i, or Linux operating system diagnostics procedure.
Off	On	POST failure (dead board)	Perform AIX, IBM i, or Linux operating system diagnostics procedure.
Off	Slow flash	Wake-up failure monitor	Perform AIX, IBM i, or Linux operating system diagnostics procedure.
Off	Fast flash	POST failure	Perform AIX, IBM i, or Linux operating system diagnostics procedure.
Off	Flashing	POST processing in progress	None
On	Off	Failure while functioning	Perform AIX, IBM i, or Linux operating system diagnostics procedure.
On	On	Failure while functioning	Perform AIX, IBM i, or Linux operating system diagnostics procedure.
Slow flash	Slow flash	Offline for download	None
Slow flash	Fast flash	Restricted offline mode, waiting for restart	None
Slow flash	Flashing	Restricted offline mode, test active	None
Fast flash	Off	Debug monitor in restricted mode	None
Fast flash	On	Not defined	None
Fast flash	Slow flash	Debug monitor in test fixture mode	None
Fast flash	Fast flash	Debug monitor in remote debug mode	None
Fast flash	Flashing	Not defined	None

Replacing Fibre Channel adapters by using hot swap

When hot swapping Fibre Channel adapters, be aware that device-related software for the storage devices might have extra devices (for example, the disk array router (dar) device that is associated with the fiber array storage technology (FAStT) or DS4800) that need to be removed. See the specific storage device documentation for information about how to remove these additional devices.

The new adapter has a unique worldwide port name (WWPN). Check the zoning and logical unit number (LUN) assignments to ensure that the new adapter functions as expected.

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe 4-port Async EIA-232 1X adapter (FC 5277 and 5785; CCIN 57D2)

Learn about the features, operating system requirements, and installation procedures for the feature code (FC) 5277 and 5785 adapters.

Overview

The PCIe 4-port Async EIA-232 1X adapter provides connections for four asynchronous EIA-232 devices using a 4-port DB-9F DTE expansion drawer cable. Ports are programmable to support EIA-232 protocols at a line speed of 128 Kbps.

The FC 5277 is a low-profile adapter. The FC 5785 is a full-height adapter.

The following figures show the adapter and cable.

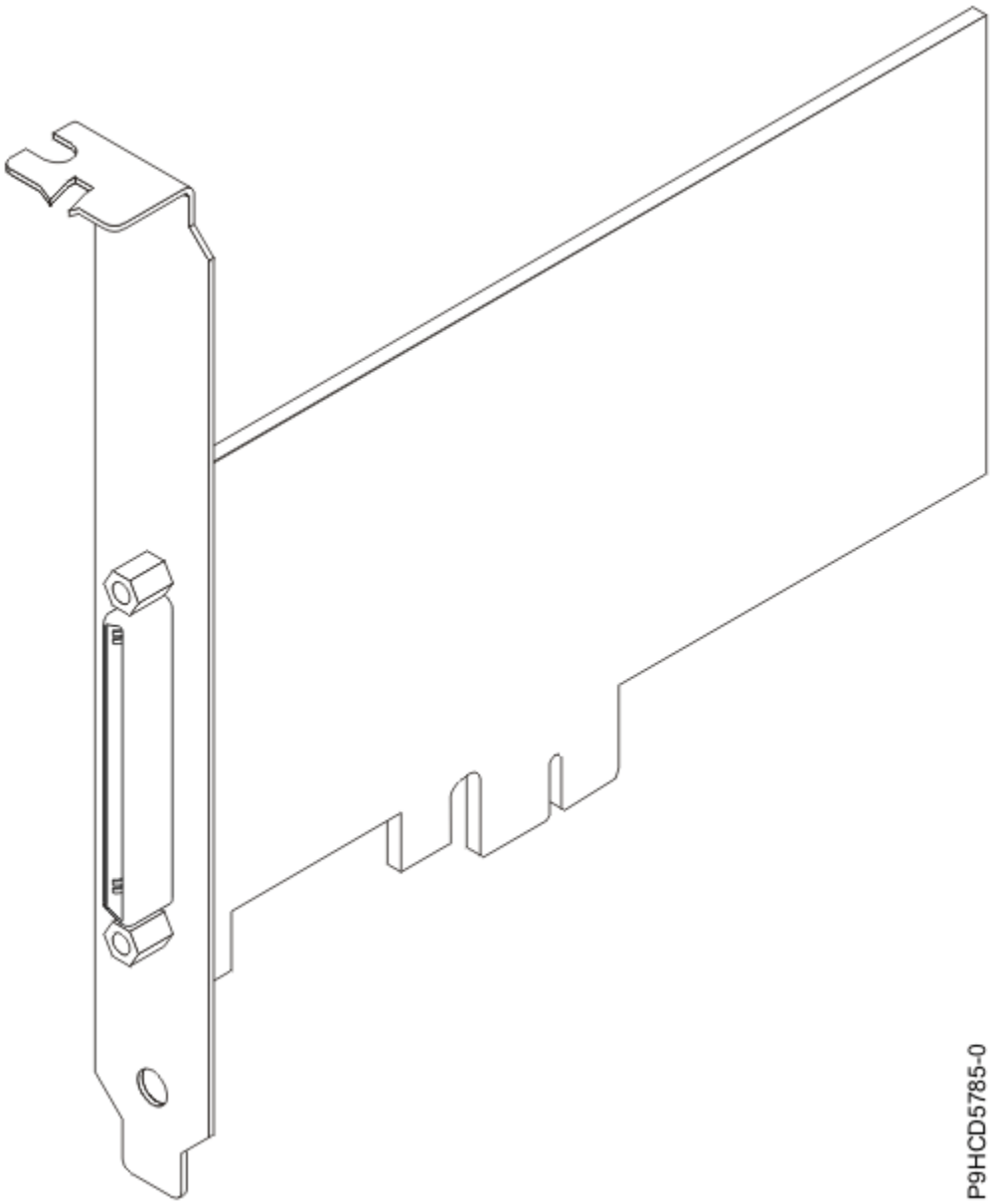


Figure 8. PCIe 4-port Async EIA-232 1X adapter

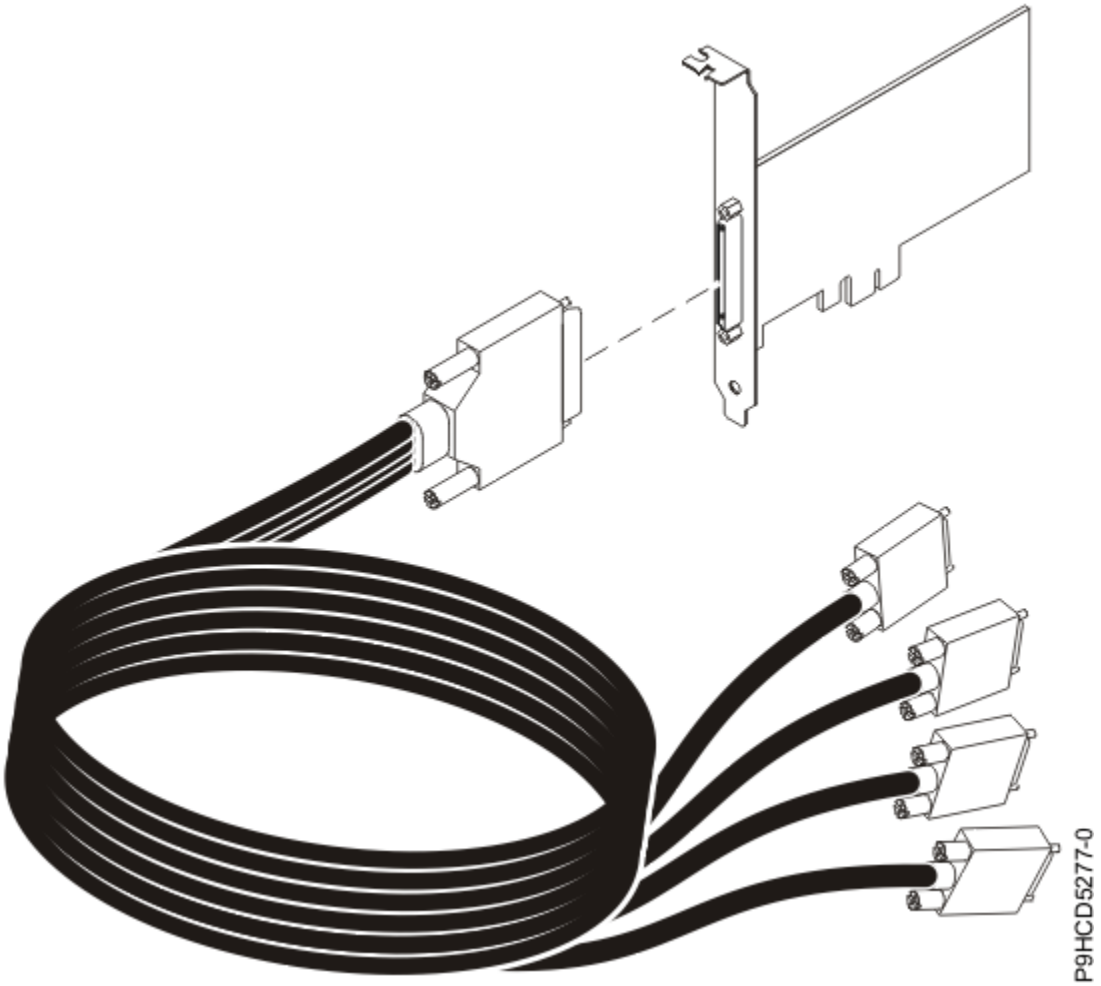


Figure 9. Cable for the PCIe 4-port Async EIA-232 1X adapter

Specifications

Item
Description

FRU number
Adapter: 46K6734

Cable: 46K6735

I/O bus architecture
PCIe-V1.0a 1x

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Busmaster
No

Adapter size
PCIe 1x, short form-factor

Connectors
Adapter: 68-pin SCSI

Cable: 68-pin SCSI to DB 9-pin shell

Wrap plug
42R5143

Preparing for installation

If you are installing your operating system at this time, install your adapter before you install the operating system. If you are installing only the device driver for this adapter, install your device driver software before you install the adapter.

Installing the adapter

For instructions about installing PCIe adapters, see Installing, removing, or replacing PCIe adapters (http://www.ibm.com/support/knowledgecenter/POWER9/p9hak/pciadpters.htm) and select the system you are working on.

Verifying the adapter installation

To verify that your system unit recognizes the PCI adapter, do the following steps:

1. If necessary, log in as root user.
2. At the command line, type: `lsdev -Cs pci`
3. Press Enter.

A list of PCI devices is displayed. If the adapter is installed correctly, the status of available for each port indicates that the adapter is installed and ready to use. If a message indicates that any of the ports are defined instead of available, shut down your server and verify that the adapter was installed correctly.

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe2 FH 4-Port 8 Gb Fibre Channel adapter (FC 5729; CCIN 5729)

Learn about the specifications and operating system requirements for the feature code (FC) 5729 adapter.

Overview

The PCIe2 FH 4-Port 8 Gb Fibre Channel adapter (FC 5729) is a high-performance adapter based on the Emulex LPe12004 PCIe Host Bus Adapter (HBA). FC 5729 is a generation-2 adapter and is supported on systems that support the generation-2 adapters. The adapter provides four Fibre Channel ports. Each Fibre Channel port provides single initiator capability over a fibre link. The ports have LC type connectors and use shortwave laser optics. The adapter connects to Fibre Channel switches and operates at link speeds of 2, 4, and 8 Gbps. The adapter automatically negotiates with the switch to the highest speed of

which the switch is capable. LEDs on each port provide information about the status and link speed of the port.

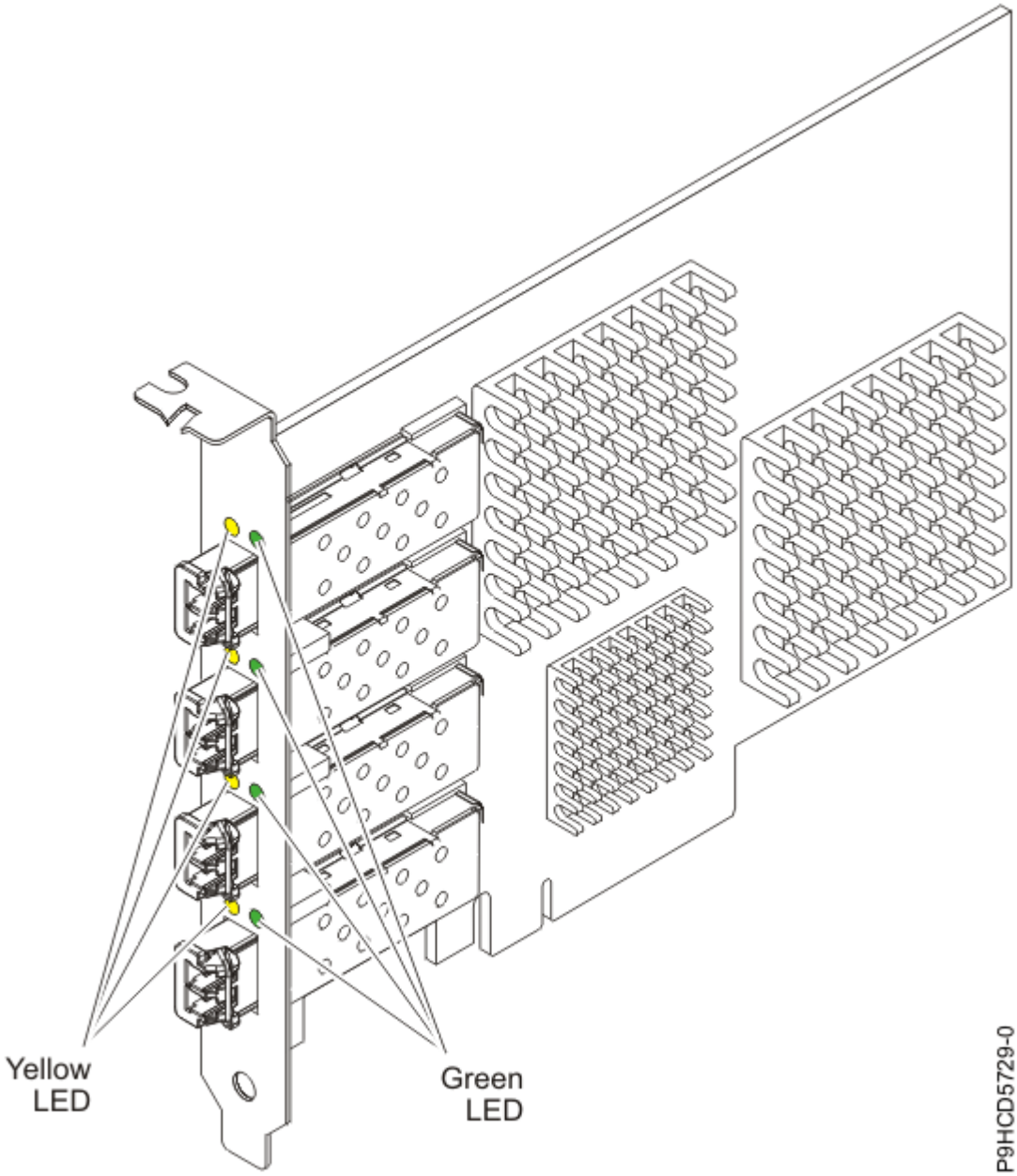


Figure 10. PCIe2 FH 4-Port 8 Gb Fibre Channel adapter

Adapter specifications

Item
Description

FRU number
74Y3467

Wrap plug FRU number
12R9314

Note: The wrap plug is included with the card, and can also be purchased from IBM.

I/O bus architecture
PCI Express (PCIe) Base 2.0 and x8 PCIe bus interface

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
3.3 V

Form factor
Full-height, full-length adapter with standard-size bracket

FC compatibility
2, 4, and 8 gigabit FC devices

Cables
Cables are the responsibility of the customer. Use multimode fibre optic cables with short-wave lasers that adhere to the following specifications:

- OM3: Multimode 50/125 micron fibre, 2000 MHz x km bandwidth
- OM2: Multimode 50/125 micron fibre, 500 MHz x km bandwidth
- OM1: Multimode 62.5/125 micron fibre, 200 MHz x km bandwidth

Because core sizes are different, only OM1 cables can be connected to other OM1 cables. For best results, do not connect OM2 cables to OM3 cables. However, if an OM2 cable is connected to an OM3 cable, the characteristics of the OM2 cable applies to the entire length of the cables.

The following table shows the supported distances for the three different cable types at the three different link speeds.

Table 15. Supported cable distances by link speed

Cable type	2.125 Gbps	4.25 Gbps	8.5 Gbps
OM3	0.5 m - 500 m	0.5 m - 380 m	0.5 m - 150 m
OM2	0.5 m - 300 m	0.5 m -150 m	0.5 m - 50 m
OM1	0.5 m - 150 m	0.5 m - 70 m	0.5 m - 21 m

Adapter LED

Green and yellow LEDs can be seen through openings in the mounting bracket of the adapter. Green indicates firmware operation and yellow signifies port activity. Table 16 on page 81 summarizes the link rate conditions. There is a one second pause when the LED is off between each group of fast flashes (2, 3, or 4). Observe the LED sequence for several seconds to be sure that you have correctly identified the state.

Table 16. Normal LED states

Green LED	Yellow LED	State
Slow flashing	Off	Normal, link inactive or not started
On	2 fast flashes	2 Gbps link rate - normal, link active
On	3 fast flashes	4 Gbps link rate - normal, link active
On	4 fast flashes	8 Gbps link rate - normal, link active

Power-on self test (POST) conditions and results are summarized in Table 17 on page 82. These states can be used to identify abnormal states or problems. Follow the action to be taken for each condition.

Table 17. POST conditions and results			
Green LED	**Yellow LED**	**State**	**Action to be taken**
Off	Off	Wake-up failure (dead board)	Perform the AIX or IBM i operating system diagnostics.
Off	On	POST failure (dead board)	Perform the AIX or IBM i operating system diagnostics.
Off	Slow flashing	Wake-up failure monitor	Perform the AIX or IBM i operating system diagnostics.
Off	Fast flashes	POST failure	Perform the AIX or IBM i operating system diagnostics.
Off	Flashing	POST processing in progress	None
On	Off	Failure while functioning	Perform the AIX or IBM i operating system diagnostics.
On	On	Failure while functioning	Perform the AIX or IBM i operating system diagnostics.
Slow flashes	Slow flashing	Offline for download	None
Slow flashes	Fast flashes	Restricted offline mode, waiting for restart	None
Slow flashes	Flashing	Restricted offline mode, test active	None

Replacing Fibre Channel adapters using hot swap

When hot swapping Fibre Channel adapters, be aware that device-related software for the storage devices might have additional devices (for example, the dar device associated with the FAStT or DS4800) that need to be removed. Refer to specific storage device documentation for information about how to remove these additional devices.

The adapter has a unique worldwide port name (WWPN). Check the zoning and LUN assignments to ensure that the new adapter functions as expected.

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).

- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

POWER GXT145 PCI Express Graphics Accelerator (FC 5748; CCIN 5269)

Learn about the features, requirements, installation notes, and troubleshooting tips for the POWER GXT145 PCI Express Graphics Accelerator adapter.

Overview

The POWER GXT145 PCI Express Graphics Accelerator adapter is a PCI Express (PCIe) adapter that accelerates and enhances the system unit video. The adapter has no hardware switches to set. Mode selection is made through the software. Figure 11 on page 83 shows the adapter and its connectors.

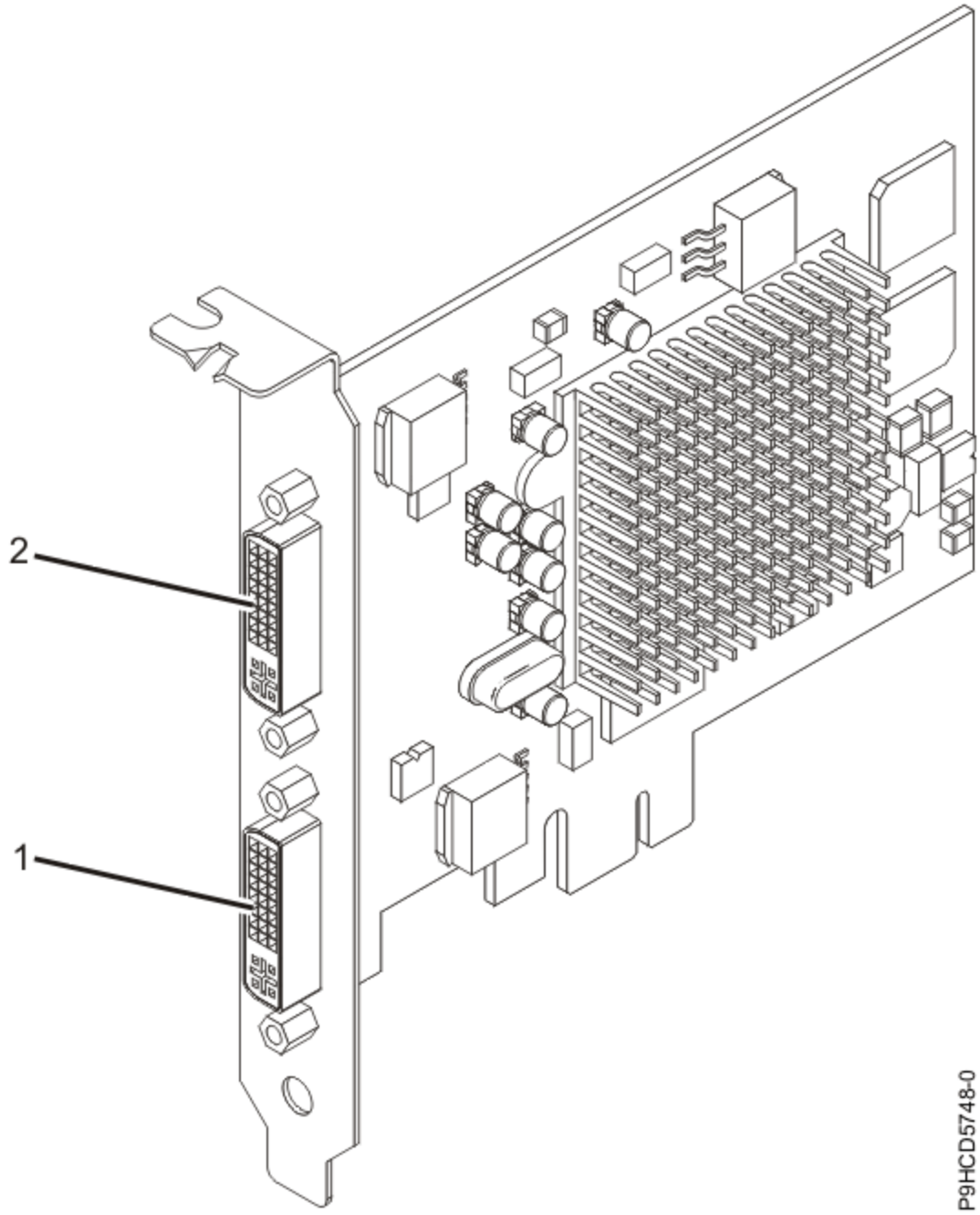


Figure 11. POWER GXT145 PCI Express Graphics Accelerator adapter

1
Primary DVI connector (28 pin), analog, or digital

2
Secondary DVI connector (28 pin), analog, or digital

Connect the primary monitor to connector 1. If you are using an optional, secondary monitor, connect the secondary monitor to connector 2. In the system or logical partition running Linux, the video that is displayed on the secondary monitor is the same as the video displayed the primary monitor, and at the same resolution and refresh rate.

The following table shows the feature code, custom card identification number (CCIN), and field-replaceable unit (FRU) part number for the adapter.

Table 18. CCIN and FRU number for FC 5748

Feature code (FC)	Custom card identification number (CCIN)	Field-replaceable unit (FRU) part number
5748	5269	10N7756

This adapter provides the following features:

- 8-bit indexed or 24-bit true color.
- 32-MB SDRAM frame buffer.
- x1 PCIe bus interface.
- Two DVI-I analog or digital connectors.
- One monitor connected, analog, up to 2048 x 1536 resolution.
- One monitor connected, digital, up to 1280 x 1024 resolution.
- A second monitor supported on secondary connector at up to 1600 x 1200 analog or 1280 x 1024 digital. A second monitor supported on secondary connector at up to 1600 x 1200 analog or 1280 x 1024 digital.
  - For systems or logical partitions running Linux, a second monitor is supported on the secondary connector at resolutions up to 1600 x 1200 analog or 1280 x 1024 digital.
  - For systems or logical partitions running AIX, when running with two monitors, both monitors must have an analog connection with the same resolution, up to 1600 x 1200. The image on the primary monitor is also displayed on the secondary monitor.
- Display power management: Video Electronics Standards Association (VESA), Display Power Management Signaling (DPMS)

For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Preparing for installation

If you are installing your operating system at this time, install your adapter before you install the operating system. If you are installing only the device driver for this adapter, install your device driver software before you install the adapter.

Installing the adapter

For instructions about installing PCIe adapters, see Installing, removing, or replacing PCIe adapters (http://www.ibm.com/support/knowledgecenter/POWER9/p9hak/pciadpters.htm) and select the system you are working on.

Verifying the adapter installation

To verify that your system unit recognizes the PCI adapter, do the following steps:

1. If necessary, log in as root user.
2. At the command line, type: `lsdev -Cs pci`
3. Press Enter.

A list of PCI devices is displayed. If the adapter is installed correctly, the status of available for each port indicates that the adapter is installed and ready to use. If a message indicates that any of the ports are defined instead of available, shut down your server and verify that the adapter was installed correctly.

Troubleshooting

If you have video problems after the initial installation, follow these procedures to troubleshoot the problem:

- Check the cables.
- Check the device driver software installation.
- Check the console.
- Check the adapter installation.

Checking the cables

1. Ensure the monitor cables are connected to the correct adapter.
2. If you have more than one video adapter, be sure that each adapter is connected to a monitor.
3. Verify that the connections are secure.
4. If no log-in prompt appears, restart the system unit.

Checking the device driver software installation

Verify that the device driver for the POWER GXT145 PCI Express Graphics Accelerator adapter is installed by typing the following command and then pressing Enter:

```
lslpp -l all | grep GXT145
```

If the GXT145 device driver is installed, the following table is an example of the data that appears if you are running AIX Version 5.2:

```
devices.pci.2b102725.X11 5.2.0.105 COMMITTED AIXwindows GXT145 Graphics
devices.pci.2b102725.diag 5.2.0.105 COMMITTED GXT145 Graphics Adapter
devices.pci.2b102725.rte   5.2.0.105  COMMITTED GXT145 Graphics Adapter
```

If the POWER GXT145 device driver did not fully install, reinstall the driver. For instructions, see Installing the AIX device driver software (www.ibm.com/support/knowledgecenter/POWER9/p9hak/pxhak_installing_devicedriver_aix.htm).

Checking the console

1. If you continue to experience problems, you can redirect the monitor to the new adapter using the **chdisp** command.
2. If you continue to experience problems after you have checked your cables and tried the **chdisp** command, run diagnostics.

Checking the adapter installation

Verify that the system unit recognizes the POWER GXT145 PCI Express Graphics Accelerator adapter.

At the AIX command-line type `lsdev -Cs pci`. If the POWER GXT145 PCI Express Graphics Accelerator adapter is correctly installed, the following is an example of the data that appears:

```
cor0 Available 0K-00 GXT145 Graphics Adapter
```

If the message indicates that the adapter is DEFINED instead of AVAILABLE, shut down the system unit and check the POWER GXT145 PCI Express Graphics Accelerator adapter to ensure that it is installed

correctly. If you continue to experience problems after following the steps in this section, contact service and support for assistance.

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe3 LP 2-Port 10 GbE NIC and RoCE SR Adapter (FC EC2M, FC EC2N, and FC EL54; CCIN 57BE)

Learn about the specifications and operating system requirements for the feature codes (FC) EC2M, EC2M, EC2N, and EL54 adapters.

Overview

FC EC2N and FC EL54 are full-height adapters. FC EC2M is a low-profile adapter. The names of these two adapters are:

- FC EC2N and FC EL54: PCIe3 2-Port 10 GbE NIC and RoCE SR adapter
- FC EC2M: PCIe3 LP 2-Port 10 GbE NIC and RoCE SR adapter

This PCIe generation 3 adapter provides two 10 Gb SR optical fiber ports. The adapter is a converged network adapter supporting both NIC and IBTA RoCE standard. RoCE is Remote Direct Memory Access (RDMA) over Converged Ethernet. Using RoCE, the adapter can support significantly greater bandwidth with low latency and minimize CPU overhead by more efficiently using memory access. This offloads the CPU from I/O networking tasks, improving performance and scalability.

The adapter has two preinstalled optical transceivers. Little connector (LC) type connectors connect the adapter to standard 10-Gb SR optical cabling and provide up to 300 m (984.25 ft) cable length. The two transceiver ports are used for connectivity with other servers or switches in the network. Each port provides Ethernet connectivity with a nominal data rate of 10 gigabits per second (Gbps). The link aggregation and failover features of the adapter are ideal for critical network applications that require redundancy and high availability. Figure 12 on page 87 shows the low-profile adapter and Figure 13 on page 88 shows the full-height adapter.

The adapter provides the following features:

- The adapter is a PCIe3 NIC network convergence adapter.
- The adapter supports RoCE and NIC functions but not concurrently on same adapter.
- The adapter supports the following standards for the different ports and functions:
  - AIX NIM and Linux Network Install are supported
  - IBTA RoCE v2 support

  - IEEE 802.3ae in the 10 GbE ports
  - 802.3ab in the 1 GbE ports
  - Ether II and IEEE 802.3 for encapsulated frames
  - 802.1p for setting up priority levels in tagged VLAN frames
  - 802.1Q for VLAN tagging
  - 802.3x for flow control
  - 802.3ad for load-balancing and failover
  - IEEE 802.3ad and 802.3 for link aggregation
- The adapter provides message signal interrupts (MSI), MSI-X, and support of legacy pin interrupts.
- The adapter supports jumbo frames up to 9.6 KB.
- The adapter supports gigabit EtherChannel (GEC) with the existing software.
- The adapter supports TCP checksum offload transmission control protocol (TCP), user datagram protocol (UDP), TCP segmentation Offload (TSO) for IPv4 and IPv6.
- Supports TCP segmentation or large send offload
- Supports EEPROM-SPI and single EEPROM

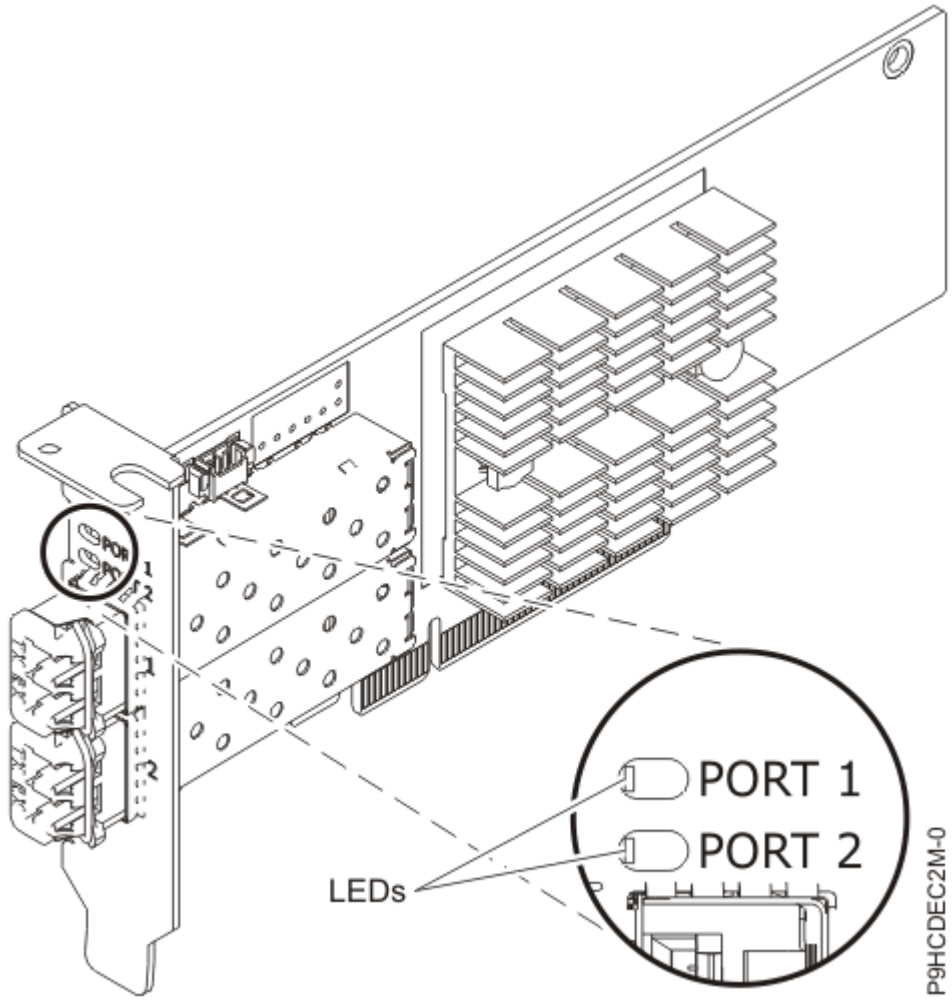


Figure 12. PCIe3 LP 2-Port 10 GbE NIC and RoCE SR adapter (FC EC2M)

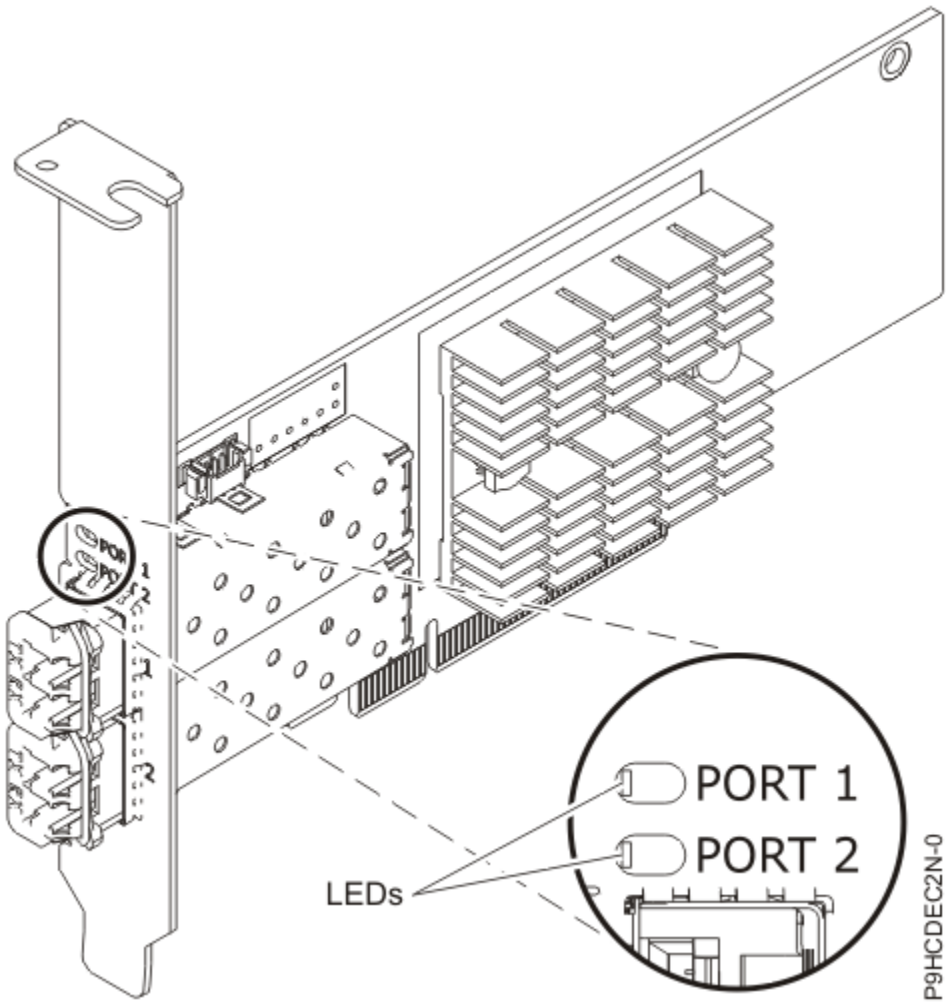


Figure 13. PCIe3 2-Port 10 GbE NIC and RoCE SR adapter (FC EC2N and FC EL54)

Specifications

Item
Description

Adapter FRU number
00RX875

Low-profile tailstock: 00RX872

I/O bus architecture
PCIe3 x8

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
3.3 V

Form factor
Short

Cables
Supports standard 10-Gb SR optical cabling and up to 300 m (984.25 ft) cable length.

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe3 2-port 10 Gb NIC & RoCE SR/Cu adapter (FC EC2R and EC2S; CCIN 58FA)

Learn about the specifications and operating system requirements for feature code (FC) EC2R and EC2S adapters.

Overview

FC EC2R and EC2S are both the same adapter with different feature codes. FC EC2R is a low-profile adapter and FC EC2S is a full-height adapter.

The PCIe3 2-port 10 Gb NIC & RoCE SR/Cu Adapter is a PCI Express (PCIe) generation 3 (Gen3) x8 adapter. The adapter provides two 10 Gb SFP+ ports and supports both the Ethernet network interface controller (NIC) function and RDMA over Converged Ethernet (RoCE). The adapter can support significantly greater bandwidth with low latency using RoCe. It also minimizes CPU overhead by more efficiently using memory access. This offloads the CPU from I/O networking tasks, improving performance and scalability.

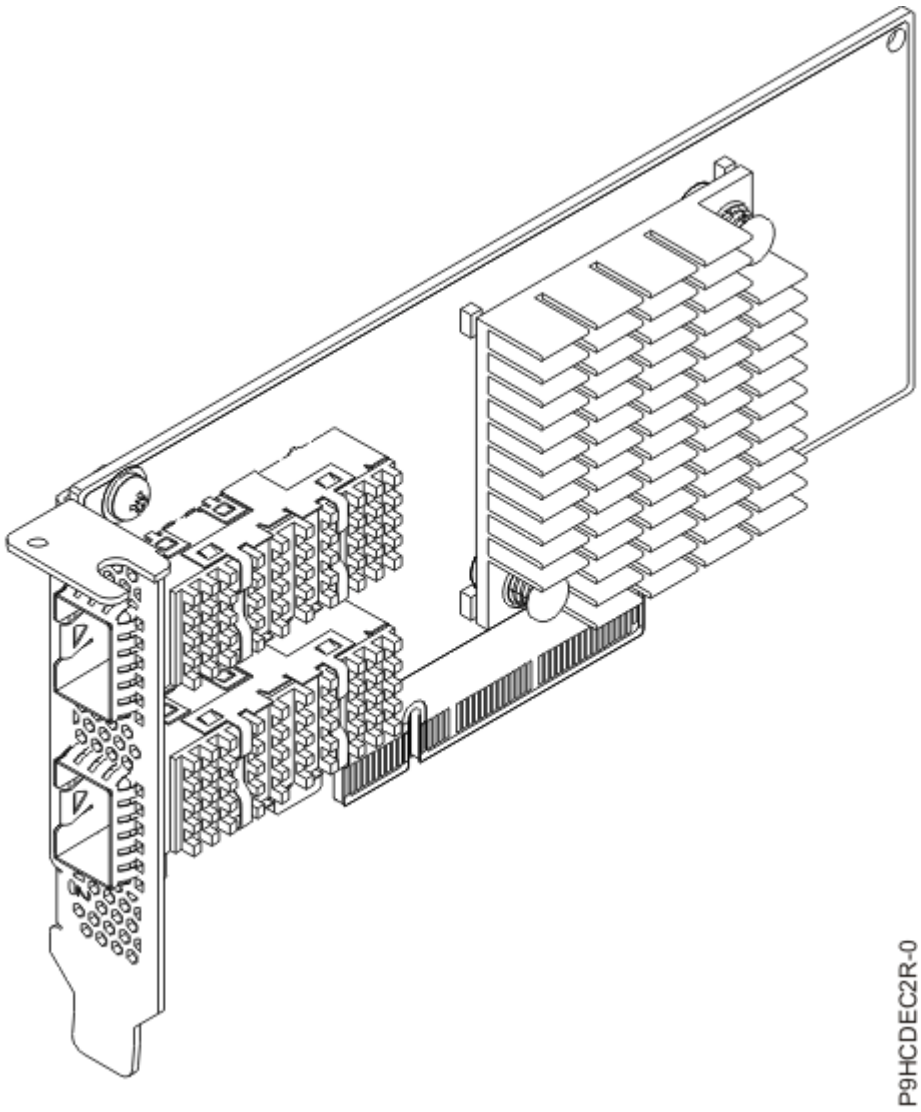


Figure 14. PCIe3 LP 2-port 10 Gb NIC & RoCE SR/Cu Adapter (FC EC2R)

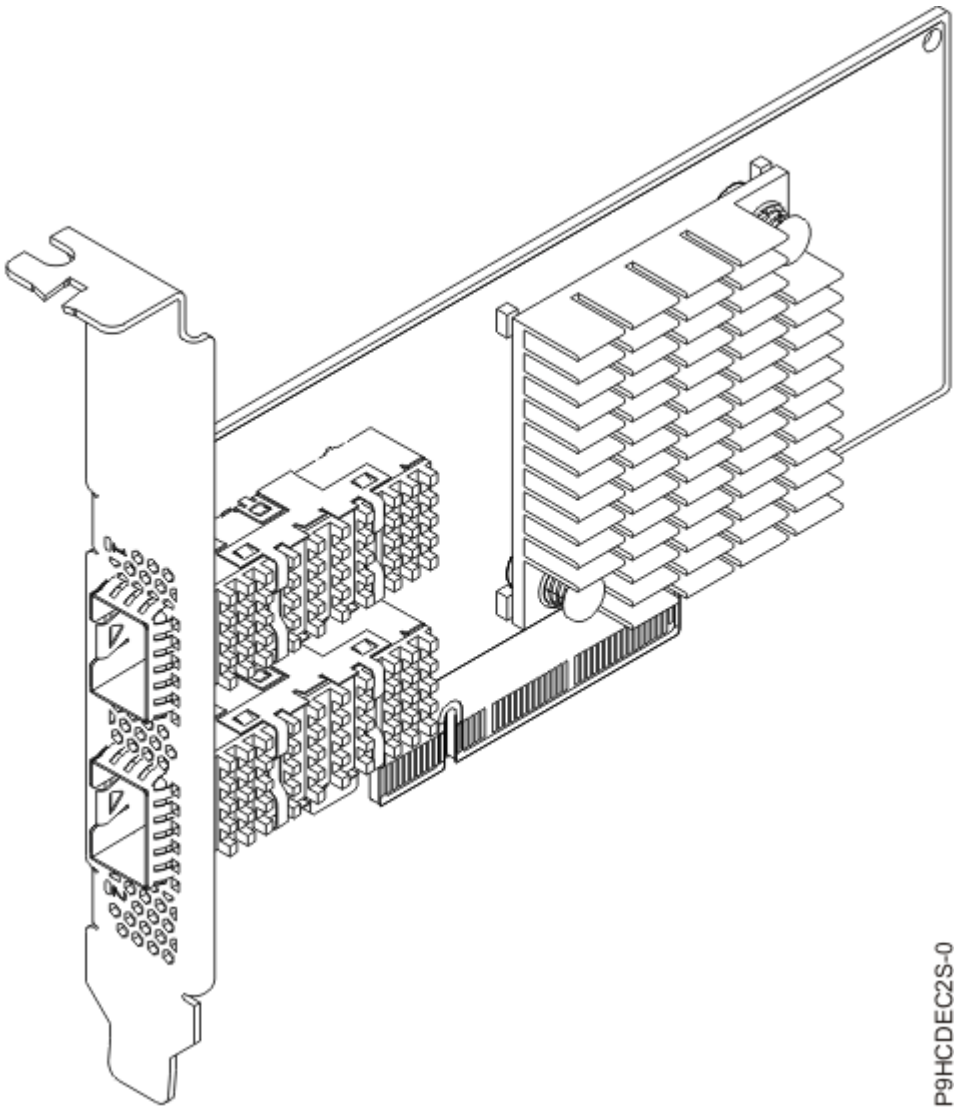


Figure 15. PCIe3 2-port 10 Gb NIC & RoCE SR/Cu Adapter (FC EC2S)

Specifications

Item
Description

Adapter FRU number
01FT759

Wrap Plug FRU number
74Y7010 (Twinax wrap plug)

12R9314 (Optical wrap plug)

I/O bus architecture
PCIe3 x8

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
3.3 V, 12 V

Form factor

Short, low-profile (FC EC2R)

Short, with full-height tailstock (FC EC2S)

Attributes provided

RDMA over Converged Ethernet (RoCE)

Dual port 10 Gb Ethernet network connectivity

Supports 10 Gb Ethernet SFP+ connectivity

Supports 10 Gb SFP+ SR connectivity with a 10 Gb optical transceiver (IBM® P/N 77P9336, purchased separately)

AIX® Network Installation Management (NIM) support

PCI Express 3.0 (up to 8 GT/s) x8

PCIe Gen 3.0 compliant, 1.1 and 2.0 compatible

IEEE 802.3ae (10 Gb Ethernet), IEEE 802.3ad (Link Aggregation and Failover), IEEE 802.3az (Energy Efficient Ethernet), IEEE 802.1Q/P (VLAN Tagging), IEEE 802.10au (Congestion Notification), IEEE 802.1Qbg, IEEE 802.3Qaz D0.2 (ETS), IEEE 802.1Qbb D1.0 (PFC), IEEE 1588v2 (PTP)

Jumbo frame support up to 9.6 KB

VXLAN and NVGRE Overlay Network offload support

TCP/UDP/IP stateless offload

TCP/UDP checksum offload

TCP segmentation offload

PowerVM SR-IOV support. For more information see, PowerVM® SR-IOV FAQs.

Cables

For 10 GbE, IBM® offers Direct Attach Copper (DAC) cables up to 5 M. SFP based transceivers are included on each end of these cables. For more information about adapter cabling, see the “Cable and Transceiver information” on page 92.

Transceivers

IBM® qualifies and supports SFP+ optical transceiver (FC EB46) to install into the adapter. Customers can also use their own optical cabling and SFP+ optical transceiver for the other end. The 10 Gb optical transceiver is capable up to 300 M through the OM3 cable or 82 M through OM2 cable. Either one or both of the adapter’s two SFP+ ports can be populated.

Cable and Transceiver information

Use multimode fiber optic cables with shortwave lasers that adhere to the following specifications:

- OM3 or OM4: Multimode 50/125 micron fiber, 2000 MHz x km bandwidth
- OM2: Multimode 50/125 micron fiber, 500 MHz x km bandwidth
- OM1: Multimode 62.5/125 micron fiber, 200 MHz x km bandwidth

Because core sizes are different, OM1 cables can only be connected to other OM1 cables. For best results, OM2 cables must not be connected to OM3 or OM4 cables. However, if an OM2 cable is connected to an OM3 or OM4 cable, the characteristics of the OM2 cable apply to the entire length of the cables. The following table shows the supported distances for the different fiber optic cable types at different link speeds.

Table 19. Cable type and distance (10 Gb/s)			
Rate	**Cable type and distance**		
10 Gb/s	OM1	OM2	OM3
	0.5 m to 33 m (1.64 ft to 108.26 ft)	0.5 m to 82 m (1.64 ft to 269.02 ft)	0.5 meters to 300 meters (1.64 ft to 984.25 ft)

Table 20. Optical transceivers and cables	
Feature code	**Description**
EB46	10 Gb optical transceiver (purchased separately)
EN01	10 Gb/s 1 m (3.3 ft) copper active twinax Ethernet cable
EN02	10 Gb/s 3 m (9.8 ft) copper active twinax Ethernet cable
EN03	10 Gb/s 5 m (16.4 ft) copper active twinax Ethernet cable

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe3 2-port 25/10 Gb NIC & RoCE SFP28 adapter (FC EC2T and FC EC2U; CCIN 58FB)

Learn about the specifications and operating system requirements for feature code (FC) EC2T and FC EC2U adapters.

Overview

FC EC2T and EC2U are both the same adapter with different feature codes. FC EC2T is a low-profile adapter, and FC EC2U is a full-height adapter.

The PCIe3 2-PORT 25/10 Gb NIC & RoCE SFP28 Adapter (FC EC2T and EC2U) is a PCI Express® (PCIe) generation 3 (Gen3) x8 adapter. The adapter provides two 25 Gb SFP28 ports. The adapter supports both the Ethernet network interface controller (NIC) function and RDMA over Converged Ethernet (RoCE). Using RoCE, the adapter can support significantly greater bandwidth with low latency. It also minimizes

CPU overhead by more efficiently using memory access. This offloads the CPU from I/O networking tasks, improving performance and scalability.

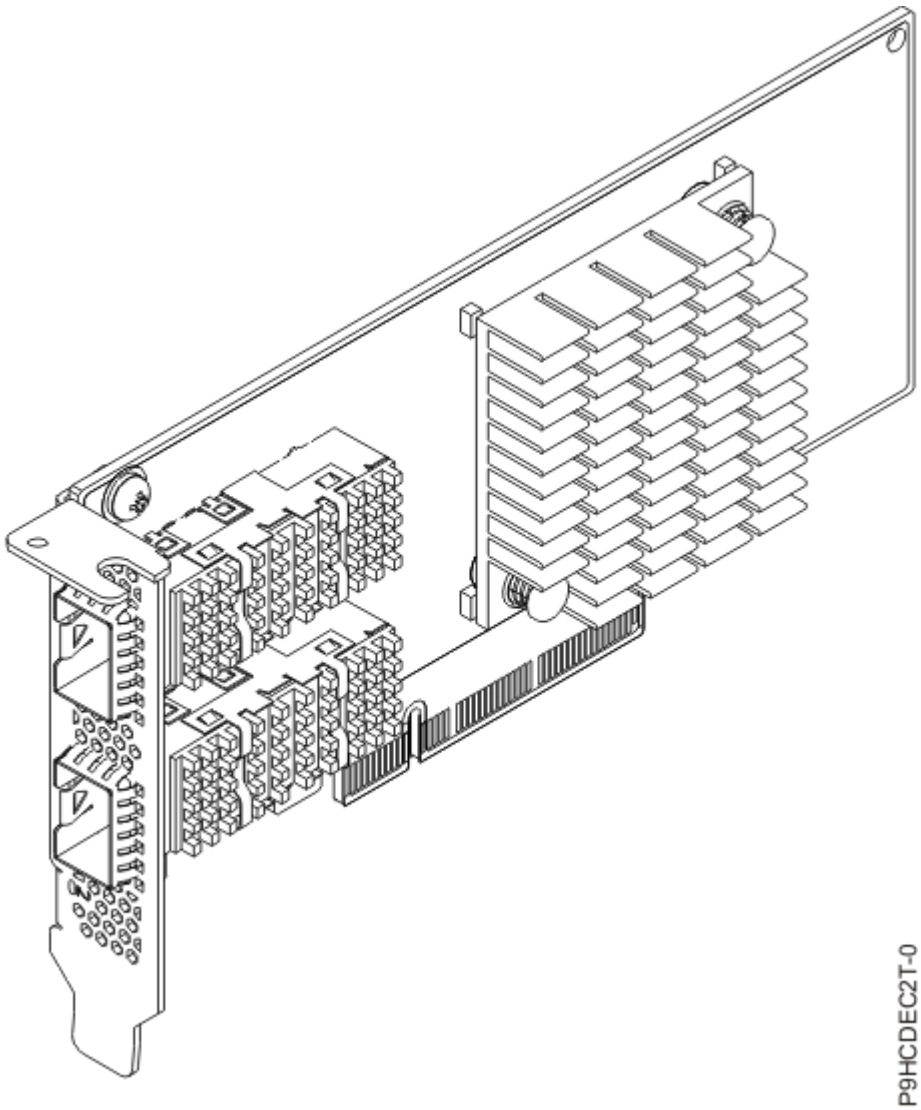


Figure 16. PCIe3 LP 2-port 25/10 Gb NIC & RoCE SFP28 Adapter (FC EC2T)

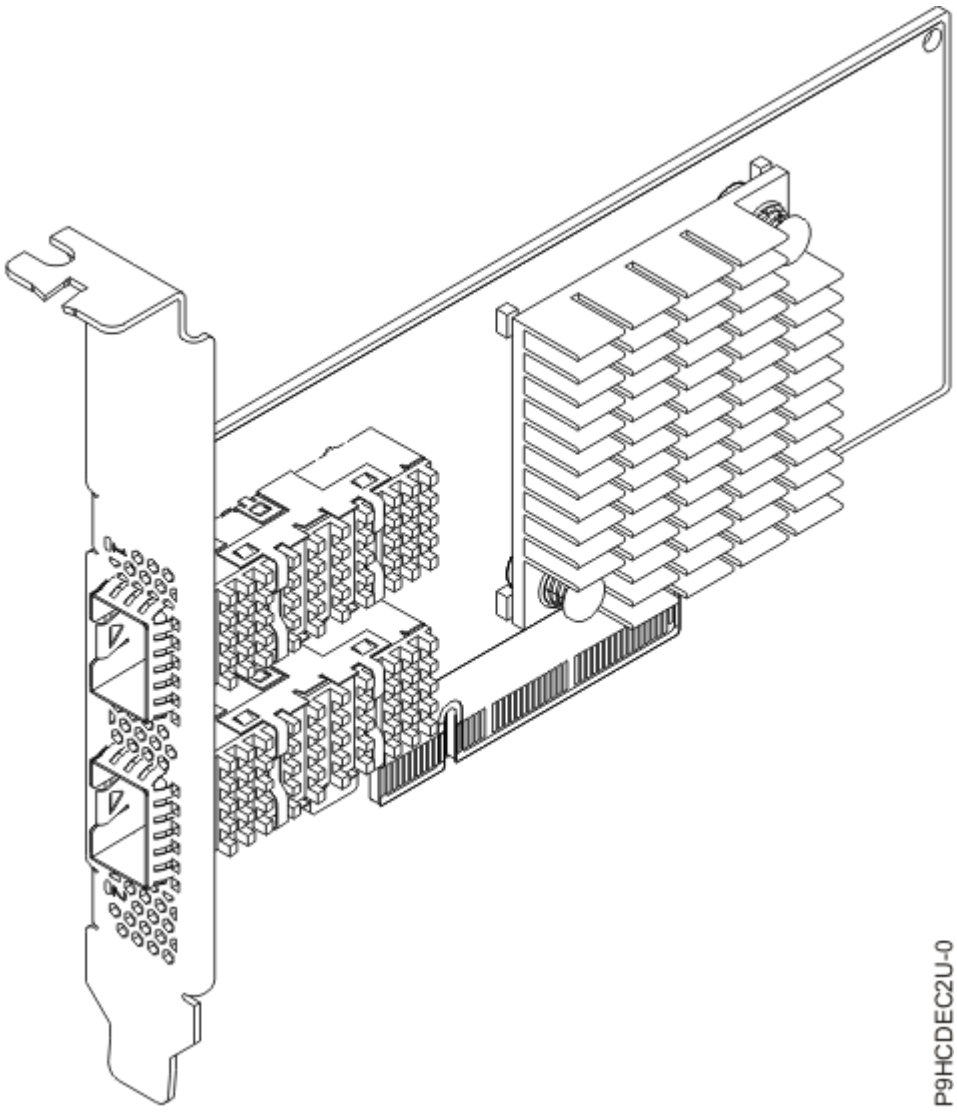


Figure 17. PCIe3 2-port 25/10 Gb NIC & RoCE SFP28 Adapter (FC EC2U)

Specifications

Item
Description

Adapter FRU number
01FT753

Wrap Plug FRU number
74Y7010 (Twinax wrap plug)

12R9314 (Optical wrap plug)

I/O bus architecture
PCIe3 x8

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
3.3 V, 12 V.

Form factor

Short, low-profile (FC EC2T).

Short, with full-height tailstock (FC EC2U).

Attributes provided

RDMA over Converged Ethernet (RoCE).

Dual port 25 Gb/10 Gb Ethernet network connectivity.

Supports 25 Gb Ethernet SFP28 connectivity.

Supports 10 Gb Ethernet SFP+ connectivity.

Supports 25 Gb SFP28 SR connectivity with a 25 Gb optical transceiver (IBM P/N 03GH278, purchased separately).

Supports 10 Gb SFP+ SR connectivity with a 10 Gb optical transceiver (IBM P/N 01FT829, purchased separately).

Supports 1 Gb RJ45 connectivity with a 1000BASE-T transceiver (IBM P/N 03FP283, purchased separately). Supports 1 Gb and full-duplex only. PowerVM® SR-IOV not supported for 1 Gb.

AIX Network Installation Management (NIM) support.

PCI Express 3.0 (up to 8 GT/s) x8.

PCIe Gen 3.0 compliant, 1.1 and 2.0 compatible.

IEEE 802.3ae (25Gb or 10Gb Ethernet), IEEE 802.3ad (Link Aggregation & Failover), IEEE 802.3az (Energy Efficient Ethernet), IEEE 802.1Q/P (VLAN Tagging), IEEE 802.10au (Congestion Notification), IEEE 802.1Qbg, IEEE 802.3Qaz D0.2 (ETS), IEEE 802.1Qbb D1.0 (PFC), IEEE 1588v2 (PTP).

Jumbo frame support up to 9.6 KB.

VXLAN and NVGRE Overlay Network offload support.

TCP/UDP/IP stateless offload.

TCP/UDP checksum offload.

TCP segmentation offload.

PowerVM SR-IOV support for 10 Gb and higher speeds.. For more information see, PowerVM SR-IOV FAQs.

Cables

For 25 GbE, IBM offers SFP28 Passive Copper 25 Gb Ethernet cables up to 2 m. SFP28 based transceivers are included on each end of these cables.

For 10 GbE, IBM offers Direct Attach Copper (DAC) cables up to 5 m. SFP-based transceivers are included on each end of these cables. For more information about adapter cabling, see “Cable and Transceiver information” on page 97.

Transceivers

For 25 GbE, IBM qualifies and supports SFP28 optical transceiver (FC EB47) to install into the adapter. Customers can also use their own optical cabling and SFP28 optical transceiver for the other end. The 25 Gb optical transceiver is capable up to 100 m through the OM4 cable or 70 M through OM3 cable. Either one or both of the adapter’s two SFP28 ports can be populated.

For 10 GbE, IBM qualifies and supports SFP+ optical transceiver (FC EB46) to install into the adapter. Customers can also use their own optical cabling and SFP+ optical transceiver for the other end. The 10 Gb optical transceiver is capable up to 300 M through the OM3 cable or 82 m through OM2 cable. Either one or both of the adapter’s two SFP28 ports can be populated.

For 1000BASE-T, IBM qualifies and supports the RJ45 transceiver (FC EB48) to install into the adapter. Customers can also use their own Cat 5e STP cabling. The 1000BASE-T transceiver is capable up to 100 m through the Cat 5e STP cable. Both of the adapter’s two RJ45 ports can be populated, but mixing 1 Gb with higher speeds is not supported. 100 Mbps or 10 Mbps speeds and half-duplex are not supported. PowerVM SR-IOV is not supported on ports with FC EB48 installed.

Cable and Transceiver information

Use multimode fiber optic cables with shortwave lasers that adhere to the following specifications:

- OM3 or OM4: Multimode 50/125 micron fiber, 2000 MHz x km bandwidth
- OM2: Multimode 50/125 micron fiber, 500 MHz x km bandwidth
- OM1: Multimode 62.5/125 micron fiber, 200 MHz x km bandwidth

Because core sizes are different, OM1 cables can only be connected to other OM1 cables. For best results, OM2 cables must not be connected to OM3 or OM4 cables. However, if an OM2 cable is connected to an OM3 or OM4 cable, the characteristics of the OM2 cable apply to the entire length of the cables. The following table shows the supported distances for the different fiber optic cable types at different link speeds.

Table 21. Cable type and distance (10 Gb/s)

Rate	**Cable type and distance**		
10 Gb/s	OM1	OM2	OM3
	0.5 m to 33 m (1.64 ft to 108.26 ft)	0.5 m to 82 m (1.64 ft to 269.02 ft)	0.5 meters to 300 meters (1.64 ft to 984.25 ft)

Table 22. Cable type and distance (25 Gb/s)

Rate	**Cable type and distance**		
25 Gb/s	OM2	OM3	OM4
	0.5 m to 20 m (1.64 ft to 65.62 ft)	0.5 m to 70 m (1.64 ft to 229.66 ft	0.5 m to 100 m (1.64 ft to 984.25 ft)

Table 23. Optical transceivers and cables

Feature code	**Description**
EB46	10 Gb optical transceiver (purchased separately)
EB47	25 Gb optical transceiver (purchased separately)
EB48	1 Gb RJ45 transceiver (purchased separately)
EB4J	25 Gb/s 0.5 m (1.6 ft) SFP28 passive copper 25 Gb Ethernet cable
EB4K	25 Gb/s 1.0 m (3.3 ft) SFP28 passive copper 25 Gb Ethernet cable
EB4L	25 Gb/s 1.5 m (4.9 ft) SFP28 passive copper 25 Gb Ethernet cable
EB4M	25 Gb/s 2.0m (6.6-ft) SFP28 passive copper 25 Gb Ethernet cable
EB4P	[100 Gb/s to 4x25 Gb/s] 2.0 m (6.6-ft) QSFP28 passive copper to SFP28 4x25 Gb Ethernet split cable
EN01	10 Gb/s 1 m (3.3 ft) copper active twinax Ethernet cable
EN02	10 Gb/s 3 m (9.8 ft) copper active twinax Ethernet cable
EN03	10 Gb/s 5 m (16.4 ft) copper active twinax Ethernet cable
EN03	10 Gb/s 5 m (16.4 ft) copper active twinax Ethernet cable

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached

devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe3 2-port 10 GbE NIC & RoCE SFP+ copper adapter (FC EC37, FC EC38, FC EL3X, and FC EL53; CCIN 57BC)

Learn about the specifications and operating system requirements for the feature code (FC) EC37, FC EC38, FC EL3X, and FC EL53 adapters.

Overview

The FC EC37 and FC EL3X are low-profile adapters, and the FC EC38 and FC EL53 are full-height adapters.

The PCIe3 2-Port 10 GbE NIC & RoCE SFP+ adapter is a PCIe generation-3 (PCIe3), dual port, 10 Gigabit Ethernet (GbE) adapter with a PCIe 3.0 host bus interface. The adapter provides two 10 Gb SFP+ ports for copper twinax cabling. These cables also include copper transceivers. The adapter is a converged network adapter supporting both NIC and IBTA RoCE standard. RoCE is Remote Direct Memory Access (RDMA) over Converged Ethernet. Using RoCE, the adapter can support significantly greater bandwidth with low latency and minimize CPU overhead by more efficiently using memory access. This offloads the CPU from I/O networking tasks, improving performance and scalability.

Active Copper twinax cables up to 5 meter in length are supported such as provided by FCs EN01, EN02 or EN03. A copper transceiver is included with these cables. See “Cables” on page 101 for details. Each 10 Gb port provides Ethernet connectivity with a nominal data rate of 10 Gbps (gigabits per second).

The adapter provides the following features:

- The adapter is a PCIe3 NIC network convergence adapter.
- The adapter supports RoCE and NIC functions but not concurrently on same adapter.
- The adapter supports the following standards for the different ports and functions:
  - AIX NIM and Linux Network Install are supported
  - IBTA RoCE v2 support
  - IEEE 802.3ae in the 10 GbE ports
  - 802.3ab in the 1 GbE ports
  - Ether II and IEEE 802.3 for encapsulated frames
  - 802.1p for setting up priority levels in tagged VLAN frames
  - 802.1Q for VLAN tagging
  - 802.3x for flow control
  - 802.3ad for load-balancing and failover
  - IEEE 802.3ad and 802.3 for link aggregation
- The adapter provides message signal interrupts (MSI), MSI-X, and support of legacy pin interrupts.
- The adapter supports jumbo frames up to 9.6 KB.

- The adapter supports gigabit EtherChannel (GEC) with the existing software.
- The adapter supports TCP checksum offload transmission control protocol (TCP), user datagram protocol (UDP), TCP segmentation Offload (TSO) for IPv4 and IPv6.
- Supports TCP segmentation or large send offload
- Supports EEPROM-SPI and single EEPROM

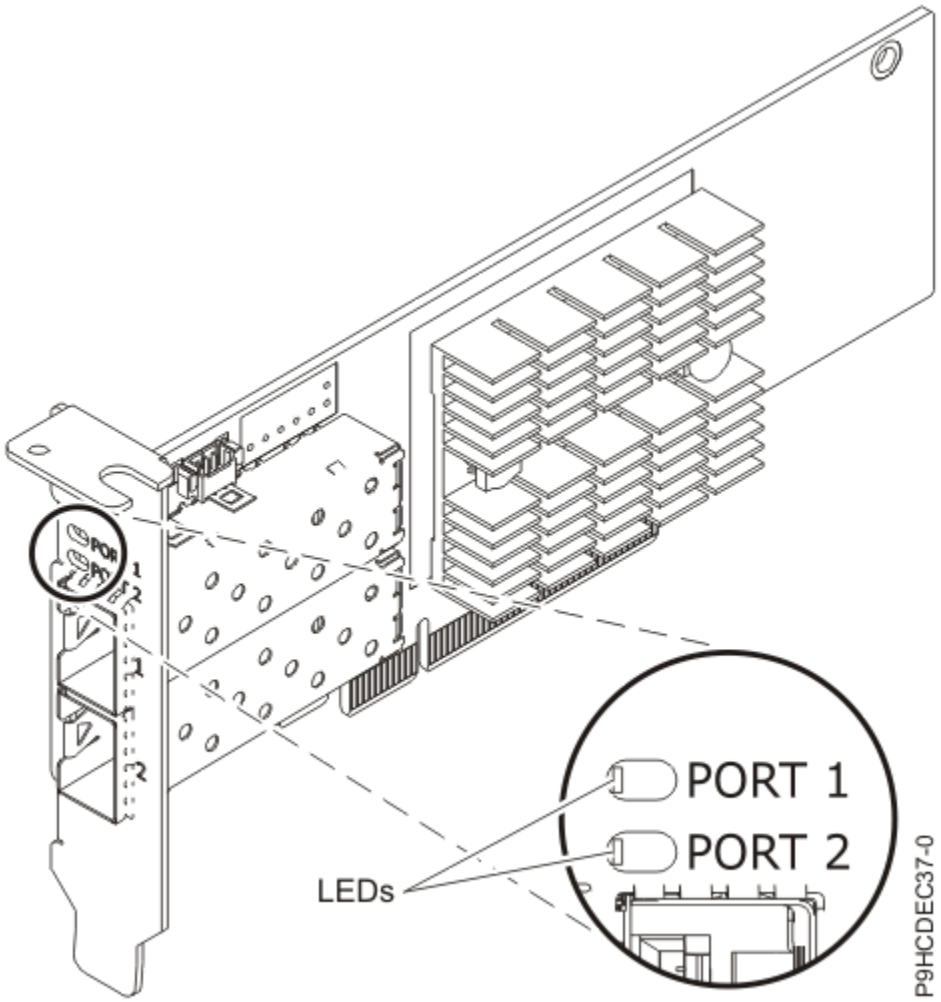


Figure 18. PCIe3 LP 2-port 10 GbE NIC & RoCE SFP+ copper adapter (FC EC37 and FC EL3X)

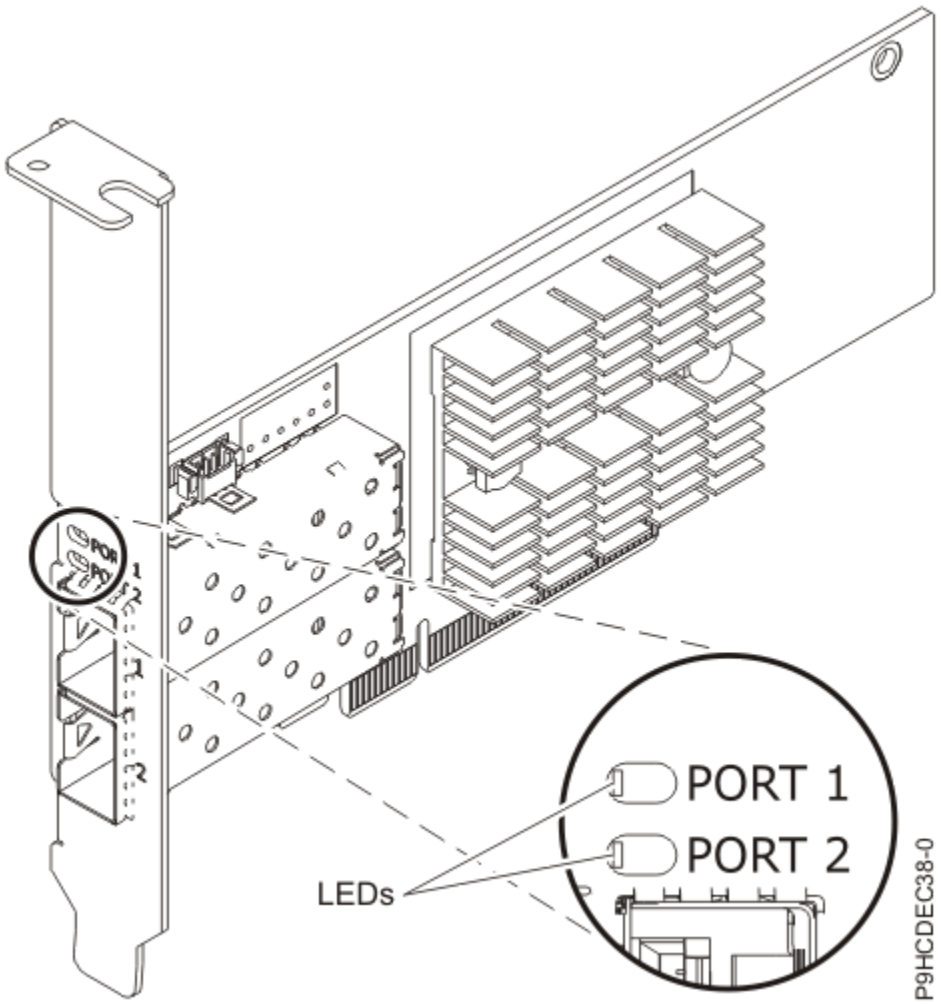


Figure 19. PCIe3 2-port 10 GbE NIC and RoCE SFP+ copper adapter (FC EC38 and FC EL53)

Specifications

Item
Description

Adapter FRU number
00RX859

Low-profile tailstock: 00RX856

I/O bus architecture
PCIe3 x8

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
3.3 V

Form factor
Short

Cables
See “Cables” on page 101 for details.

Cables

This adapter feature requires the use of compatible SFP+, 10 Gbps, copper, twinaxial, active, Ethernet cables. See Figure 20 on page 101 for a view of the cable top and cable bottom. These cables are compliant with industry standard specifications SFF-8431 Rev 4.1 and SFF-8472 Rev 10.4, and all applicable IBM requirements.

Note: These cables are EMC Class A compliant.

See Table 24 on page 101 for details about the feature codes.

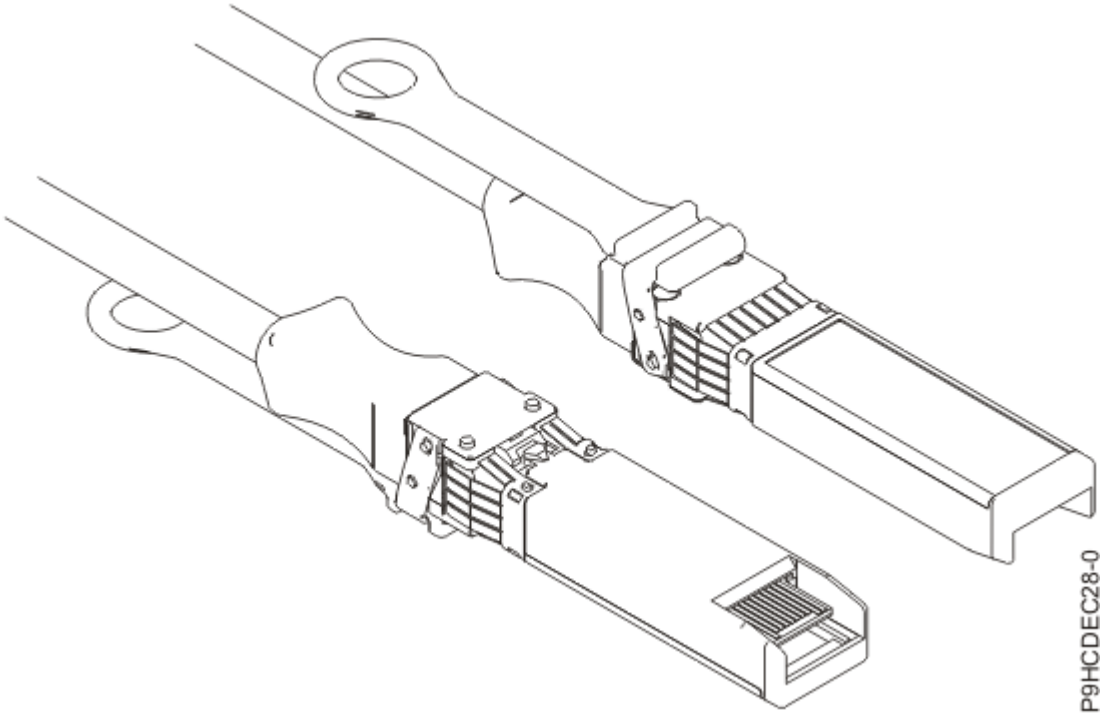


Figure 20. Top and bottom view of the cable

Table 24. Feature code, CCIN, and part number for varying lengths of the cable

Cable length	Feature code	CCIN	Part number
1 m (3.28 ft)	EN01	EF01	46K6182
3 m (9.84 ft)	EN02	EF02	46K6183
5 m (16.4 ft)	EN03	EF03	46K6184

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).

- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe3 2-port 40 GbE NIC RoCE QSFP+ adapter (FC EC3A and FC EC3B; CCIN 57BD)

Learn about the specifications and operating system requirements for the feature code (FC) EC3A and FC EC3B adapters.

Overview

The FC EC3A and FC EC3B is a PCIe generation-3 (PCIe3), dual port, 40-Gigabit Ethernet (GbE) adapter with a PCIe 3.0 host bus interface. The FC EC3A is a low-profile adapter and the FC EC3B is a regular height adapter. The adapter acts as a network interface controller (NIC) and uses the IBTA RDMA over Converged Ethernet (RoCE) protocols to provide efficient Remote Direct Memory Access (RDMA) services. The adapter delivers high-bandwidth and low-latency 40 GbE connectivity, reducing the load on the processor and efficiently using the memory access. This action off-loads the processor from networking tasks which improves the performance and scalability of the processor.

The adapter is optimized for enterprise data centers, high-performance computing, transaction databases, cloud computing, virtualization, storage, and other embedded environments. The adapter improves network performance by increasing available bandwidth to the processor and by providing enhanced performance. The adapter provides dedicated adapter resources and protection for virtual machines (VM). The link aggregation and failover features of the adapter are ideal for critical network applications that require redundancy and high availability.

The two 40 Gb quad (4-channel) small form-factor pluggable (QSFP+) transceiver ports are used for connectivity with other servers or switches in the network. Each QSFP+ port provides Ethernet connectivity with a nominal data rate of 40 gigabits per second (Gbps).

The adapter does not include transceivers. Use copper cables with QSFP+ 40 G BASE-SR transceivers for short distances. See “Cables” on page 104 for more information about the cables.

The adapter provides the following features:

- Data center bridging support (IEEE standard version CEE)
- T11.3 FC-BB-5 FCoE
- TCP/IP stateless offload in hardware
- Traffic steering across multiple cores
- Intelligent interrupt coalescence
- Advanced Quality of Service (QoS)
- RDMA over Ethernet using uDAPL

The adapter provides Ethernet NIC support with the following features:

- 64-bit kernel environments
- Multi-processor safe
- AIX Common Data Link Interface (CDLI) compliant
- Concurrent operation of NIC and RoCE device drivers while sharing the same physical port
- Standard frames (1518 bytes + 4 bytes for VLAN tag)
- Jumbo frames (9018 bytes + 4 bytes for VLAN tag)
- IPV4 or IPV6 transmit/receive TCP checksum offload
- IPV4 transmit TCP segmentation offload (commonly known as large send)

- IPV4 receive TCP segmentation aggregation (commonly known as large receive)
- Enhanced Error Handling (EEH) from PCI bus errors

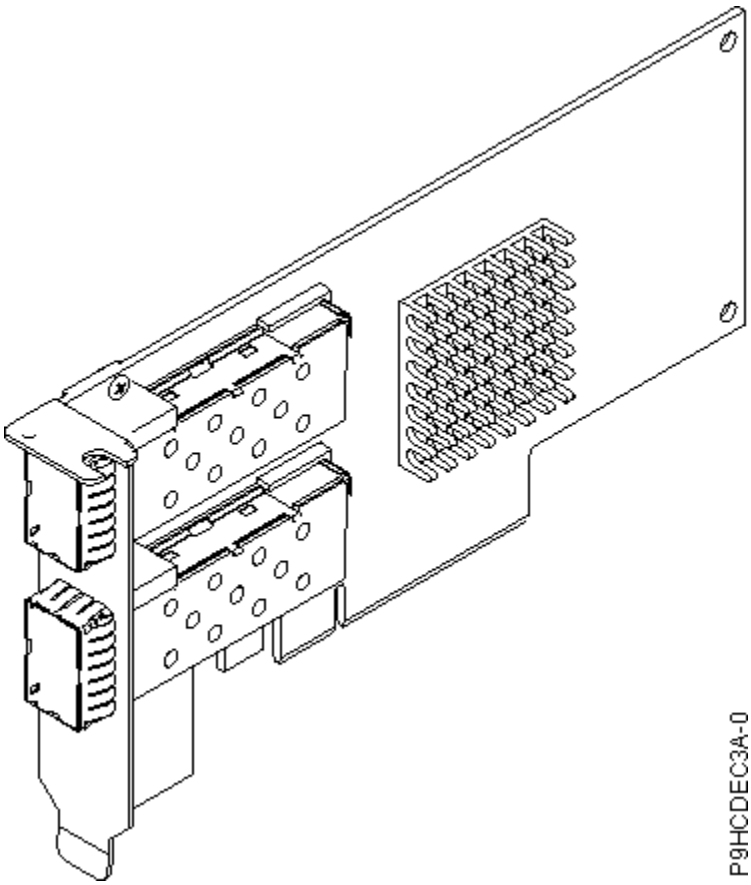


Figure 21. PCIe3 LP 2-port 40 GbE NIC RoCE QSFP+ adapter (FC EC3A)

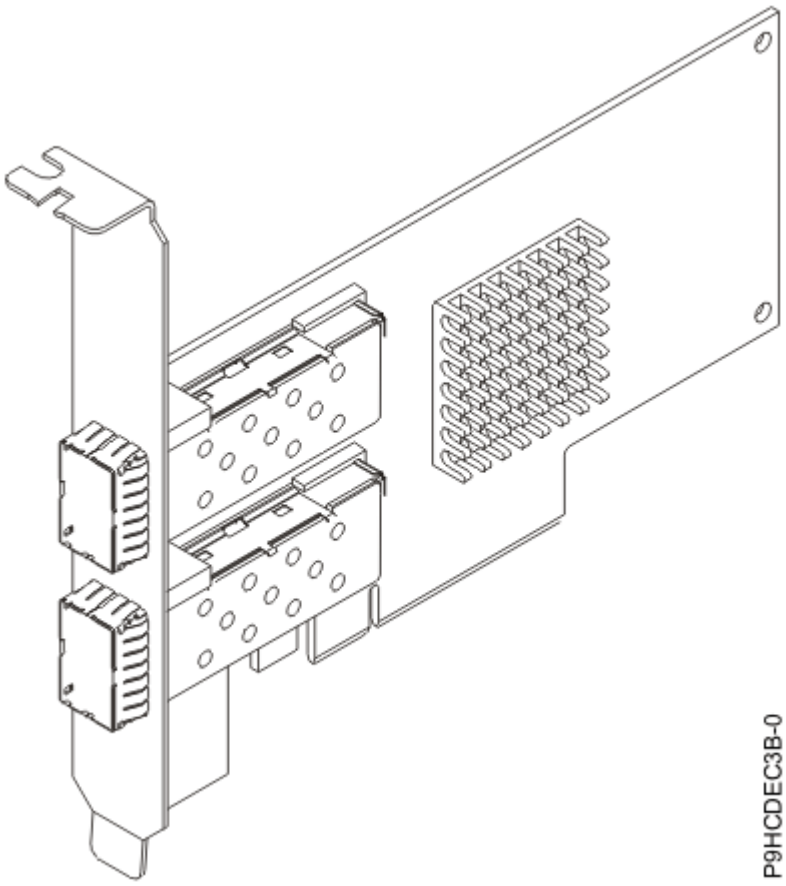


Figure 22. PCIe3 2-port 40 GbE NIC RoCE QSFP+ adapter (FC EC3B)

Specifications

Item
Description

Adapter FRU number
00FW105

I/O bus architecture
PCIe3 x8

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
3.3 V

Form factor
Short

Cables
See “Cables” on page 104 for details.

Cables

This adapter feature requires the use of compatible QSFP+, 40 Gbps, copper, twinaxial, active, Ethernet cables for cabling over short distances. See Figure 23 on page 105 for different views of the QSFP+ copper cable. For distances over 5 meters, use two optical QSFP+ SR transceivers (FC EB27 or FC EB57)

that attach to optical cables FC EB2J or FC EB2K. See Table 25 on page 105 for details about the feature codes.

Do not mix copper and optical cables on the same adapter.

These cables are compliant with industry standard specifications SFF-8431 Rev 4.1 and SFF-8472 Rev 10.4, and all applicable IBM requirements.

Note: These cables are EMC Class A compliant.

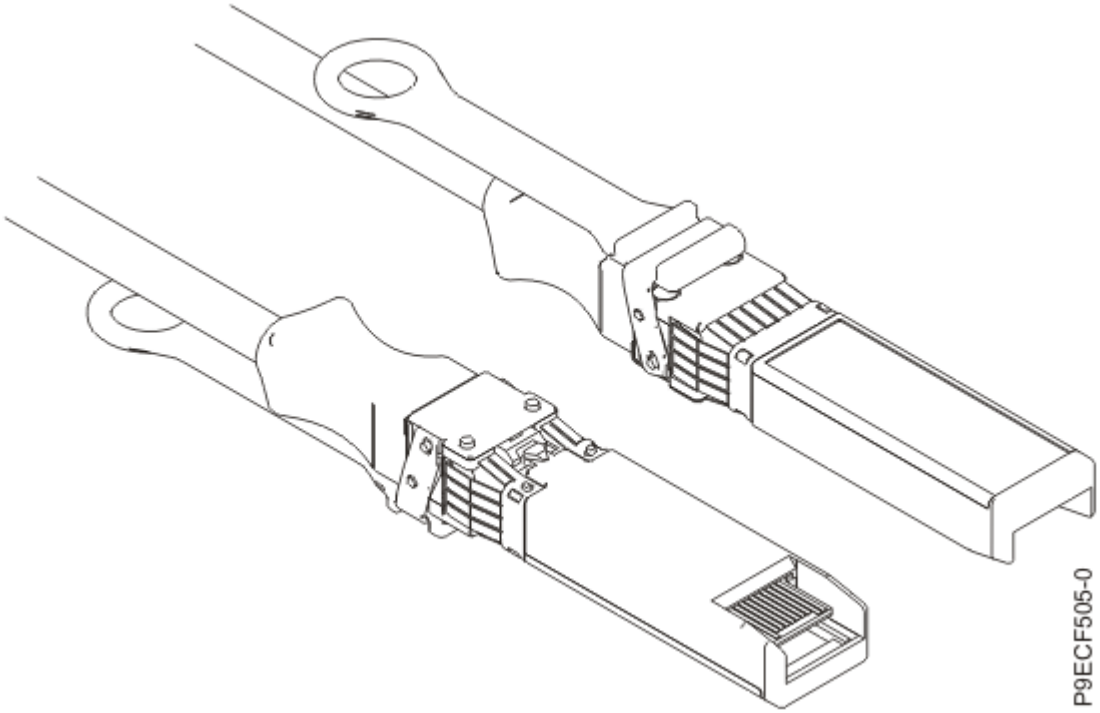


Figure 23. Top and bottom view of the cable

Table 25. Feature code and part number for varying lengths of the cable

Cable length	Feature code	CCIN	Part number
Copper cables			
1 m (3.28 ft)	EB2B		49Y7934
3 m (9.84 ft)	EB2H		49Y7935
5 m (16.4 ft)	ECBN		00D5809
Optical cables			
10 m (32.8 ft)	EB2J		41V2458
30 m (98.4 ft)	EB2K		45D6369
QSFP+ 40G BASE-SR transceiver	EB27		49Y7928
QSFP+ 40G BASE-SR transceiver	EB57		02JD565

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached

devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe3 2-port 100 Gb EDR InfiniBand adapter (FC EC3E and EC3F; CCIN 2CEA)

Learn about the specifications and operating system requirements for the feature code (FC) EC3E adapter.

Overview

FC EC3E and EC3F are both the same adapter with different feature codes. FC EC3E is a low-profile adapter and FC EC3F is a full-height adapter.

The PCIe3 2-port 100 Gb enhanced data rate (EDR) InfiniBand adapter provides high-speed connectivity with other servers or InfiniBand switches. Each port maximum of 100 Gb assumes that no other system and or switch bottlenecks are present. The adapter allows full bandwidth for a single EDR port in a PCIe3 slot and up to 128 Gb/s minus overheads for all ports. Each port maximum of 100 Gb/s assumes that no other system and or switch bottlenecks are present.

Note: The Virtual Protocol Interconnect (VPI) feature is not supported on this adapter. The adapter must be used only as an InfiniBand adapter.

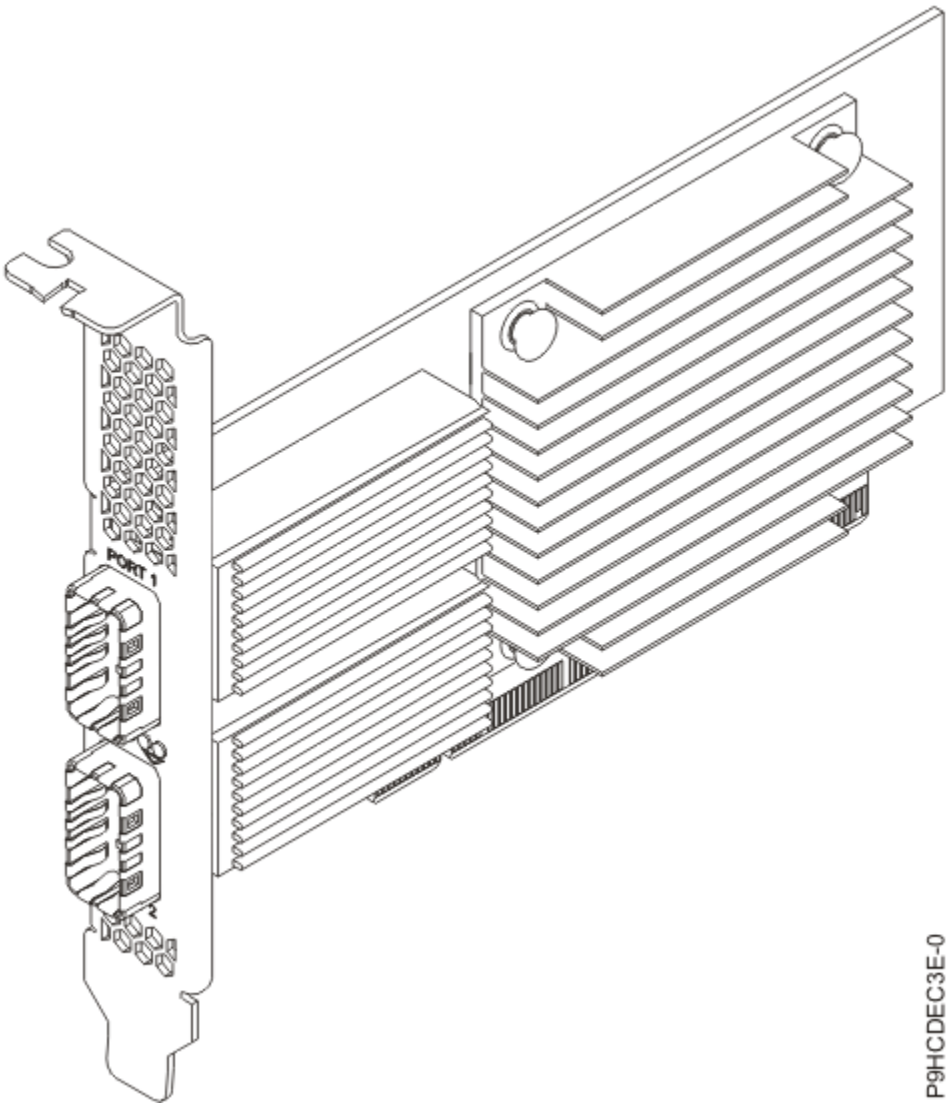


Figure 24. PCIe3 2-port 100 Gb EDR InfiniBand adapter

Specifications

Item
Description

Adapter FRU number
00WT075

I/O bus architecture
PCIe3 x16

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
3.3 V

Form factor
Short, low-profile (FC EC3E)

Short, will full-height tailstock (FC EC3F)

Cables
The two 100 Gb ports have QSFP28 connections. These 100 Gb ports support industry standard EDR DAC or optical cables.

Note: One adapter supports both types of cables. You can choose to cable just one port.

Attributes provided
PowerVM SR-IOV support. For more information see, PowerVM® SR-IOV FAQs.

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe3 2-port 100 GbE NIC & RoCE QSFP28 Adapter (FC EC3L and EC3M; CCIN 2CEC)

Learn about the specifications and operating system requirements for the feature code (FC) EC3L and EC3M adapter.

Overview

FC EC3L and EC3M are both the same adapter with different tail stock brackets. FC EC3L is a low-profile adapter and FC EC3M is a full-height adapter.

The PCIe3 2-port 100 GbE NIC & RoCE QSFP28 Adapter is a PCI Express (PCIe) generation 3 (Gen3), x16 adapter. The adapter provides two 100 Gb QSFP28 ports. The PCIe3 2-port 100 GbE (NIC and RoCE) QSFP28 Adapter supports both NIC (Network Interface Controller) and IBTA RoCE standards. RoCE is Remote Direct Memory Access (RDMA) over Converged Ethernet. Using RoCE, the adapter can support significantly greater bandwidth with low latency. It also minimizes CPU overhead by more efficiently using memory access. This offloads the CPU from I/O networking tasks, improving performance and scalability.

Note: Each port maximum of 100 Gb assumes that no other system and or switch bottlenecks are present. The adapter allows full bandwidth for a single port in a PCIe3 slot and up to 128 Gb/s minus overheads for both ports.

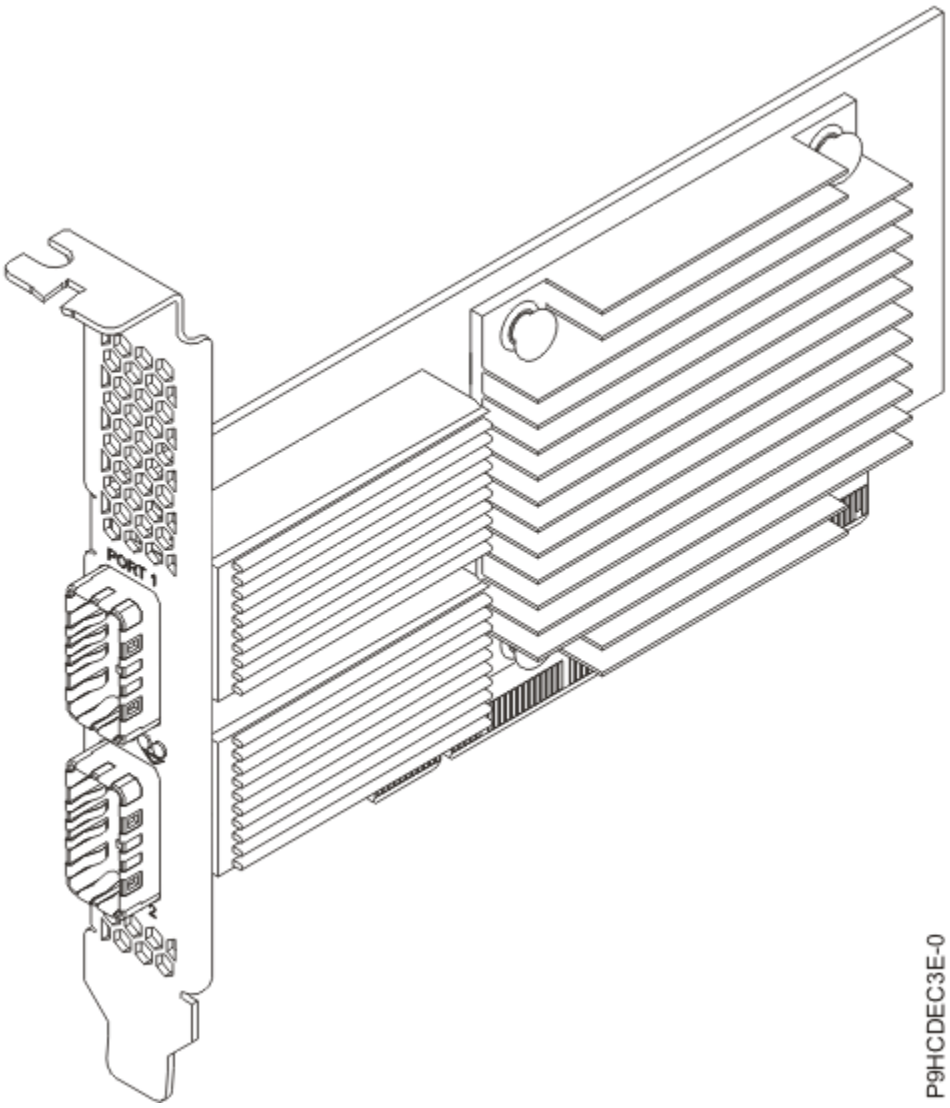


Figure 25. PCIe3 2-port 100 GbE NIC & RoCE QSFP28 Adapter

Specifications

Item
Description

Adapter FRU number
00WT078

I/O bus architecture
PCIe3 x16

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
3.3 V

Form factor
Short, low-profile (FC EC3L)

Short, with full-height tailstock (FC EC3M)

Cables

For 100G, IBM® offers either Direct Attach Copper (DAC) cables up to 2 M or Active Optical Cables (AOC) up to 100 M. QSFP28 based transceivers are included on each end of these cables. For more information about adapter cabling, see the “Cable and Transceiver Matrix” on page 110.

Note: For 40G, IBM® offers DAC cables up to 5 M. QSFP+ base transceivers are included on each end of these cables. See FC EB2B, EB2H, and ECBN for a 1 M, 3 M, and 5 M copper cables.

Transceivers

IBM qualifies and supports QSFP28 optical transceiver (FC EB59) to install into the adapter. Customers can also use their own optical cabling and QSP28 optical transceiver for the other end. This is a 100GBASE-SR4 based active optical transceiver capable up to 100 M through the OM4 cable or 70 M through OM3 cable. Either one or both of the adapter's two QSP28 ports can be populated. When two ports are filled, both can have copper cables or optical cables. Additionally, one of the cables can be copper and the other can be optical. IBM® also offers QSFP+ optical transceiver (FC EB27 or FC EB57) to install into the adapter and allowing the customer to use their own optical cabling and QSP28 optical transceiver for the other end.

Cable and Transceiver Matrix

Feature code	Description
EB59	100GBASE-SR4 Optical Transceiver MTP/MPO cable (purchased separately) • FC EB2J - 10 M • FC EB2K - 30 M
EB5J	QSFP28 Passive Copper 100 Gb Ethernet Cable - .5 M
EB5K	QSFP28 Passive Copper 100 Gb Ethernet Cable - 1 M
EB5L	QSFP28 Passive Copper 100 Gb Ethernet Cable - 1.5 M
EB5M	QSFP28 Passive Copper 100 Gb Ethernet Cable - 2 M
EB5R	QSFP28 AOC 100 Gb Ethernet Cable - 3 M
EB5S	QSFP28 AOC 100 Gb Ethernet Cable - 5 M
EB5T	QSFP28 AOC 100 Gb Ethernet Cable - 10 M
EB5U	QSFP28 AOC 100 Gb Ethernet Cable - 15 M
EB5V	QSFP28 AOC 100 Gb Ethernet Cable - 20 M
EB5W	QSFP28 AOC 100 Gb Ethernet Cable - 30 M
EB5X	QSFP28 AOC 100 Gb Ethernet Cable - 50 M
EB5Y	QSFP28 AOC 100 Gb Ethernet Cable - 100 M
EB2B	1 M Passive QSFP+ to QSFP+
EB2H	3 M Passive QSFP+ to QSFP+
ECBN	5 M Passive QSFP+ to QSFP+
EB27	QSFP+ 40G BASE-SR transceiver
EB57	QSFP+ 40G BASE-SR transceiver

Attributes provided

The adapter is based on the Mellanox ConnectX-4 adapter, which uses the ConnectX-4 EN Network Controller

Ethernet only supported in Ethernet or RoCE mode

PCIe3 compliant (1.1 and 2.0 compatible)

RDMA over Converged Ethernet (RoCE)

NIC and RoCE are concurrently supported

RoCE supported on Linux and AIX (7.2, and later)

NIC supported on all operati

TCP/UDP/IP stateless offload

LSO, LRO, and checksum offload

NIM boot support

Backward compatible with 40 Gb Ethernet when using compatible cables and transceivers

Improves performance and scalability by offloading the CPU from I/O networking tasks

Minimizes CPU overhead by more efficiently using memory access

PowerVM SR-IOV support. For more information see, PowerVM® SR-IOV FAQs.

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe3 x16 1-port 100 Gb EDR InfiniBand adapter (FC EC3T and EC3U; CCIN 2CEB)

Learn about the specifications and operating system requirements for the feature code (FC) EC3T and ECTU adapter.

Overview

FC EC3T and EC3U are both the same adapter with different feature codes. FC EC3T is a low-profile adapter and FC EC3U is a full-height adapter.

The PCIe Gen3 x16 1-port EDR InfiniBand adapter provides high-speed connectivity with other servers or InfiniBand switches. A maximum of 100 G assumes that no other system and or switch bottlenecks are present. The x16 adapter allows full bandwidth in a PCIe Gen3 slot.

The 100 Gb port has QSFP28 connection which supports industry standard EDR cables, either EDR DAC cables or EDR optical cables. One adapter can support either or both types of cable. You can choose to cable just one port if wanted.

Note: The Virtual Protocol Interconnect (VPI) feature is not supported on this adapter. The adapter must be used only as an InfiniBand adapter.

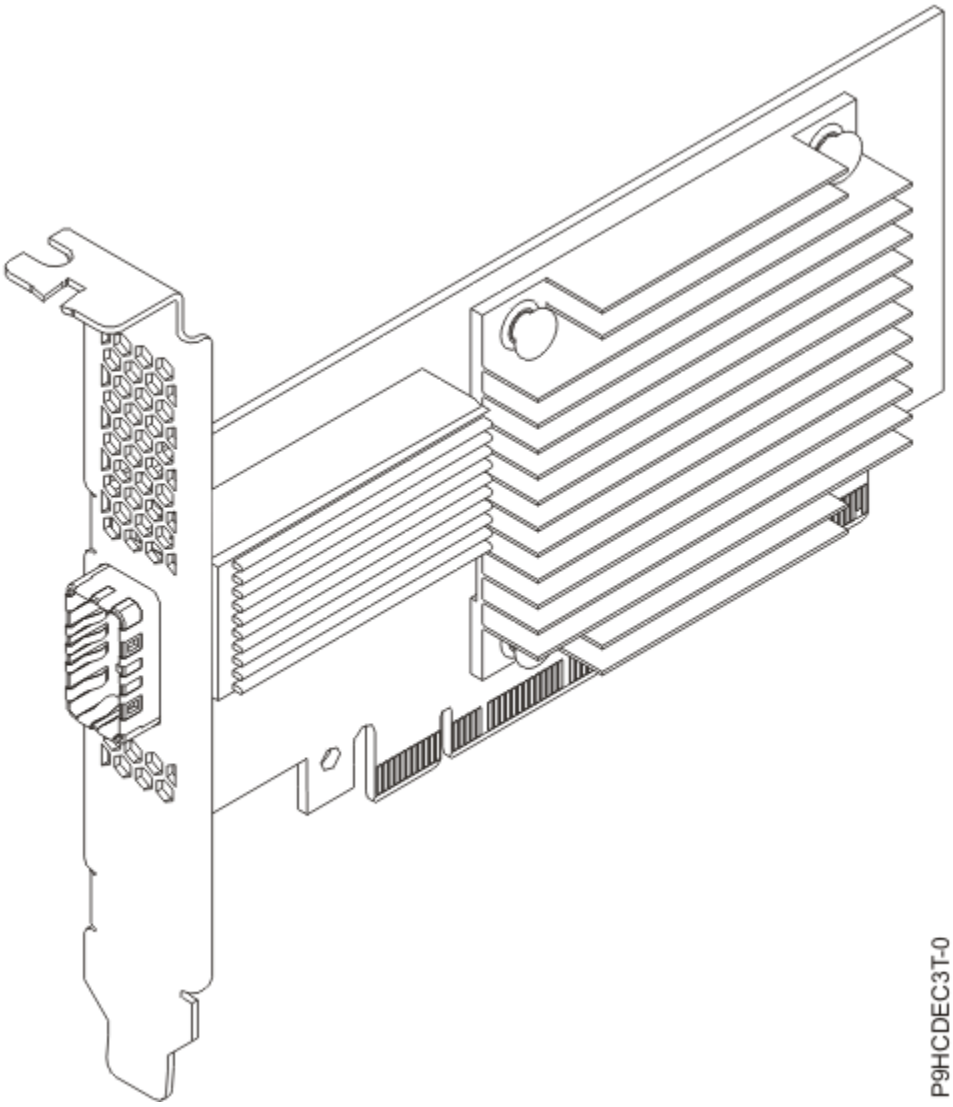


Figure 26. PCIe3 x16 1-port 100 Gb EDR InfiniBand Adapter

Specifications

Item
Description

Adapter FRU number
00WT013

I/O bus architecture
PCIe3 x16

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
3.3 V

Form factor
Short, low profile (FC EC3T)

Short, with full-height tail stock (FC EC3U)

Attributes provided
PowerVM SR-IOV support. For more information see, PowerVM® SR-IOV FAQs.

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe2 3D Graphics Adapter x1 (FC EC42)

Learn about the features, requirements, installation notes, and troubleshooting tips for the PCIe2 3D Graphics Adapter.

Overview

The PCIe2 3D Graphics Adapter is a PCI Express (PCIe) adapter that accelerates and enhances the system unit video. The adapter has no hardware switches to set. Mode selection is made through the software. Figure 27 on page 114 shows the adapter and its connectors.

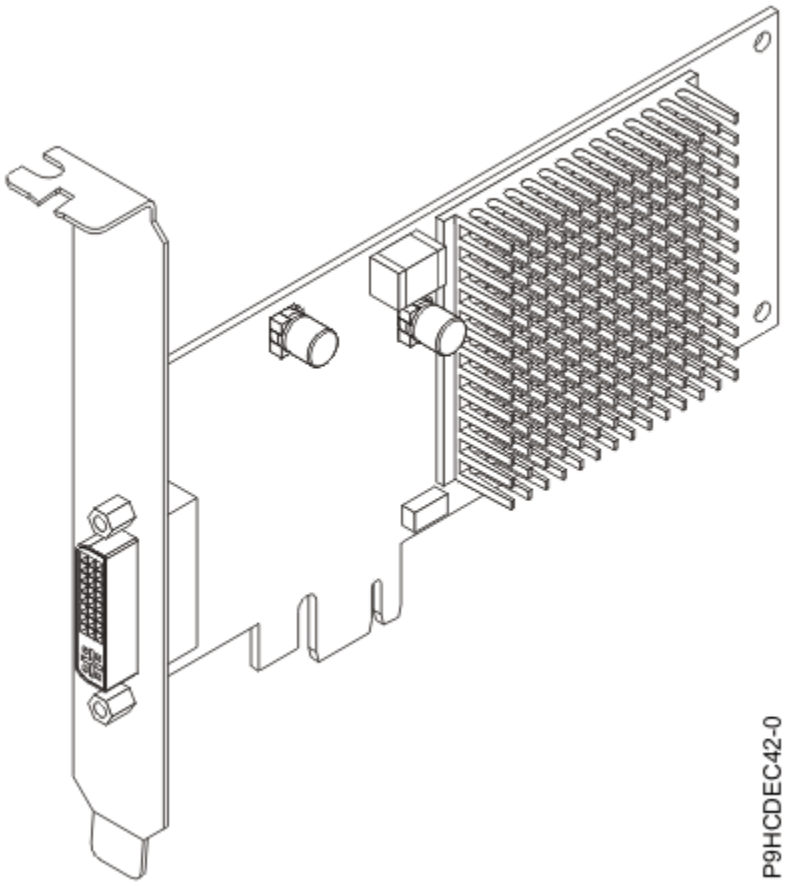


Figure 27. PCIe2 3D Graphics Adapter

Specifications

Item
Description

Adapter FRU number
00E3980

Cable part number
00E3060

Form factor
Full-height, half-length.

This adapter provides the following features:

- Placed in a single PCIe slot.
- Supports the single lane (x1) PCIe 2.1 bus interface.
- Provides 512 MB DDR3 graphics memory.
- Supports DVI or VGA outputs.
- Supports two 30 inches (76.2 cm) high-resolution displays.
- Provides a DMS-59 connector that can attach to any DMS-59 breakout cable. With the DMS-59 dongle, one or two DVI cables can be connected to the adapter. Alternatively, the DVI connector can have a DVI to VGA converter connected to it to connect a VGA monitor to the adapter.
- One analog monitor that supports a maximum resolution of up to 1920 x 1200.
- One digital monitor that supports a maximum resolution of up to 2560 x 1600.
- Display power management: Video Electronics Standards Association (VESA), Display Power Management Signaling (DPMS)

Preparing for installation

If you are installing the operating system at this time, install the adapter before you install the operating system. See “Installing the adapter” on page 115 for instructions. If you are installing only the device driver for this adapter, install the device driver software before you install the adapter.

Gathering tools and documentation

To install the adapter, make sure that you have access to the following items:

- The adapter
- The operating system documentation
- The system service guide for removing and replacing features
- The PCI adapter placement documentation
- A flat-blade screwdriver
- The media containing the device driver software

Installing the adapter

This section explains how to install the adapter. If you are installing your operating system at this time, install your adapter before you install the operating system. If the operating system is already installed and you need to install the device driver for this adapter, install the device driver software before you install the adapter.

Attention: Before you install an adapter, review the precautions in Handling static sensitive devices. Do not remove the adapter from its anti-static package until you are ready to place it in the system unit.

To install the adapter, follow these steps:

1. Determine the PCIe slot in which to place the adapter.

   The PCIe2 3D Graphics Adapter has an x1 PCIe connector and can be placed in a PCIe x1, x4, x8, or x16 slot. For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.
2. Shut down the system unit and install the adapter by using the instructions in the Installing PCI adapters topic for your system.
3. Connect the monitor cable to the adapter.

   If necessary, you can use a DVI-59 dongle for connecting a VGA 15-pin connector on a monitor cable to the DVI connector on the adapter. For example, a DVI-59 dongle is needed to connect to a display (FC 3632), a rack-mounted 7316-TF4 console, or a KVM switch.
4. Start the system unit and the monitor.
5. When prompted, configure the adapter by following the online configuration instructions.
6. When **Select Display** (console) appears, press the number key on your keyboard for the monitor that is to be the default.

Troubleshooting

If you have video problems after the initial installation, follow these procedures to troubleshoot the problem:

- Check the cables.
- Check the device driver software installation.
- Check the adapter installation.

Checking the cables

1. Ensure the monitor cables are connected to the correct adapter.
2. If you have more than one video adapter, be sure that each adapter is connected to a monitor.
3. Verify that the connections are secure.
4. If no log-in prompt appears, restart the system unit.

Checking the device driver software installation

Verify that the device driver for the PCIe2 3D Graphics Adapter is installed.

Checking the adapter installation

Verify that the system unit recognizes the PCIe2 3D Graphics Adapter.

At the Linux command-line enter `lspci -vmm -k -d 1002:68f2`. If the PCIe2 3D Graphics Adapter is correctly installed, the following is an example of the data that appears:

```
Device: 0009:01:00.0
Class: VGA compatible controller
Vendor: Advanced Micro Devices, Inc. [AMD/ATI]
Device: Cedar GL [FirePro 2270]
SVendor: Advanced Micro Devices, Inc. [AMD/ATI]
SDevice: Device 0126
PhySlot: U78CB.001.WZS000T-P1-C2
Driver: radeon
```

If the adapter does not show up, verify your LPAR configuration. If the adapter does show up but you are experiencing issues related to this adapter, such as visual glitches, incorrect colors, no image displayed, slow or incorrect rendering, and other problems with the display, you can run the standalone diagnostics for the adapter available in the IBM Installation Toolkit for PowerLinux.

If the message indicates that the adapter is DEFINED instead of AVAILABLE, shut down the system unit and check the PCIe2 3D Graphics Adapter to ensure that it is installed correctly. If you continue to experience problems after following the steps in this section, contact service and support for assistance.

IBM Installation Toolkit for PowerLinux

To troubleshoot problems for the 3D Graphics adapter, you can use the IBM Installation Toolkit for PowerLinux, a stand-alone diagnostic toolkit for systems that have the 3D Graphics adapter installed.

To diagnose problems with the 3D graphics adapter installed in a system, and work with the IBM Installation Toolkit, complete the following steps:

1. Download the DVD ISO image from IBM Installation Toolkit website (http://www-304.ibm.com/webapp/set2/sas/f/lopdiags/installtools/home.html).
2. Create a DVD for the downloaded ISO image.
3. Insert the DVD in the system DVD drive and boot the system.

   Note: You can also use the NIM to boot the system.
4. Once the DVD has booted, select the 3D graphics diagnostics application.
5. Choose the option 2 - Wizard mode graphical (using X). The Graphical desktop is displayed.
6. Right-click on the desktop area, and click **IBM** > **PCIe2 3D Graphics Adapter**.
7. Follow the on-screen instructions to diagnose the problem with the 3D Graphics adapter and resolve the problem.

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe2 LP 4-Port USB 3.0 Adapter (FC EC45 and FC EC46; CCIN 58F9)

Learn about the specifications for the feature code (FC) EC45 and FC EC46 adapter.

The PCIe2 LP 4-Port USB 3.0 Adapter (FC EC45) is a PCI Express (PCIe) generation 2, low-profile, high-performance expansion adapter. The FC EC45 is a low-profile adapter and the FC EC46 is regular-height adapter. The adapters provide the following features and support:

- The adapter is compliant with PCIe base specification revision 2.
- The adapter is a single-lane (1x) PCI Express with a throughput of 5 Gbps.
- The adapter is a single-slot, half-length short form factor, PCIe2 card.
- The adapter is FCC Class A compliant.
- The adapter provides four downstream, external, high-speed Universal Serial Bus (USB) 3.0 ports with Type A connectors.
- The USB ports are also compatible with USB specifications, revision 1.1 and 2.0 devices.
- The adapter supports the simultaneous operation of multiple USB 3.0, USB 2.0, and USB 1.1 devices.

  Restriction: When multiple keyboards are attached to the USB ports on the system or on the USB adapter, only one keyboard can be used while the partition is booting-up.
- The adapter provides 2k electrically erasable and programmable read-only memory (EEPROM) at 256 bytes.
- The provides supports integrated dual-speed USB transceivers.

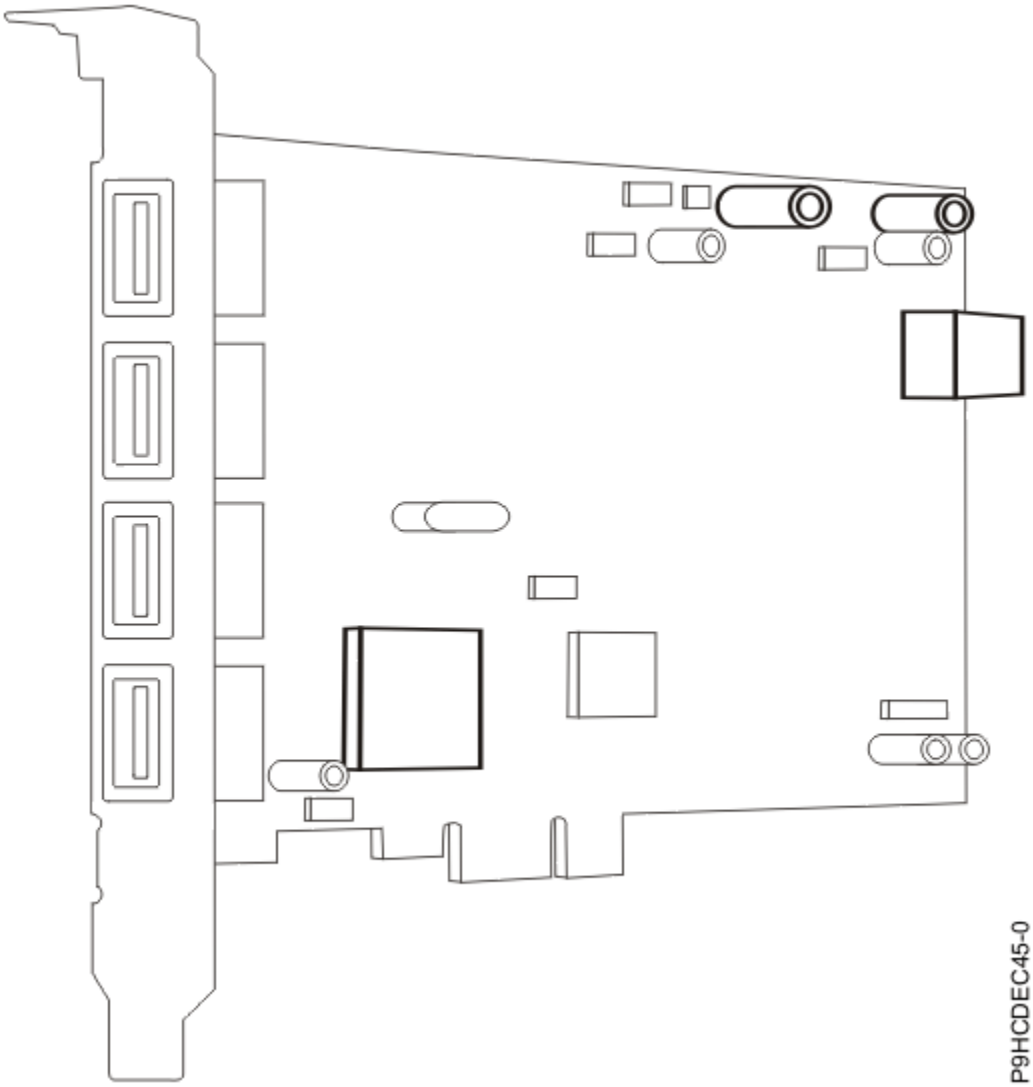


Figure 28. PCIe2 LP 4-port USB 3.0 adapter (FC EC45)

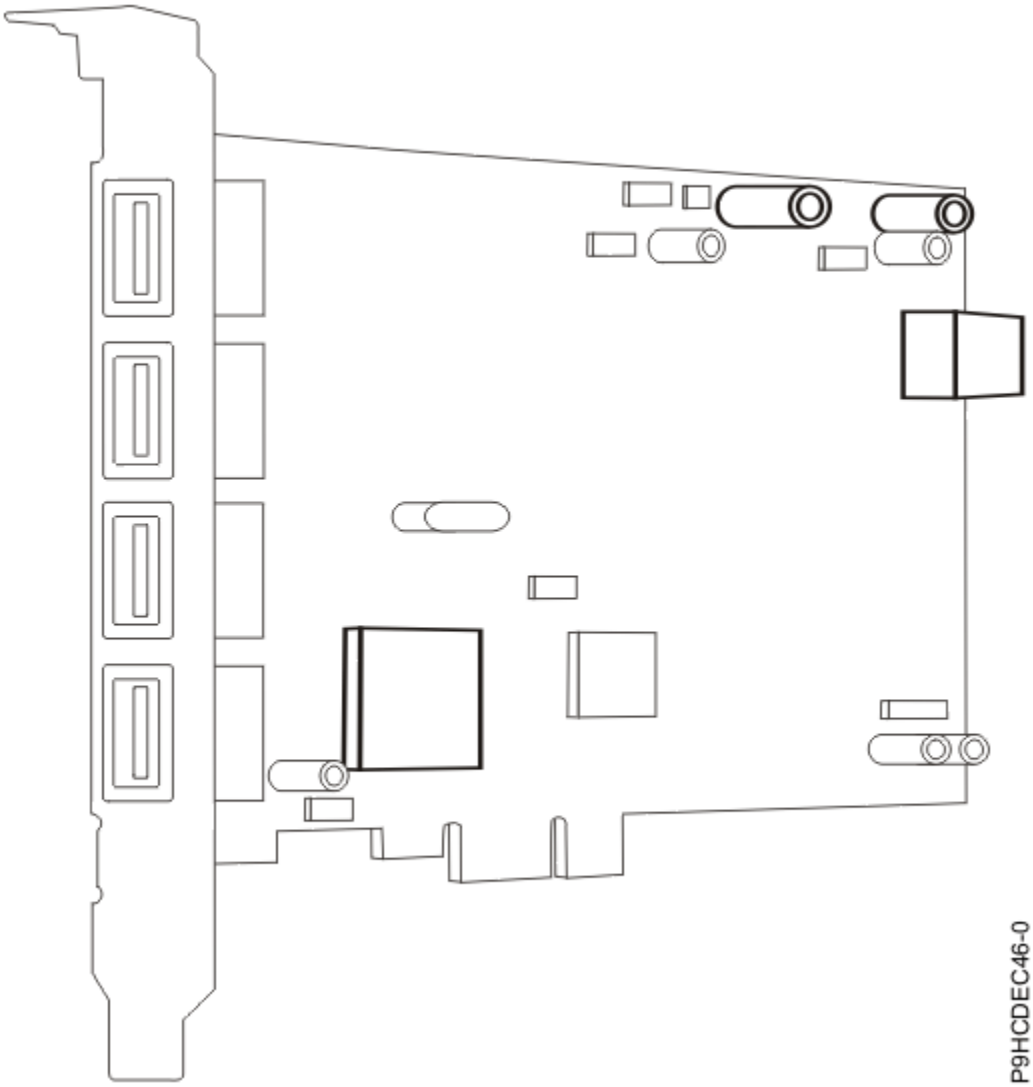


Figure 29. PCIe2 LP 4-port USB 3.0 adapter (FC EC46)

Specifications

Item
Description

FRU number
00E2932

Low-profile tailstock part number: 00E2934

I/O bus architecture
PCIe 2.2 compliant

Slot priority
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Busmaster
Yes

Form factor
FC EC45: Short form factor, half-length

FC EC46: Short form factor, half-length

Connector
Standard USB single pin-type series A receptacle

Wrap plug
None

Cables
Use USB cable (FC 4256) per port

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe2 LP 3D Graphics Adapter x16 (FC EC51)

Learn about the specifications and operating system requirements for feature code (FC) EC51.

Overview

The PCIe2 LP 3D Graphics Adapter x16 is a PCI Express (PCIe) generation 2.1 (Gen2.1) x16 adapter. The adapter can only be used in a x16 PCIe (Gen2) slot in the system. The adapter accelerates and enhances the system unit video. It has no hardware switches to set and the mode selection is made through the software.

Important: FC EC51 is explicitly not enabled Petit boot since it is not `kexec` safe. The adapter will crash the kernel when trying to boot a host OS.

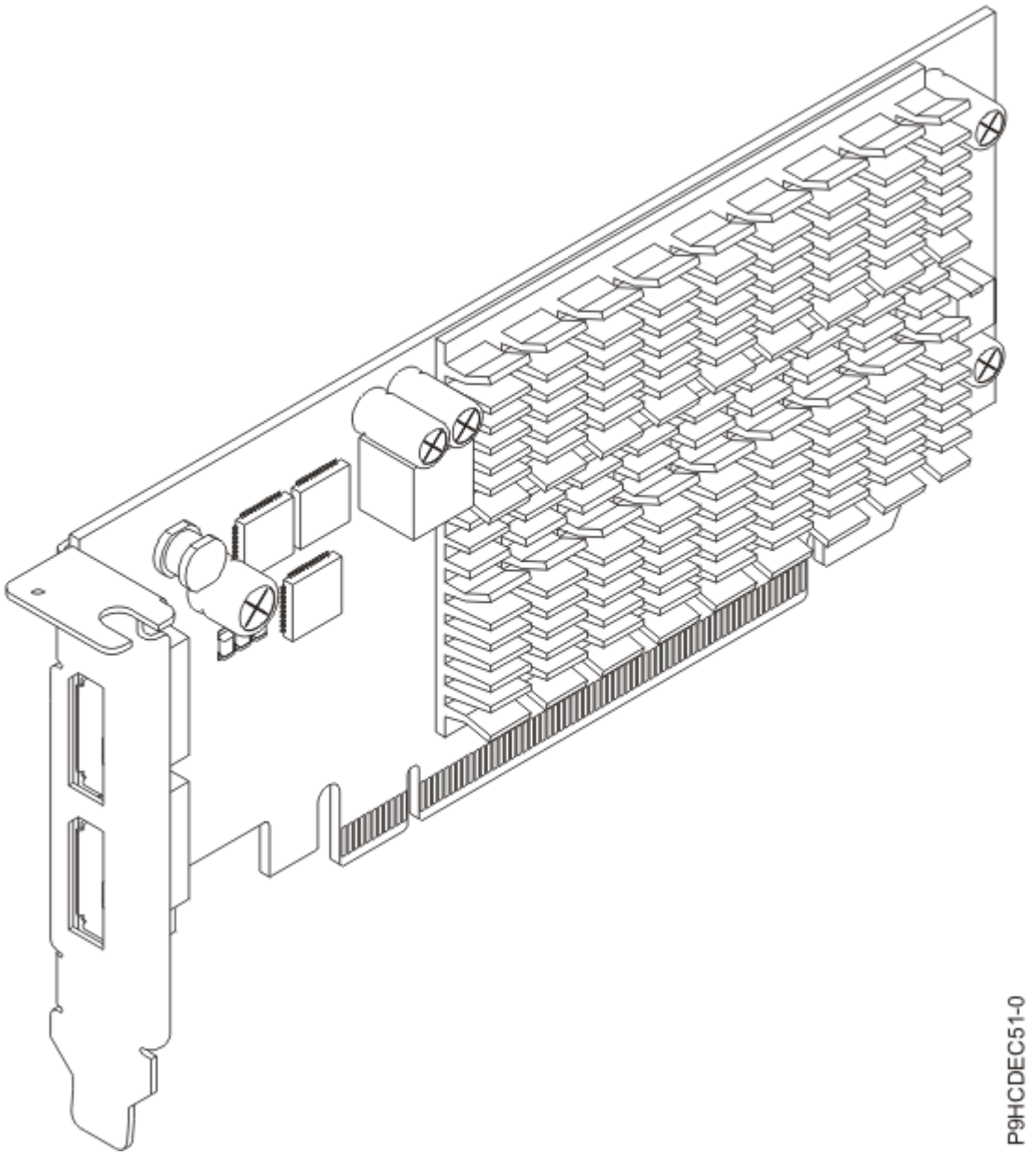


Figure 30. PCIe2 LP 3D Graphics Adapter x16 (FC EC51)

Specifications

Item
Description

Adapter FRU number
00WT180

I/O bus architecture
PCIe2.1

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Supported Systems
POWER9 processor-based systems

Voltage
3.3 V, 12 V

Form factor
Short, with full-height tailstock

Attributes provided
Not hot-pluggable

Passive cooling

Provides 512 MB DDR3 graphics memory

Supports display PORT outputs

Supports two 30 inches (76.2 cm) high-resolution displays

Provides two display port connectors that can attach to any display port cable

Video Electronics Standards Association (VESA) and Display Power Management Signaling (DPMS)

Cables
Please note that display port cables are not included with this adapter. For a list of supported cables, see below.

Note: IBM does not support video cable lengths that exceed 3 meters.

- Display port to display port cable
- Display port to VGA cable
- Display port to DVI cable
- Display port to HDMI cable

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe3 2x4 NVMe M.2 internal carrier adapter (FC EC59)

Learn about the specifications and operating system requirements for the PCIe3 2x4 NVMe M.2 internal carrier adapter (FC EC59).

Overview

The PCIe3 2x4 NVMe M.2 internal carrier adapter is an internal PCI Express generation-3 (PCIe3) adapter that is integrated into the supported systems. The adapter supports up to two NVMe M.2 Flash modules (FC ES14) and is intended to be used primarily for storage (operating system boot).

Depending on your system, you can have the following configurations:

- A single PCIe3 2x4 NVMe M.2 internal carrier adapter can be installed in the internal PCIe3 x8 slot (P1-C49) in supported systems. It can also be installed in the other internal PCIe3 x8 slot (P1-C50) if the PCIe3 x8 SAS RAID internal adapter 6 Gb (FC EJ1C) is installed in slot P1-C49.
- Up to two PCIe 2x4 NVMe M.2 internal carrier adapters (FC EC59) with two NVMe M.2 Flash modules (FC ES14) each can be installed in supported systems.

Important: Ensure that the 01GY502 SAS divider is re-installed and the 01GY494 SAS slot air block is in place if you're replacing the FC EC59 in slot P1-C49. f you're adding a second FC EC59 in slot P1-C50, the 01GY502 SAS divider and 01GY494 SAS slot air block must be removed.

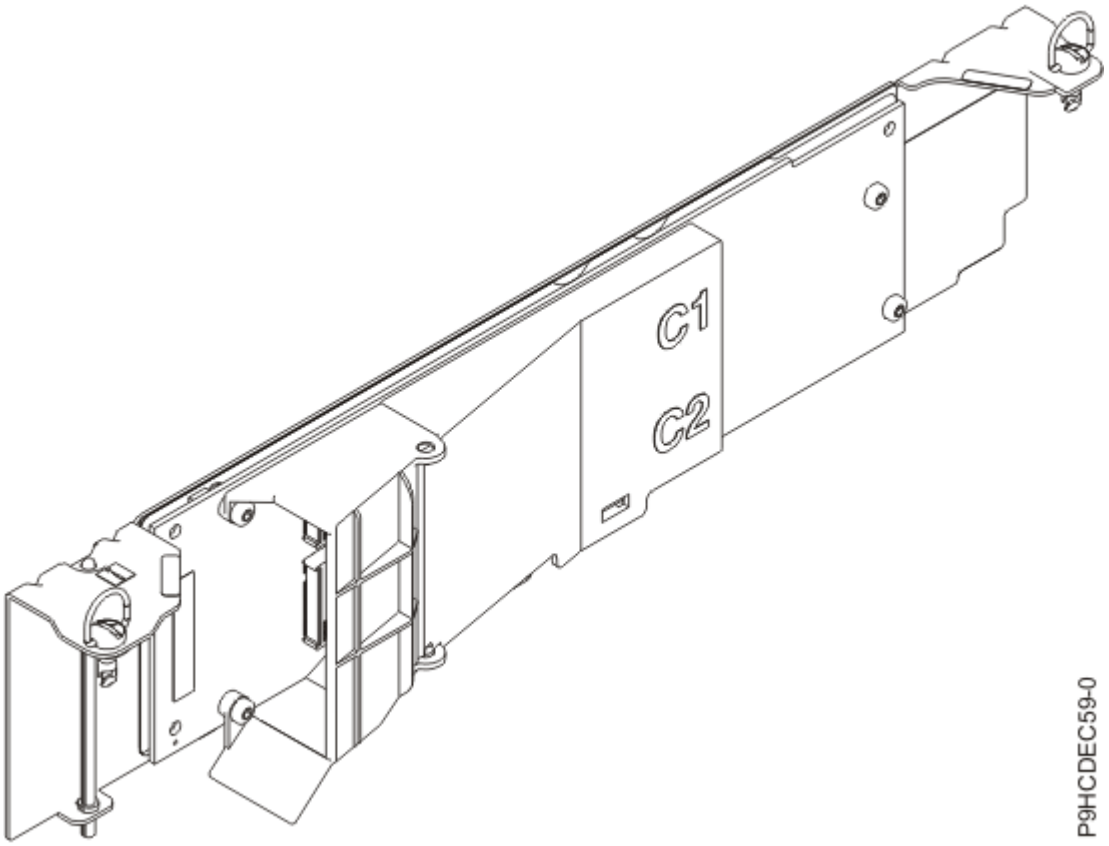


Figure 31. PCIe3 2x4 NVMe M.2 internal carrier adapter

Specifications

Item
Description

Adapter FRU number
01DH181

I/O bus architecture
PCIe3 2x4 (or x8)

Slot requirement
One internal PCIe3 x8 slot (P1-C49 or P1-C50)

Voltage
12 V

Maximum number
2

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the nvme-cli tool to manage NVMe devices can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe3 x8 NVMe 1.6 TB SSD NVMe Flash Adapter (FC EC5A, EC5B, EC5G, EC6U, and EC6V; CCIN 58FC)

Learn about the specifications and operating system requirements for feature code (FC) EC5A, EC5B, EC5G, EC6U, and EC6V adapters.

Overview

FC EC5A, EC5B, EC5G, EC6U, and EC6V are all the same adapters with different feature codes. FC EC5A, EC5G, and EC6U are low-profile adapters. FC EC5B and EC6V are full-height adapters. FC EC5A, EC5B, and EC5G are supported on AIX or Linux operating systems. FC EC6U and EC6V are supported on IBM i operating system.

The PCIe3 x8 NVMe 1.6 TB SSD NVMe adapter is a Peripheral Component Interconnect Express (PCIe) generation 3 (Gen3) x8 adapter. The adapter can be used in either a x8 or x16 PCIe (Gen3) slot in the system and uses Non-Volatile Memory Express (NVMe). NVMe is a high-performance software interface that can read or write flash memory. Compared to a Serial-attached SCSI (SAS) or Serial Advanced Technology Attachment (SATA) solid-state drive (SSD), the NVMe Flash adapter provides more read or write, input or output operations per second (IOPS) and larger throughput (GB/sec). The type of workload has a great impact on the maximum write capacity. If a high percentage of more sequentially oriented write operations are performed instead of random write operations, the maximum write capacity will be large. To extend the life of the NVMe device, the application that is using the NVMe device must convert small random write operations to larger sequential write operations. The write operations that exceed the maximum write capacity of the adapter continues to operate for some time but the performance will be slow. The life of the device is not affected depending on whether the application uses sequential oriented write operations or random read operations from the device. A Predictive Failure Analysis message is displayed when the adapter that is enabled by the system administrator must be replaced. To monitor the percentage usage of the adapter, see Checking the amount of remaining life in NVMe devices. If the adapter exceeds the maximum write capability, the adapter's replacement is not covered under IBM warranty or maintenance. This adapter has protection against single Flash channel failures. To prevent the entire adapter from failing, software RAID should be used. For high-value applications where the content in the adapter must be protected, additional NVMe Flash adapters with OS mirroring or software Redundant Array of Independent Disks (RAID) are recommended. This adapter is not supported in the PCIe Gen3 I/O drawer.

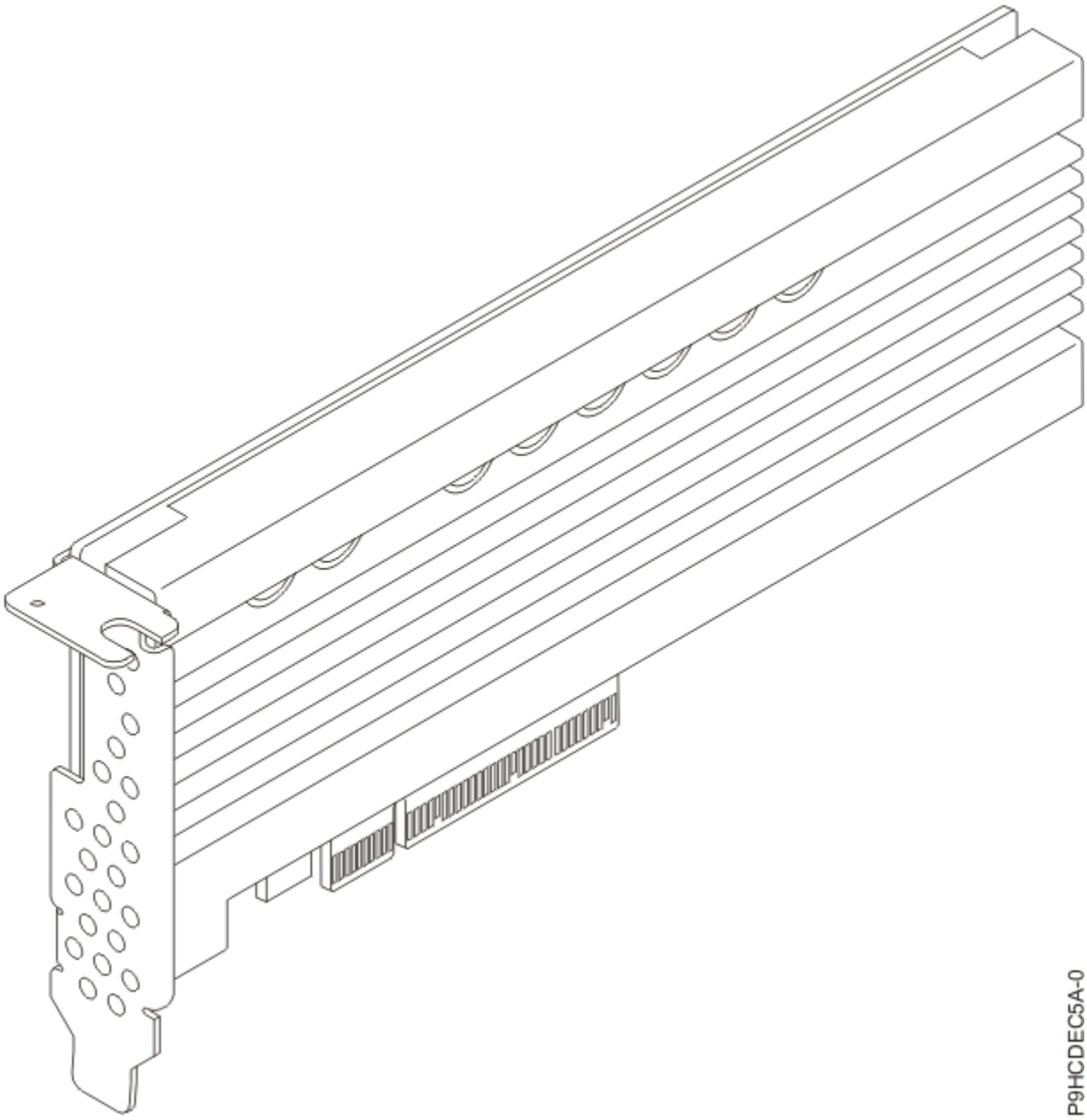


Figure 32. PCIe3 x8 NVMe 1.6 TB SSD NVMe Flash Adapter

Specifications

Item
Description

Adapter FRU number
01DH570.

I/O bus architecture
PCIe3 x8.

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
3.3 V, 12 V.

Form factor

Short, low-profile (FC EC5A, EC5G, and EC6U).

Short, with full-height tail stock (FC EC5B and EC6V).

Maximum number

For details about the maximum number of adapters that are supported, see Adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Attributes provided

1.6 TB of low latency flash memory.

Non-Volatile Write Buffer.

Hot Plug Capable.

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the nvme-cli tool to manage NVMe devices can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe3 x8 NVMe 3.2 TB SSD NVMe Flash Adapter (FC EC5C, EC5D, EC6W, and EC6X; CCIN 58FD)

Learn about the specifications and operating system requirements for feature code (FC) EC5C, EC5D, EC6W, and EC6X adapters. FC EC5C and EC6W are low-profile adapters and FC EC5D and EC6X are full-height adapters. FC EC5C and EC5D are supported on AIX or Linux operating systems. FC EC6W and EC6X are supported on the IBM i operating system.

Overview

The PCIe3 x8 NVMe 1.6 TB SSD NVMe adapter is a Peripheral Component Interconnect Express (PCIe) generation 3 (Gen3) x8 adapter. The adapter can be used in either a x8 or x16 PCIe (Gen3) slot in the system and uses Non-Volatile Memory Express (NVMe). NVMe is a high-performance software interface that can read or write flash memory. Compared to a Serial-attached SCSI (SAS) or Serial Advanced Technology Attachment (SATA) solid-state drive (SSD), the NVMe Flash adapter provides more read or write, input or output operations per second (IOPS) and larger throughput (GB/sec). The type of workload has a great impact on the maximum write capacity. If a high percentage of more sequentially oriented write operations are performed instead of random write operations, the maximum write capacity will be large. To extend the life of the NVMe device, the application that is using the NVMe device must convert small random write operations to larger sequential write operations. The write operations that exceed the maximum write capacity of the adapter continues to operate for some time but the performance will be slow. The life of the device is not affected depending on whether the application uses sequential oriented write operations or random read operations from the device. A Predictive Failure Analysis message is displayed when the adapter that is enabled by the system administrator must be replaced. To monitor

the percentage usage of the adapter, see Checking the amount of remaining life in NVMe devices. If the adapter exceeds the maximum write capability, the adapter's replacement is not covered under IBM warranty or maintenance. This adapter has protection against single Flash channel failures. To prevent the entire adapter from failing, software RAID should be used. For high-value applications where the content in the adapter must be protected, additional NVMe Flash adapters with OS mirroring or software Redundant Array of Independent Disks (RAID) are recommended. This adapter is not supported in the PCIe Gen3 I/O drawer.

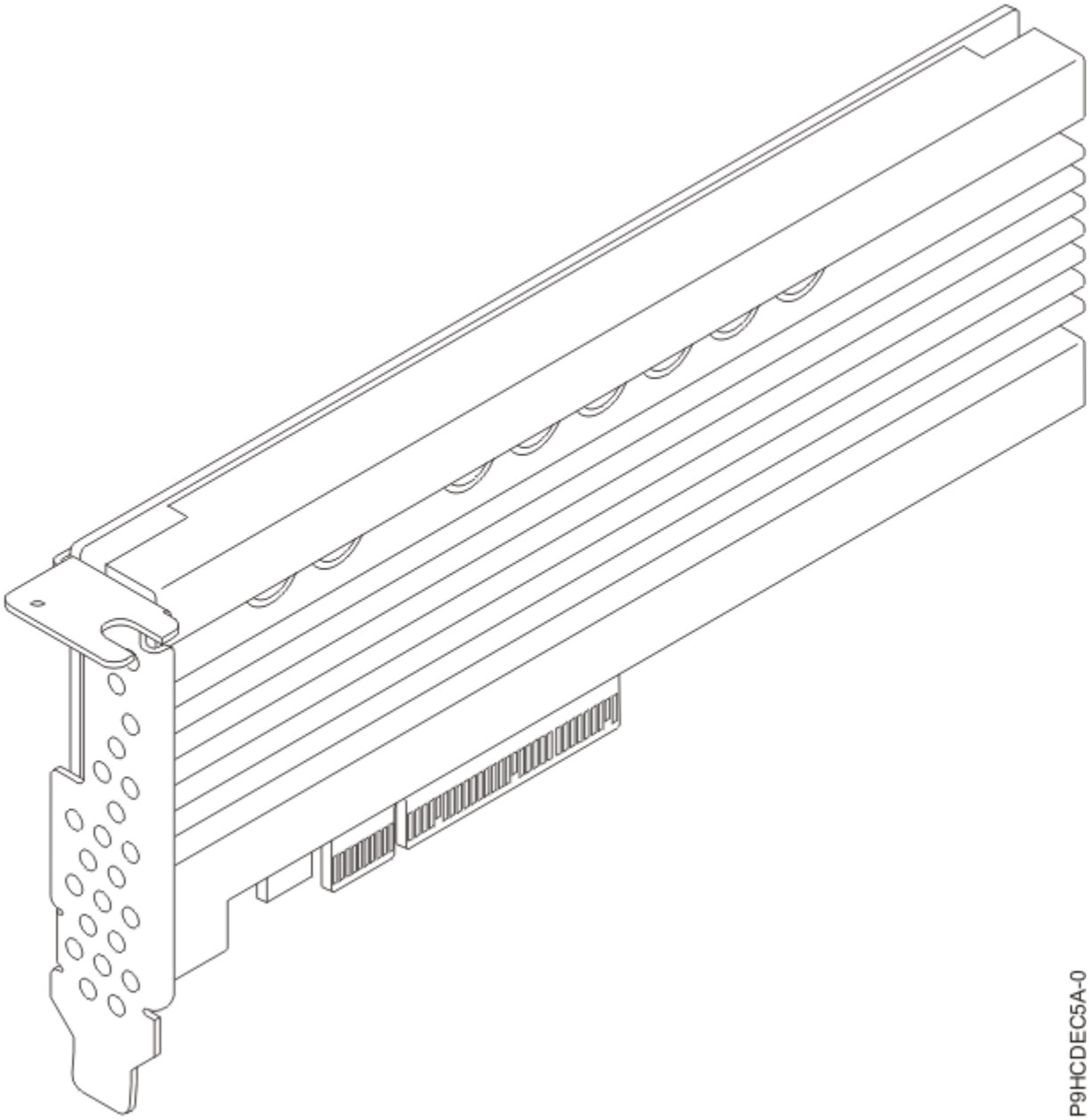


Figure 33. PCIe3 x8 NVMe 3.2 TB SSD NVMe Flash Adapter

Specifications

Item
Description

Adapter FRU number
01LK431

I/O bus architecture
PCIe3 x8

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
3.3 V, 12 V

Form factor
Short, low-profile (FC EC5C and EC6W)

Short, with full-height tailstock (FC EC5D and EC6X)

Maximum number
For details about the maximum number of adapters that are supported, see Adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Attributes provided
3.2 TB of low latency flash memory

Non-Volatile Write Buffer

Hot Plug Capable

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the nvme-cli tool to manage NVMe devices can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe3 x8 NVMe 6.4 TB SSD NVMe Flash Adapter (FC EC5E, EC5F, EC6Y, and EC6Z; CCIN 58FE)

Learn about the specifications and operating system requirements for feature code FC EC5E, EC5F, EC6Y, and EC6Z adapters. FC EC5E and EC6Y are low-profile adapters and EC5F and EC6Z are full-height adapters. FC EC5E and EC5F are supported on AIX or Linux operating systems. FC EC6Y and EC6Z are supported on the IBM i operating system.

Overview

The PCIe3 x8 NVMe 1.6 TB SSD NVMe adapter is a Peripheral Component Interconnect Express (PCIe) generation 3 (Gen3) x8 adapter. The adapter can be used in either a x8 or x16 PCIe (Gen3) slot in the system and uses Non-Volatile Memory Express (NVMe). NVMe is a high-performance software interface that can read or write flash memory. Compared to a Serial-attached SCSI (SAS) or Serial Advanced Technology Attachment (SATA) solid-state drive (SSD), the NVMe Flash adapter provides more read or write, input or output operations per second (IOPS) and larger throughput (GB/sec). The type of workload has a great impact on the maximum write capacity. If a high percentage of more sequentially oriented

write operations are performed instead of random write operations, the maximum write capacity will be large. To extend the life of the NVMe device, the application that is using the NVMe device must convert small random write operations to larger sequential write operations. The write operations that exceed the maximum write capacity of the adapter continues to operate for some time but the performance will be slow. The life of the device is not affected depending on whether the application uses sequential oriented write operations or random read operations from the device. A Predictive Failure Analysis message is displayed when the adapter that is enabled by the system administrator must be replaced. To monitor the percentage usage of the adapter, see Checking the amount of remaining life in NVMe devices. If the adapter exceeds the maximum write capability, the adapter's replacement is not covered under IBM warranty or maintenance. This adapter has protection against single Flash channel failures. To prevent the entire adapter from failing, software RAID should be used. For high-value applications where the content in the adapter must be protected, additional NVMe Flash adapters with OS mirroring or software Redundant Array of Independent Disks (RAID) are recommended. This adapter is not supported in the PCIe Gen3 I/O drawer.

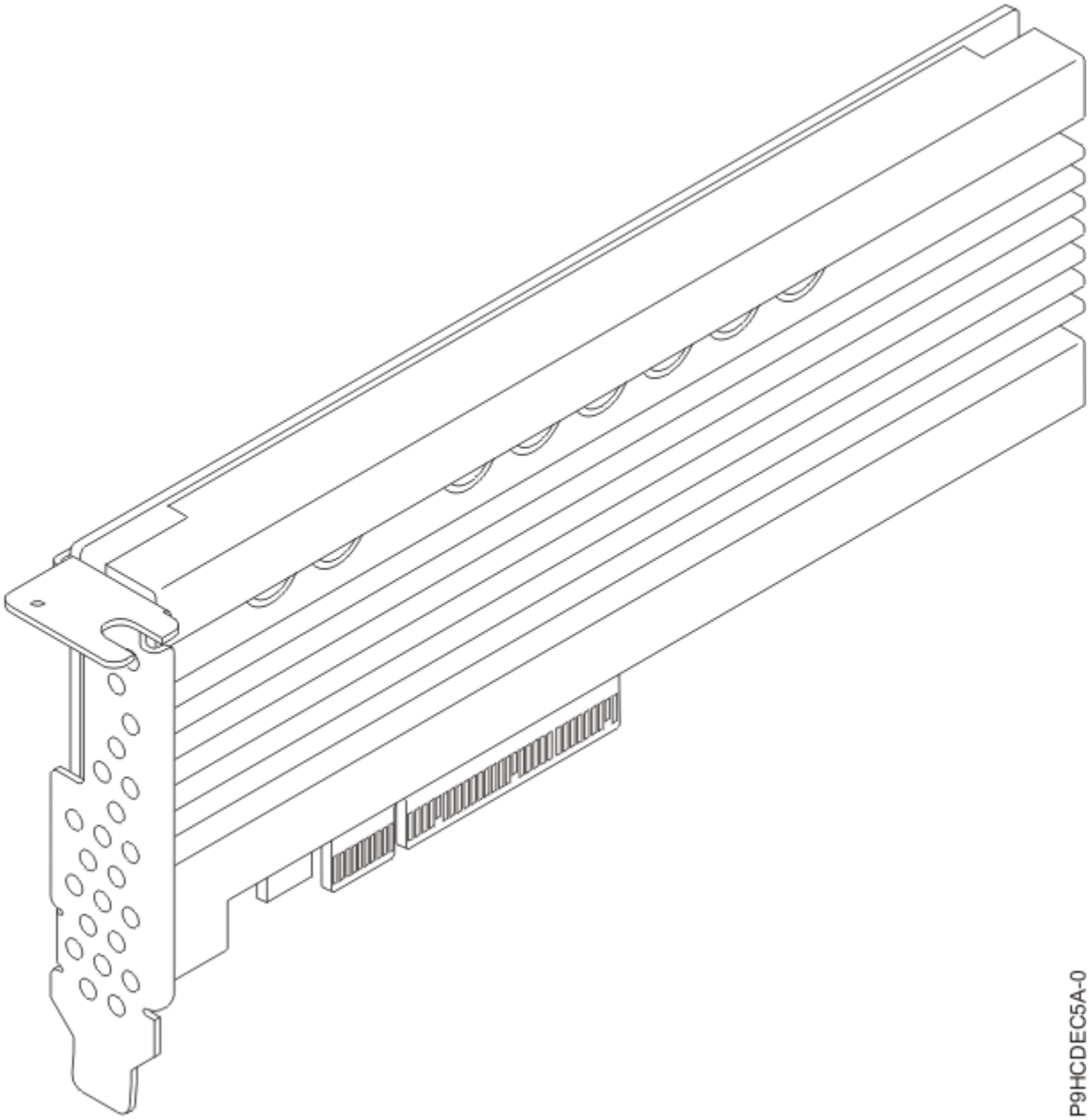


Figure 34. PCIe3 x8 NVMe 6.4 TB SSD NVMe Flash Adapter

Specifications

Item
Description

Adapter FRU number
01LK435

I/O bus architecture
PCIe3 x8

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
3.3 V, 12 V

Form factor
Short, low-profile (FC EC5E and EC6Y)

Short, with full-height tailstock (FC EC5F and EC6Z)

Maximum number
For details about the maximum number of adapters that are supported, see Adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Attributes provided
6.4 TB of low latency flash memory

Non-Volatile Write Buffer

Hot Plug Capable

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the nvme-cli tool to manage NVMe devices can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe4 x16 1-Port EDR 100 GB IB ConnectX-5 CAPI Capable Adapter (FC EC62 and EC63; CCIN 2CF1)

Learn about the specifications and operating system requirements for feature code (FC) EC62 and EC63 adapters.

Overview

FC EC62 and EC63 are both the same adapter with different feature codes. FC EC62 is a low-profile adapter and FC EC63 is a full-height adapter.

The PCIe4 x16 1-Port enhanced data rate (EDR) 100 GB Infiniband (IB) ConnectX-5 CAPI Capable Adapter is a PCI Express (PCIe) generation 4 (Gen4) x16 adapter. The adapter enables higher HPC performance with new Message Passing Interface (MPI) offloads, such as MPI Tag Matching and MPI AlltoAll operations, advanced dynamic routing, and new capabilities to perform various data algorithms.

Note: The Virtual Protocol Interconnect (VPI) feature is not supported on this adapter. The adapter must be used only as an InfiniBand adapter.

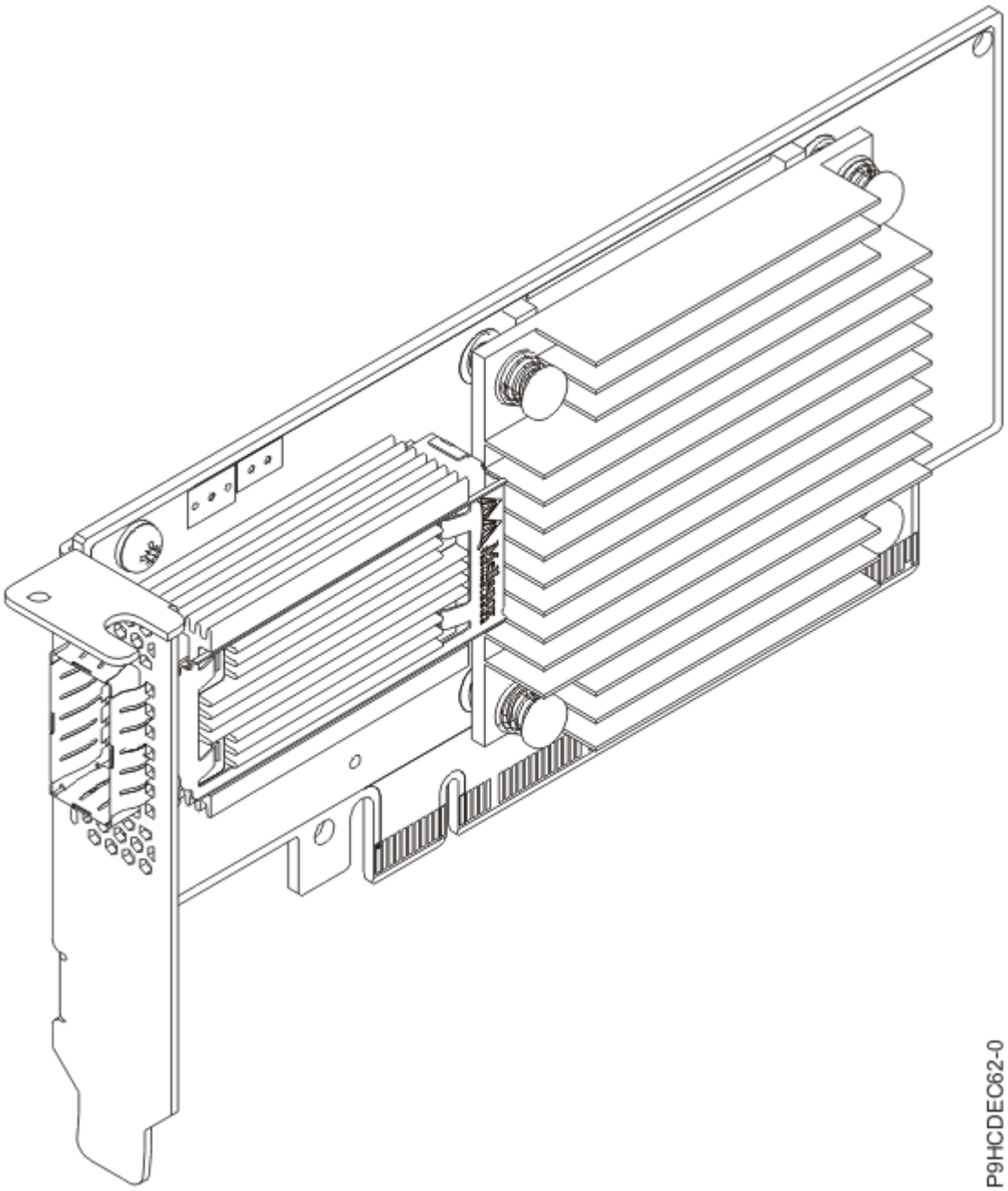


Figure 35. PCIe4 x16 1-Port EDR 100 GB IB ConnectX-5 CAPI Capable Adapter

Specifications

Item
Description

Adapter FRU number
00WT179

I/O bus architecture
PCIe4 x16

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Thermal requirement
If you have an 8335-GTG, 8335-GTH, or 8335-GTX system, you might be required to set the thermal mode of the system to a setting other than the default setting, depending on your system, adapter, and cable type. For details, see Determining and setting the thermal mode for an 8335-GTG, 8335-GTH, or 8335-GTX system.

Voltage
3.3 V, 12 V

Form factor
Short, low-profile (FC EC62)

Short, with full-height tailstock (FC EC63)

Attributes provided
EDR 100 Gb/s InfiniBand or 100 Gb/s Ethernet per port

PCIe4 Support

IBM CAPI v2 support

Tag Matching and Rendezvous Offloads

Hardware-based I/O virtualization

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe4 x16 2-Port EDR 100 GB IB ConnectX-5 CAPI Capable Adapter (FC EC64 and EC65; CCIN 2CF2)

Learn about the specifications and operating system requirements for feature code (FC) EC64 and EC65 adapters.

Overview

FC EC64 and EC65 are both the same adapter with different feature codes. FC EC64 is a low-profile adapter and FC EC65 is a full-height adapter.

PCIe4 x16 2-Port EDR 100 GB IB ConnectX-5 CAPI Capable Adapter is a PCI Express (PCIe) generation 4 (Gen4) x16 adapter. The adapter enables higher HPC performance with new Message Passing Interface (MPI) offloads, such as MPI Tag Matching and MPI AlltoAll operations, advanced dynamic routing, and new capabilities to perform various data algorithms.

Note: The Virtual Protocol Interconnect (VPI) feature is not supported on this adapter. The adapter must be used only as an InfiniBand adapter.

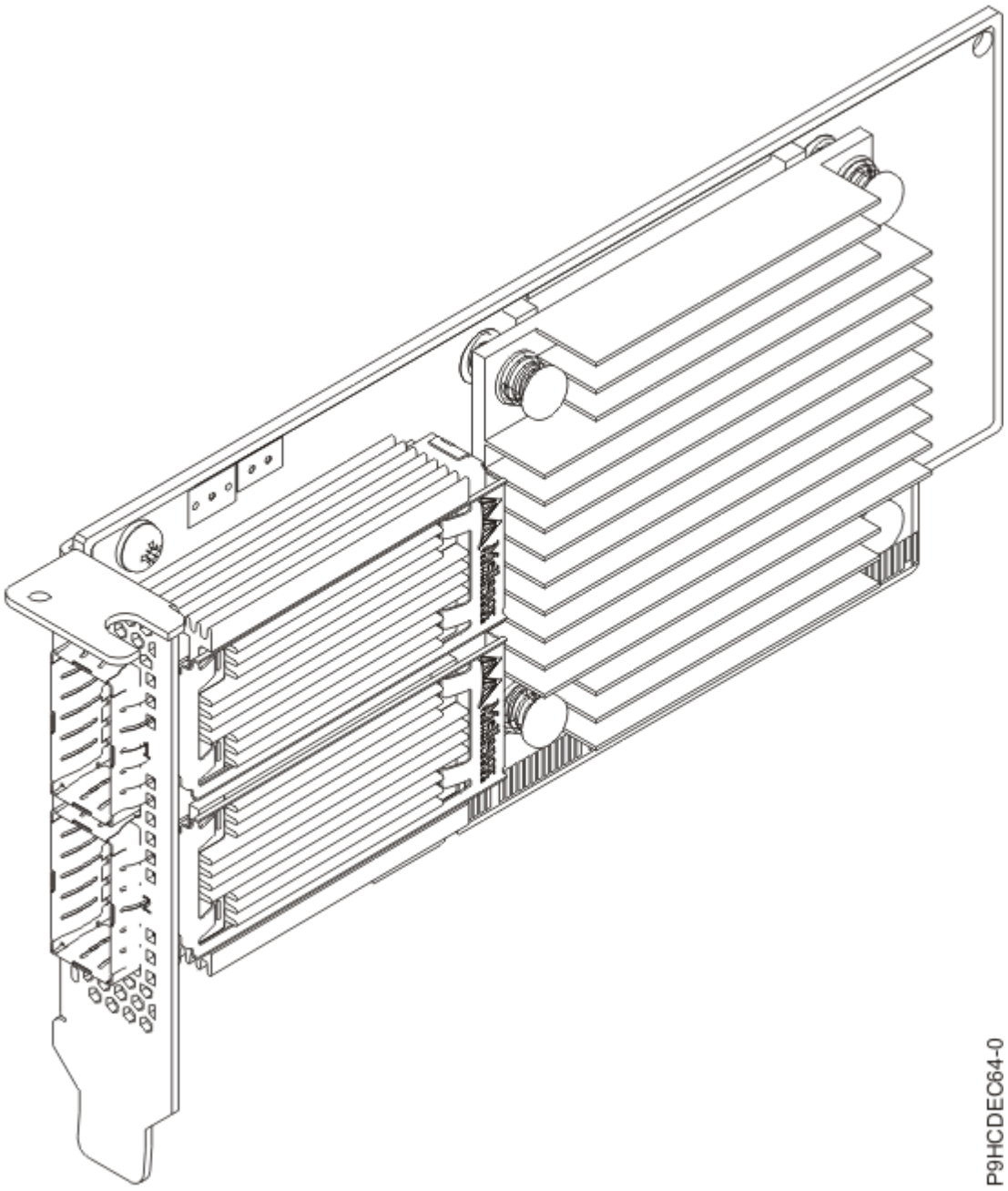


Figure 36. PCIe4 x16 2-Port EDR 100 GB IB ConnectX-5 CAPI Capable Adapter

Specifications

Item
Description

Adapter FRU number
00WT176

I/O bus architecture
PCIe4 x16

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Thermal requirement
If you have an 8335-GTG, 8335-GTH, or 8335-GTX system, you might be required to set the thermal mode of the system to a setting other than the default setting, depending on your system, adapter, and cable type. For details, see Determining and setting the thermal mode for an 8335-GTG, 8335-GTH, or 8335-GTX system.

Voltage
3.3 V, 12 V

Form factor
Short, low-profile

Attributes provided
EDR 100 Gb/s InfiniBand per port

PCIe4 Support

IBM CAPI v2 support

Tag Matching and Rendezvous Offloads

Hardware-based I/O virtualization

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe4 2-port 100 GbE RoCE x16 adapter (FC EC66 and EC67; CCIN 2CF3)

Learn about the specifications and operating system requirements for feature code (FC) EC66 and EC67 adapters.

Overview

FC EC66 is a full-height adapter and FC EC67 is a low-profile adapter.

The PCIe4 2-port 100GbE RoCE Adapter is a PCI Express (PCIe) generation 4 (Gen4) x16 adapter. The adapter provides two 100GbE QSFP28 ports. The PCIe4 2-port 100GbE RoCE Adapter supports both NIC (Network Interface Controller) and IBTA RoCE standards. RoCE is Remote Direct Memory Access (RDMA) over Converged Ethernet. Using RoCE, the adapter can support significantly greater bandwidth with low latency. It also minimizes the CPU overhead by more efficiently using memory access. This offloads the CPU from I/O networking tasks, improving performance and scalability.

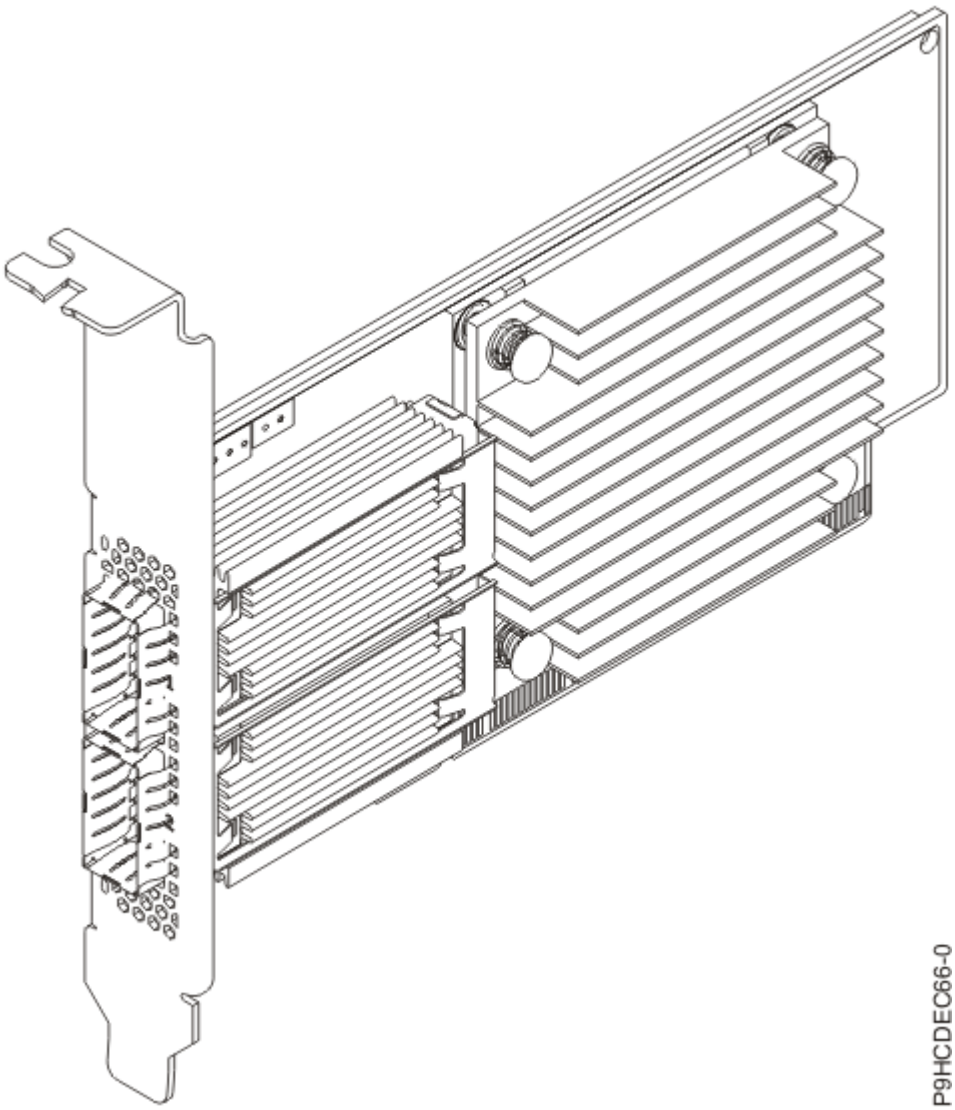


Figure 37. 2-port 100 GbE RoCE En Connectx-5 Gen4 PCIe x16 adapter (FC EC66)

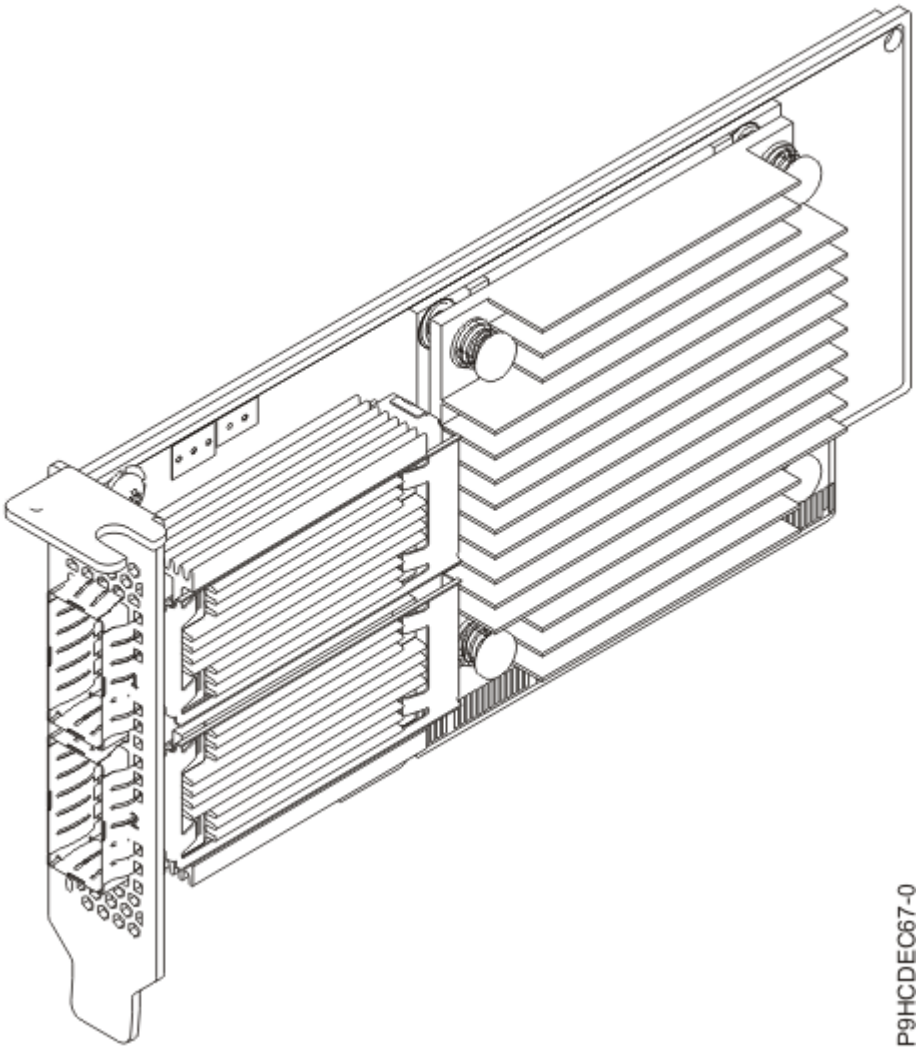


Figure 38. 2-port 100 GbE RoCE En Connectx-5 Gen4 PCIe x16 adapter (FC EC67)

Specifications

Item
Description

Adapter FRU number
01FT742

I/O bus architecture
PCIe4 x16

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Cables

For 100G, IBM offers either Direct Attach Copper (DAC) cables up to 2 M or Active Optical Cables (AOC) up to 100 M. QSFP28 based transceivers are included on each end of these cables. For more information about adapter cabling, see the (CHANGE TO LINK) Cable and transceiver matrix.

Note: For 40G, IBM offers DAC cables up to 3 M. QSFP+ base transceivers are included on each end of these cables. See FC EB2B and EB2H for a 1 M and 3 M copper cables.

Transceivers

IBM qualifies and supports QSFP28 optical transceiver (FC EB59) to install into the adapter. Customers can also use their own optical cabling and QSP28 optical transceiver for the other end. This is a 100GBASE-SR4 based active optical transceiver capable up to 100 M through the OM4 cable or 70 M through OM3 cable. Either one or both of the adapter's two QSP28 ports can be populated. When two ports are filled, both can have copper cables or optical cables. Additionally, one of the cables can be copper and the other can be optical. IBM® also offers QSFP+ optical transceiver (FC EB27 or FC EB57) to install into the adapter and allowing the customer to use their own optical cabling and QSFP+ optical transceiver for the other end.

Cable and transceiver matrix

Table 26. Cable and transceiver matrix

Feature	Description
EB59	100GBASE-SR4 optical transceiver MTP/MPO cable (purchased separately) • FC EB2J - 10 M • FC EB2K - 30 M
EB5J	QSFP28 Passive Copper 100 Gb Ethernet Cable - .5 M
EB5K	QSFP28 Passive Copper 100 Gb Ethernet Cable - 1 M
EB5L	QSFP28 Passive Copper 100 Gb Ethernet Cable - 1.5 M
EB5M	QSFP28 Passive Copper 100 Gb Ethernet Cable - 2 M
EB5R	QSFP28 AOC 100 Gb Ethernet Cable - 3 M
EB5S	QSFP28 AOC 100 Gb Ethernet Cable - 5 M
EB5T	QSFP28 AOC 100 Gb Ethernet Cable - 10 M
EB5U	QSFP28 AOC 100 Gb Ethernet Cable - 15 M
EB5V	QSFP28 AOC 100 Gb Ethernet Cable - 20 M
EB5W	QSFP28 AOC 100 Gb Ethernet Cable - 30 M
EB5X	QSFP28 AOC 100 Gb Ethernet Cable - 50 M
EB5Y	QSFP28 AOC 100 Gb Ethernet Cable - 100 M
EB2B	1 M Passive QSFP+ to QSFP+
EB2H	3 M Passive QSFP+ to QSFP+
EB27 or EB57	QSFP+ 40G BASE-SR4 optical transceiver MTP/MPO cable (purchased separately) • FC EB2J - 10 M • FC EB2K - 30 M

Voltage

3.3 V, 12 V

Form factor

Short, with full-height tailstock (FC EC66)

Short, low-profile (FC EC67)

Attributes provided

PCI Express 4.0 (up to 16GT/s) x16

PCIe Gen 4.0 compliant (1.1, 2.0, and 3.0 compatible)

RDMA over Converged Ethernet (RoCE)

Dual-port of 100 Gb/s Ethernet per port

NIC and RoCE are concurrently supported

RoCE supported on linux and AIX (7.2, and later)

NIC supported on all OSes

TCP/UDP/IP stateless offload

LSO, LRO, and checksum offload

NIM boot support

The adapter is based on the Mellanox ConnectX-5 adapter, which uses the ConnectX-5 EN Network Controller

Backward compatible with 40 Gb Ethernet when using compatible cables and transceivers

Improves performance and scalability by offloading the CPU from I/O networking tasks

Minimizes CPU overhead by more efficiently using memory access

PowerVM SR-IOV support. For more information see, PowerVM® SR-IOV FAQs.

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe4 x16, 2-port HDR 100 Gb InfiniBand ConnectX-6 adapter (FC EC6G; CCIN 590E)

Learn about the specifications and operating system requirements for feature code (FC) EC6G.

Overview

FC EC6G is a low-profile adapter. The PCIe4 x16 2-Port high data rate (HDR) 100 Gb InfiniBand (IB) ConnectX-6 adapter is a PCI Express (PCIe) generation 4 (Gen4) x16 adapter. The adapter can be used in a x16 PCIe slot in the system. The adapter enables higher HPC performance with new Message Passing Interface (MPI) offloads, such as MPI Tag Matching and MPI AlltoAll operations, advanced dynamic

routing, and new capabilities to perform various data algorithms. The HDR 100 Gb adapter supports connecting to an HDR 200 Gb switch by using HDR 100 Gb splitter cables (Direct Attach Copper-DAC or Active Optical Cables-AOC). Splitter cables allow a single HDR 200 Gb switch port to connect to HDR 100 Gb ports, doubling a typical HDR switch capacity from 40 ports to 80 ports. The HDR 100 Gb adapter also supports enhanced data rate (EDR) copper and optical cables when connecting to EDR 100 Gb or HDR 200 Gb InfiniBand switches. See “Cable matrix” on page 141 for more details.

Note: The Virtual Protocol Interconnect® (VPI) feature is supported on this adapter.

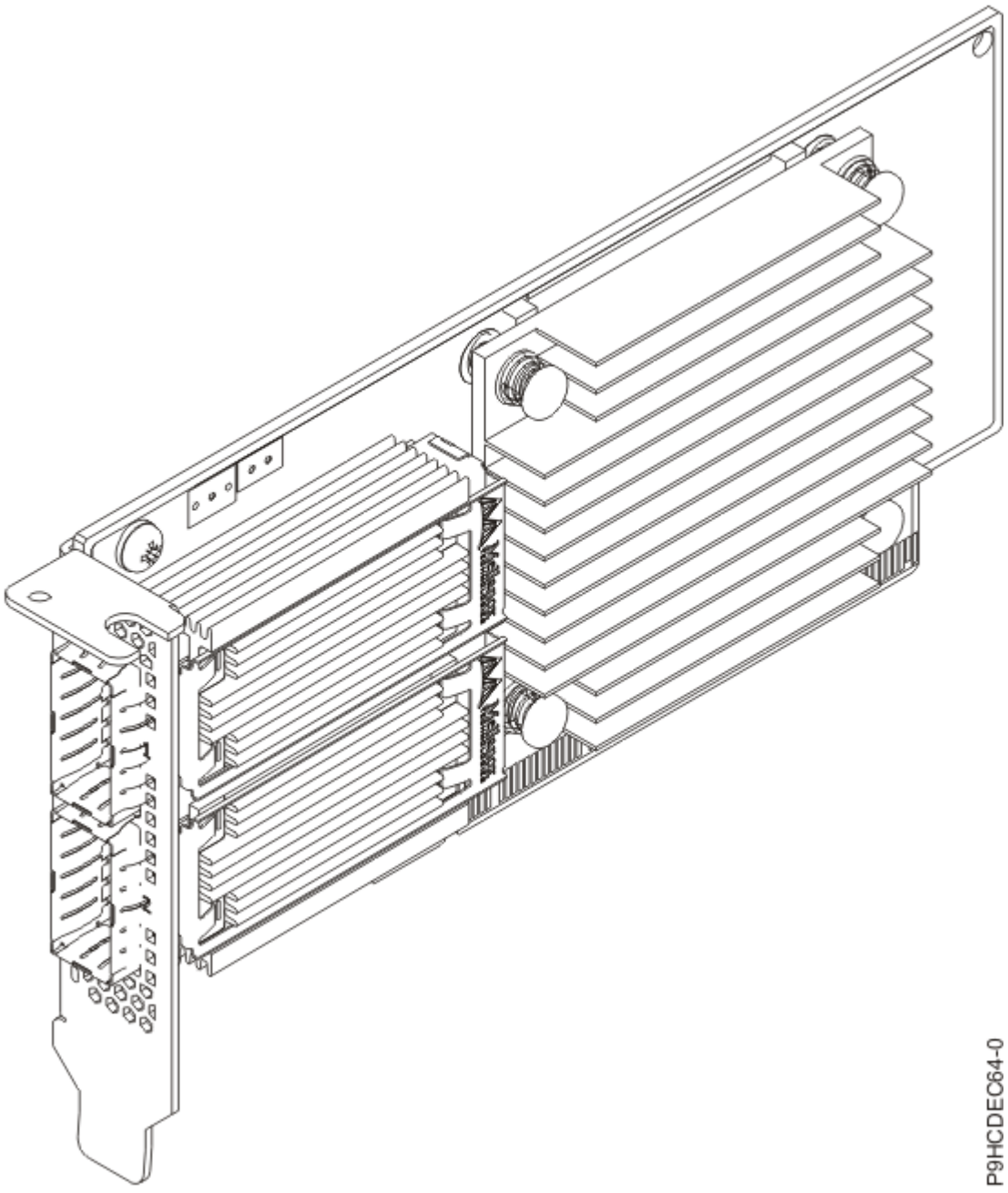


Figure 39. 2-port HDR 100 Gb InfiniBand ConnectX-6 adapter (FC EC6G)

Specifications

Item
Description

Adapter FRU number
02CM912

I/O bus architecture
PCIe4 x16

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Cables

For HDR 100 Gb, IBM offers either Direct Attach Copper (DAC) cables up to 2 M or Active Optical Cables (AOC) up to 100 M. QSFP56 based transceivers are included on each end of these cables.

Cable matrix
The EDR cables that are listed in the table support connecting an HDR 100 Gb adapter to EDR 100 Gb or HDR 200 Gb InfiniBand switches. The HDR 100 Gb splitter cables that are listed in the table support connecting to an HDR 100 Gb adapter to an HDR 200 Gb switch.

Note: An HDR 200 Gb switch port must be in split-mode configuration when using the HDR 100 Gb splitter cables.

Table 27. Cable matrix

Feature	Description
EB50	Copper EDR 100 GbE cable - 0.5 M
EB51	Copper EDR 100 GbE cable - 1 M
EB54	Copper EDR 100 GbE cable - 1.5 M
EB52	Copper EDR 100 GbE cable - 2 M
EB5A	Optical EDR 100 GbE cable - 3 M
EB5B	Optical EDR 100 GbE cable - 5 M
EB5C	Optical EDR 100 GbE cable - 10 M
EB5D	Optical EDR 100 GbE cable - 15 M
EB5E	Optical EDR 100 GbE cable - 20 M
EB5F	Optical EDR 100 GbE cable - 30 M
EB5G	Optical EDR 100 GbE cable - 50 M
EB5H	Optical EDR 100 GbE cable - 100 M

Voltage
3.3 V, 12 V

Form factor

Short, low-profile (FC EC6G)

Attributes provided
PCI Express 4.0 (up to 16GT/s) x16

PCIe Gen 4.0 compliant (1.1, 2.0, and 3.0 compatible)

The adapter is based on the Mellanox ConnectX-6 adapter

Improves performance and scalability by offloading the CPU from I/O networking tasks

Minimizes CPU usage by using the memory access more efficiently

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe2 LP 2-Port USB 3.0 Adapter (FC EC6J and FC EC6K; CCIN 590F)

Learn about the specifications for the feature code (FC) EC6J and FC EC6K adapter.

The PCIe2 LP 2-Port USB 3.0 adapter (FC EC6J) is a PCI Express (PCIe) generation 2, low-profile, high-performance expansion adapter. The FC EC6J is a low-profile adapter and the FC EC6K is full-height adapter. These adapters provide the following features and support:

- They are compliant with PCIe base specification revision 2.
- They are single-lane (1x) PCI Express with a throughput of 5 Gbps.
- They are single-slot, half-height, half-length form factor, PCIe2 card.
- They are FCC Class A compliant.
- They provide two downstream, external, SuperSpeed Universal Serial Bus (USB) 3.0 ports with Type A connectors.
- The USB ports are also compatible with USB specifications, revision 1.1 and 2.0 devices.
- They support the simultaneous operation of multiple USB 3.0, USB 2.0, and USB 1.1 devices.

  Restriction: When multiple keyboards are attached to the USB ports on the system or on the USB adapter, only one keyboard can be used while the partition is booting-up.

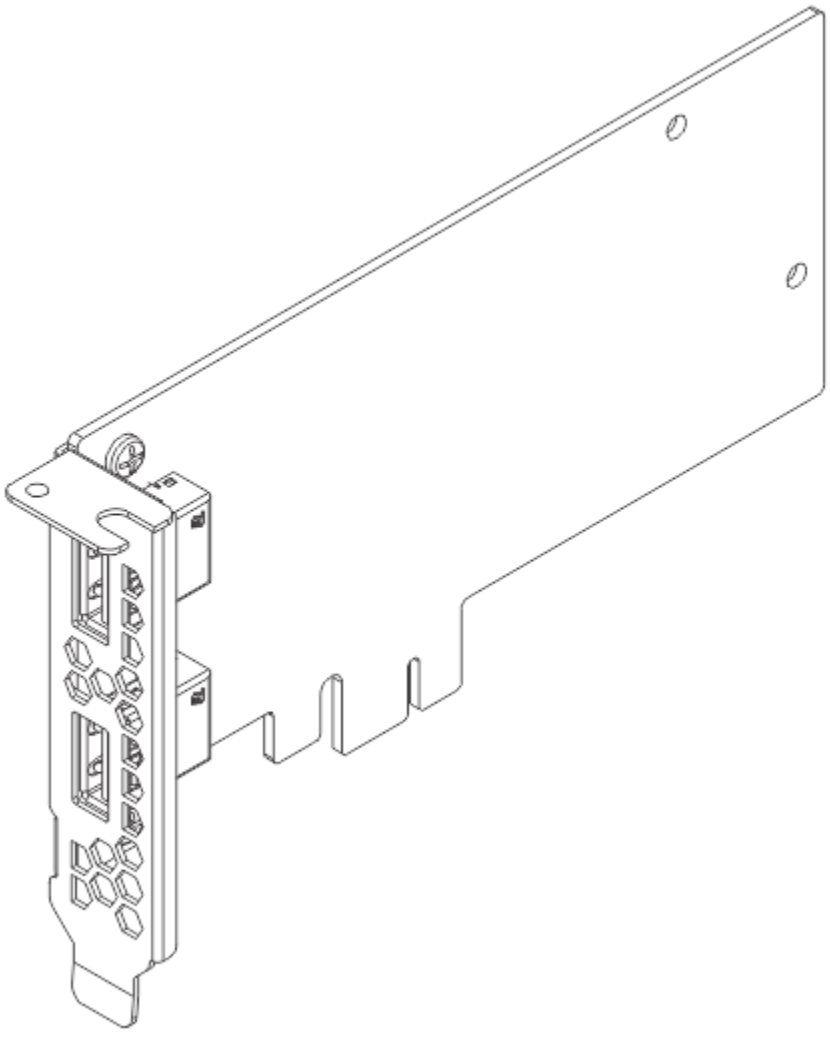


Figure 40. PCIe2 LP 2-port USB 3.0 adapter (FC EC6J)

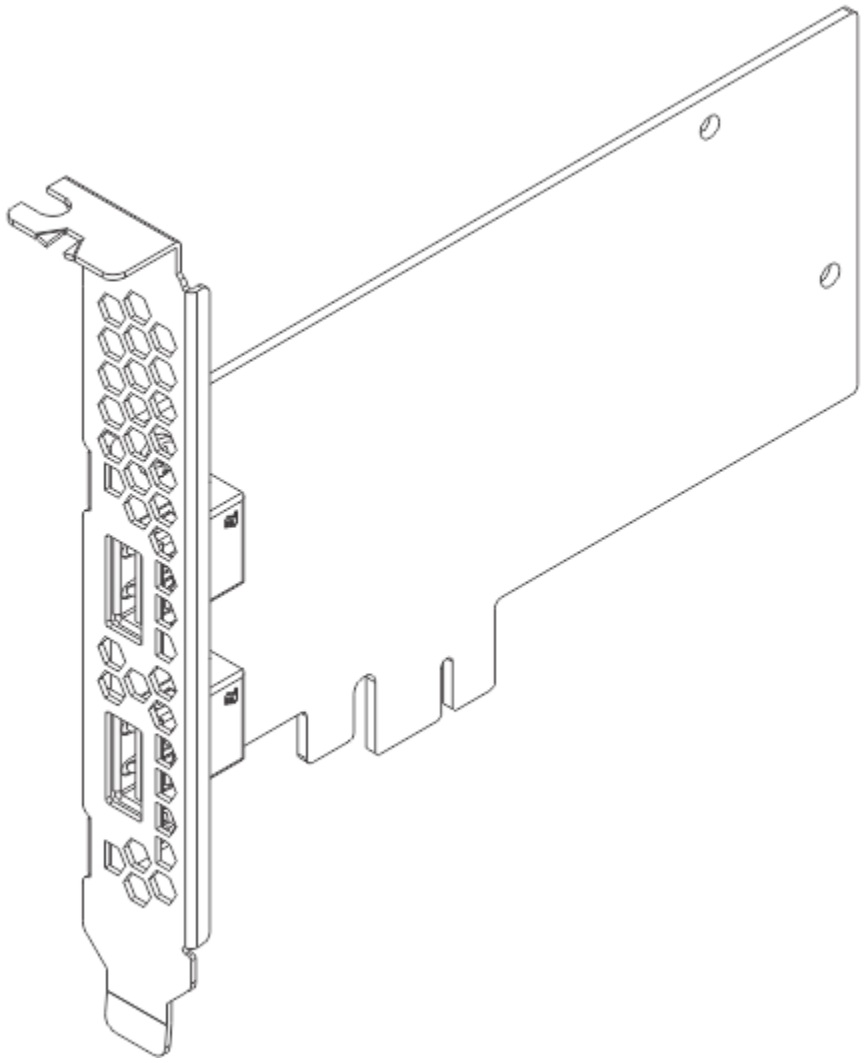


Figure 41. PCIe2 LP 2-port USB 3.0 adapter (FC EC6K)

Specifications

Item
Description

FRU number
02JD518

I/O bus architecture
PCIe 2.2 compliant

Slot priority
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Busmaster
Yes

Form factor
FC EC6J: Short form factor, half-length

FC EC6K: Full-height form factor, half-length

Connector
Standard USB single pin-type series A receptacle

Wrap plug
None

Cables
Use USB cable (FC 4256) per port

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe4 2-port 100GbE RoCE x16 adapter (FC EC75 and EC76; CCIN 2CFB)

Learn about the specifications and operating system requirements for feature code (FC) EC75 and EC76 adapters.

Overview

FC EC75 is a low-profile adapter and FC EC76 is a full-height adapter.

The PCIe4 2-port 100GbE RoCE x16 adapter is a PCI Express (PCIe) generation 4 (Gen4) x16 adapter. The adapter provides two 100GbE En ConnectX-6 DX QFSP56 ports. The PCIe4 2-port 100GbE RoCE En ConnectX-6 DX QFSP56 adapter supports both NIC (Network Interface Controller) and IBTA RoCE standards. RoCE stand for Remote Direct Memory Access (RDMA) over Converged Ethernet. Using RoCE, the adapter can support significantly greater bandwidth with low latency. It also minimizes the CPU overhead by more efficiently using memory access. This process offloads the CPU from I/O networking tasks, improving performance and scalability.

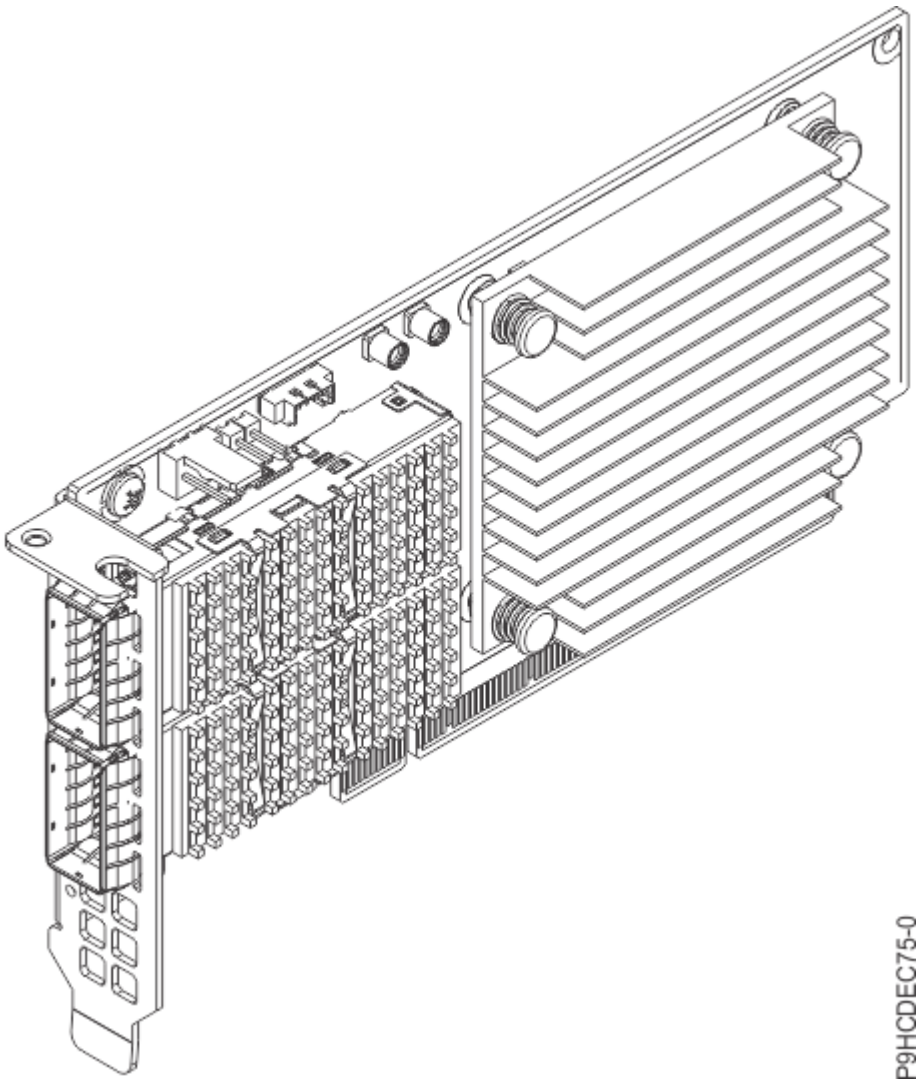


Figure 42. PCIe4 2-port 100GbE RoCE x16 adapter (FC EC75)

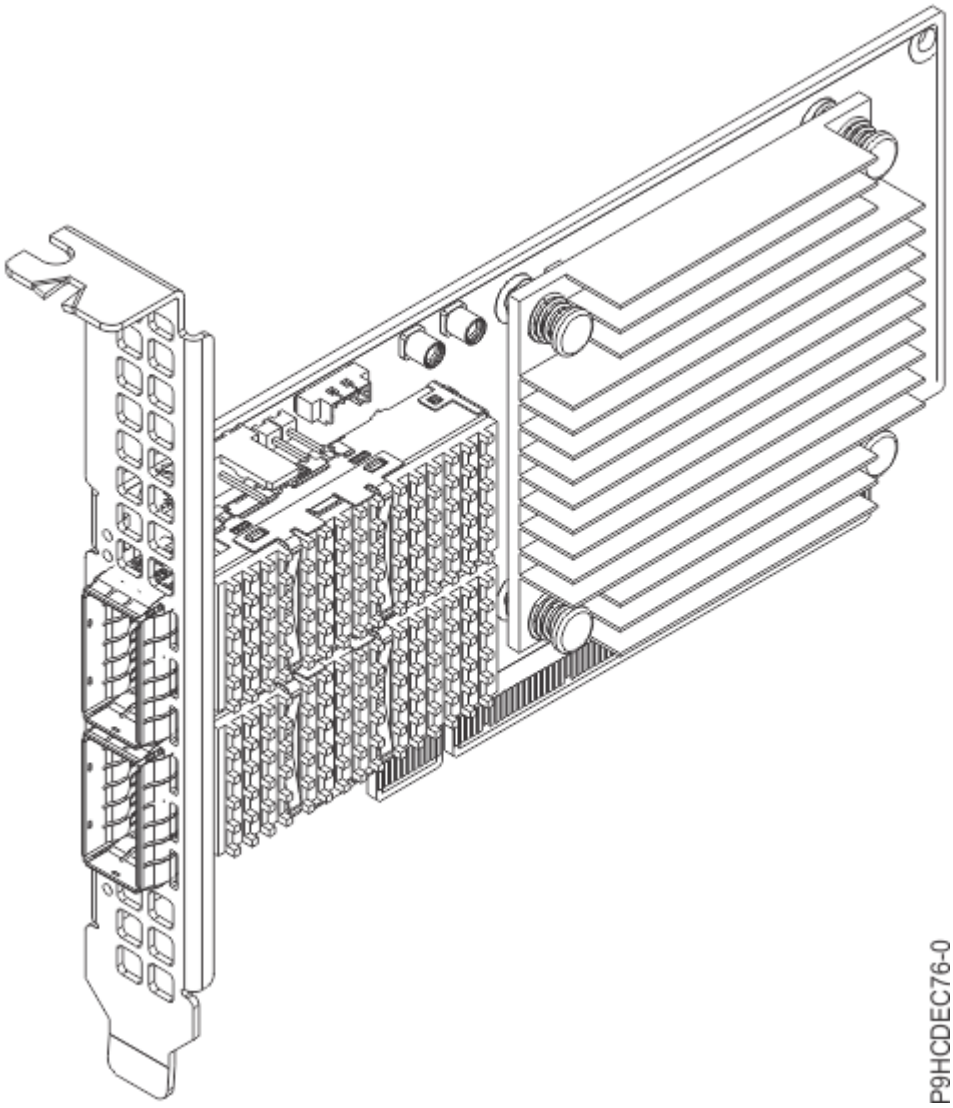


Figure 43. PCIe4 2-port 100GbE RoCE x16 adapter (FC EC76)

Specifications

Item
Description

Adapter FRU number
02CM921

I/O bus architecture
"PCIe4 2-port 100 GbE RoCE x16 adapter (FC EC66 and EC67; CCIN 2CF3)" on page 135

PCIe4 x16

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Cables

For 100G, IBM offers either Direct Attach Copper (DAC) cables up to 2 M or Active Optical Cables (AOC) up to 50 M. Quad Small Form-factor Pluggable (QSFP) based transceivers are included on each end of these cables. For more information about adapter cabling, see the Cable and transceiver matrix.

Transceivers

IBM qualifies and supports QSFP optical transceiver (FC EB59) to install into the adapter. You can also use your own optical cabling and QFSP56 optical transceiver for the other end. This is a 100GBASE-SR4 based active optical transceiver is available up to 100 M through the OM4 cable or 70 M through OM3 cable. Either one or both of the two QFSP56 ports on the adapter can be populated. When two ports are filled, both ports can have copper cables or optical cables. Additionally, one of the cables can be copper and the other can be optical.

Cable and transceiver matrix

Table 28. Cable and transceiver matrix

Feature	Description
EB59	100GBASE-SR4 optical transceiver MTP/MPO cable (purchased separately) • FC EB2J - 10 M • FC EB2K - 30 M
EB5J	QSFP28 Passive Copper 100 Gb Ethernet Cable - .5 M
EB5K	QSFP28 Passive Copper 100 Gb Ethernet Cable - 1 M
EB5L	QSFP28 Passive Copper 100 Gb Ethernet Cable - 1.5 M
EB5M	QSFP28 Passive Copper 100 Gb Ethernet Cable - 2 M
EB5R	QSFP28 AOC 100 Gb Ethernet Cable - 3 M
EB5S	QSFP28 AOC 100 Gb Ethernet Cable - 5 M
EB5T	QSFP28 AOC 100 Gb Ethernet Cable - 10 M
EB5U	QSFP28 AOC 100 Gb Ethernet Cable - 15 M
EB5V	QSFP28 AOC 100 Gb Ethernet Cable - 20 M
EB5W	QSFP28 AOC 100 Gb Ethernet Cable - 30 M
EB5X	QSFP28 AOC 100 Gb Ethernet Cable - 50 M
EB5Y	QSFP28 AOC 100 Gb Ethernet Cable - 100 M
EB2B	1 M Passive QSFP+ to QSFP+
EB2H	3 M Passive QSFP+ to QSFP+
EB27 or EB57	QSFP+ 40G BASE-SR4 optical transceiver MTP/MPO cable (purchased separately) • FC EB2J - 10 M • FC EB2K - 30 M

Voltage

3.3 V, 12 V

Form factor

Short, low-profile (FC EC75)

Short, with full-height tailstock (FC EC76)

Attributes provided

PCI Express 4.0 (up to 16GT/s) x16

PCIe Gen 4.0 compliant (1.1, 2.0, and 3.0 compatible)

RDMA over Converged Ethernet (RoCE)

Dual-port of 100 Gb/s Ethernet per port

NIC and RoCE are concurrently supported

RoCE supported on Linux and AIX (7.2, and later)

NIC supported on all operating systems

TCP/UDP/IP stateless offload

LSO, LRO, and checksum offload

NIM boot support

The adapter is based on the Mellanox ConnectX-6DX adapter, which uses the ConnectX-6DX EN Network Controller

Backward compatible with 40 Gb Ethernet when using compatible cables and transceivers

Improves performance and scalability by offloading the CPU from I/O networking tasks

Minimizes CPU overhead by more efficiently using memory access

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe4 2-port 100GbE RoCE with Crypto x16 adapter (FC EC77 and EC78; CCIN 2CFA)

Learn about the specifications and operating system requirements for feature code (FC) EC77 and EC78 adapters.

Overview

FC EC77 is a low-profile adapter and FC EC78 is a full-height adapter.

The PCIe4 2-port 100GbE RoCE with Crypto x16 adapter is a PCI Express (PCIe) generation 4 (Gen4) x16 adapter. The adapter provides two 100GbE En ConnectX-6 DX QSFP56 ports. The secure-key adapter provides both cryptographic coprocessor and cryptographic accelerator functions in a single PCIe card. This adapter is suited for applications that require high-speed, security-sensitive, RSA acceleration, cryptographic operations for data encryption and digital signing. Additionally, the adapter is useful in secure management, use of cryptographic keys, or custom cryptographic applications. It provides secure

storage of cryptographic keys in a tamper-resistant hardware security module that is designed to meet FIPS 140-2 level 4 security requirements. The adapter runs in dedicated mode only.

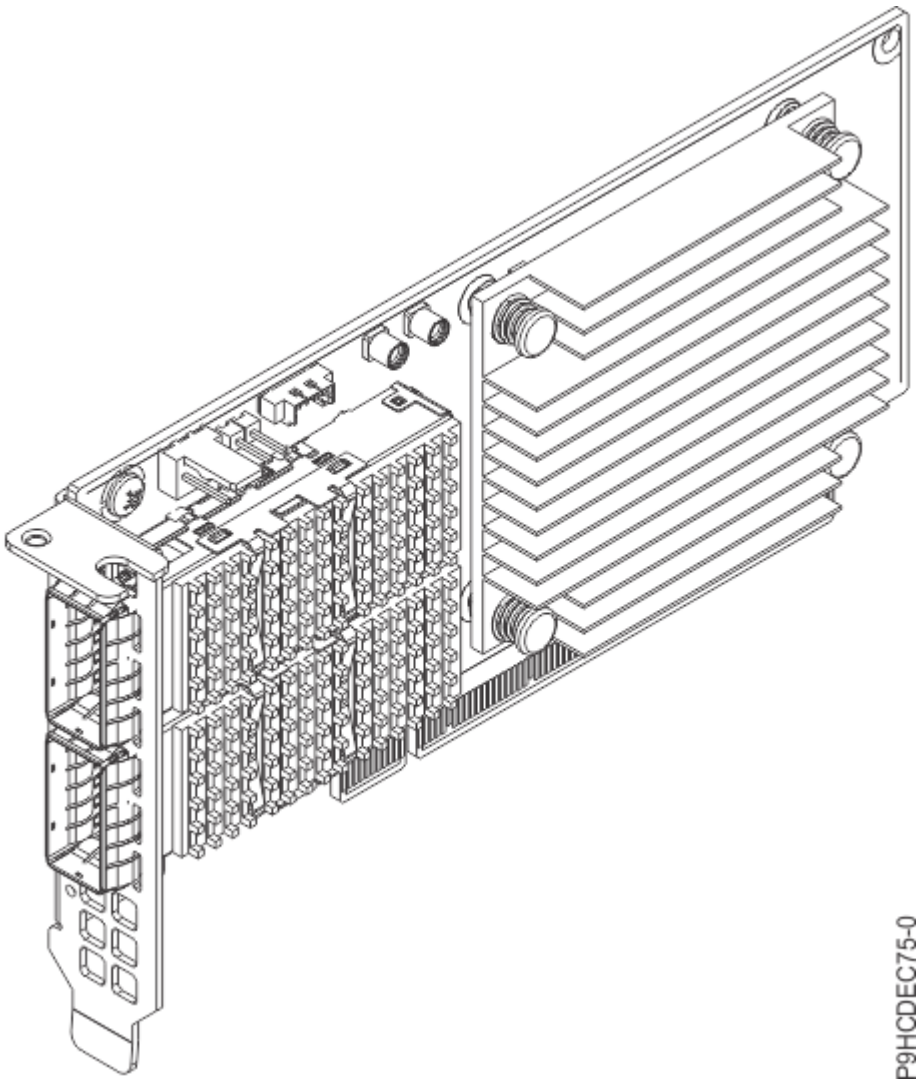


Figure 44. PCIe4 2-port 100GbE RoCE with Crypto x16 adapter (FC EC77)

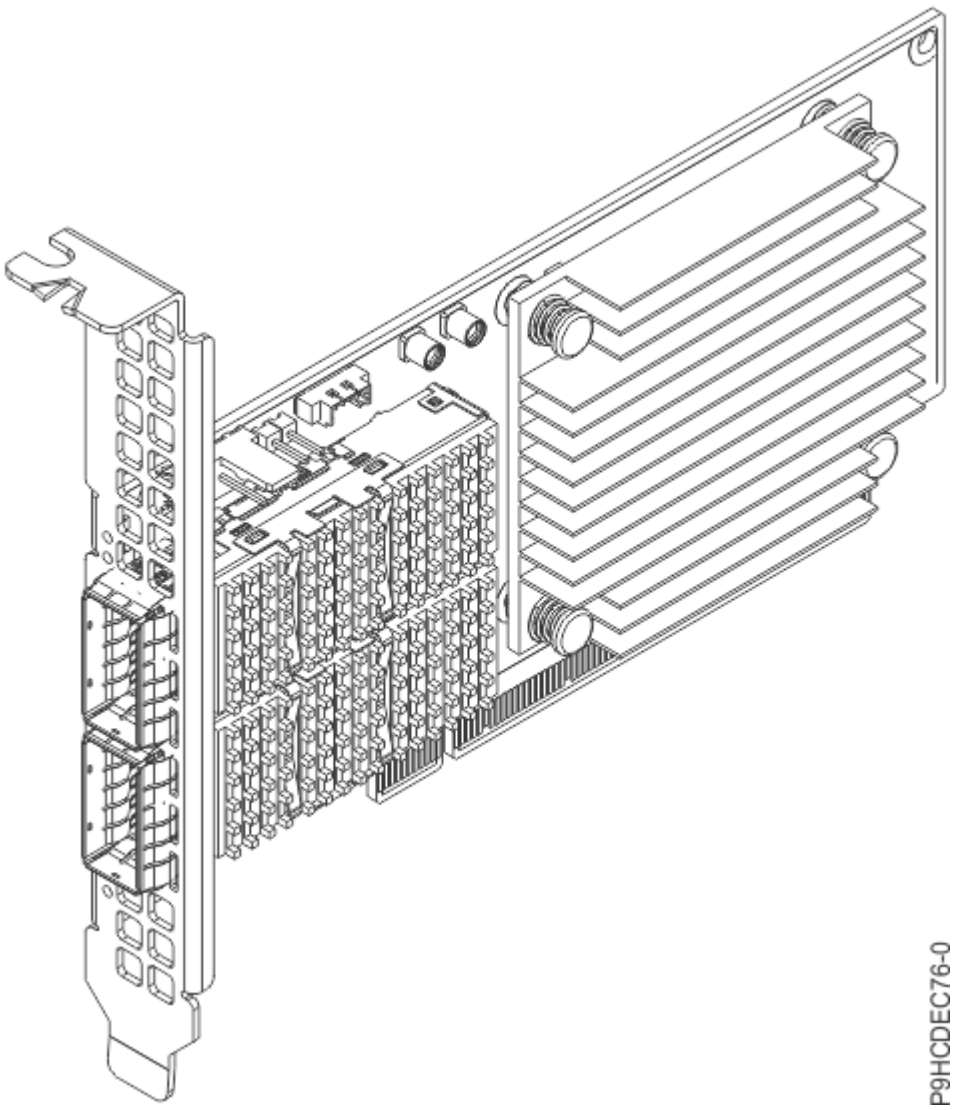


Figure 45. PCIe4 2-port 100GbE RoCE with Crypto x16 adapter (FC EC78)

Specifications

Item
Description

Adapter FRU number
02CM993

I/O bus architecture
PCIe4 x16

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Cables

For 100G, IBM offers either Direct Attach Copper (DAC) cables up to 2 M or Active Optical Cables (AOC) up to 50 M. Quad Small Form-factor Pluggable (QSFP) based transceivers are included on each end of these cables. For more information about adapter cabling, see the Cable and transceiver matrix.

Transceivers

IBM qualifies and supports QSFP optical transceiver (FC EB59) to install into the adapter. You can also use your own optical cabling and QSFP56 optical transceiver for the other end. This 100GBASE-SR4 based active optical transceiver is available up to 100 M through the OM4 cable or 70 M through OM3 cable. Either one or both of the two QSFP56 ports on the adapter can be populated. When two ports are filled, both ports can have copper cables or optical cables. Additionally, one of the cables can be copper and the other can be optical.

Cable and transceiver matrix

Table 29. Cable and transceiver matrix

Feature	Description
EB59	100GBASE-SR4 optical transceiver MTP/MPO cable (purchased separately) • FC EB2J - 10 M • FC EB2K - 30 M
EB5J	QSFP28 Passive Copper 100 Gb Ethernet Cable - .5 M
EB5K	QSFP28 Passive Copper 100 Gb Ethernet Cable - 1 M
EB5L	QSFP28 Passive Copper 100 Gb Ethernet Cable - 1.5 M
EB5M	QSFP28 Passive Copper 100 Gb Ethernet Cable - 2 M
EB5R	QSFP28 AOC 100 Gb Ethernet Cable - 3 M
EB5S	QSFP28 AOC 100 Gb Ethernet Cable - 5 M
EB5T	QSFP28 AOC 100 Gb Ethernet Cable - 10 M
EB5U	QSFP28 AOC 100 Gb Ethernet Cable - 15 M
EB5V	QSFP28 AOC 100 Gb Ethernet Cable - 20 M
EB5W	QSFP28 AOC 100 Gb Ethernet Cable - 30 M
EB5X	QSFP28 AOC 100 Gb Ethernet Cable - 50 M
EB5Y	QSFP28 AOC 100 Gb Ethernet Cable - 100 M
EB2B	1 M Passive QSFP+ to QSFP+
EB2H	3 M Passive QSFP+ to QSFP+
EB27 or EB57	QSFP+ 40G BASE-SR4 optical transceiver MTP/MPO cable (purchased separately) • FC EB2J - 10 M • FC EB2K - 30 M

Voltage

3.3 V, 12 V

Form factor

Short, low-profile (FC EC77)

Short, with full-height tailstock (FC EC78)

Attributes provided

PCI Express 4.0 (up to 16GT/s) x16

PCIe Gen 4.0 compliant (1.1, 2.0, and 3.0 compatible)

RDMA over Converged Ethernet (RoCE)

Dual-port of 100 Gb/s Ethernet per port

NIC and RoCE are concurrently supported

RoCE supported on Linux and AIX (7.2, and later)

NIC supported on all operating systems

TCP/UDP/IP stateless offload

LSO, LRO, and checksum offload

NIM boot support

The adapter is based on the Mellanox ConnectX-6DX adapter, which uses the ConnectX-6DX EN Network Controller

Backward compatible with 40 Gb Ethernet when using compatible cables and transceivers

Improves performance and scalability by offloading the CPU from I/O networking tasks

Minimizes CPU overhead by more efficiently using memory access

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe4 x8 NVMe 1.6 TB Flash Adapter (FC EC7A, EC7B, EC7J, and EC7K; CCIN 594A)

Learn about the specifications and operating system requirements for feature code FC EC7A, EC7B, EC7J, and EC7K adapters. FC EC7A and EC7J are low-profile adapters and EC7B and EC7K are full-height adapters. FC EC7A and EC7B are supported on AIX or Linux operating systems. FC EC7J and EC7K are supported on the IBM i operating system.

Overview

The PCIe4 x8 NVMe 1.6 TB SSD NVMe adapter is a Peripheral Component Interconnect Express (PCIe) generation 4 (Gen4) x8 adapter. The adapter can be used in either a x8 or x16 PCIe (Gen4) slot in the system and uses Non-Volatile Memory Express (NVMe). NVMe is a high-performance software interface that can read or write flash memory. Compared to a Serial-attached SCSI (SAS) or Serial Advanced Technology Attachment (SATA) SSD, the NVMe adapter provides more read or write, input or output operations per second (IOPS) and larger throughput (GB/sec). The type of workload has a great impact on the maximum write capacity. If a high percentage of more sequentially oriented write operations is

used instead of random write operations, the maximum write capacity will be large. To extend the life of the NVMe device, the application that is using the device must convert small random write operations to larger sequential write operations. The write operations that exceeds the maximum write capacity of the adapter continue to operate for some time, but the performance will be slow. The life of the device is not affected depending on whether the application uses sequential or random read operations from the device. A Predictive Failure Analysis message is displayed when the adapter that is enabled by the system administrator must be replaced. To monitor the percentage usage of the adapter, see Checking the amount of remaining life in NVMe devices. You can monitor the percentage used for the adapter by using the fuel gauge command or fuel gauge tool that is available in the operating system. If the maximum write capability is achieved, the adapter's replacement is not covered under IBM warranty or maintenance. This adapter has protection against single Flash channel failures. To prevent the entire adapter from failing, software RAID should be used. For high-value applications where the content in the adapter must be protected, additional NVMe Flash adapters with OS mirroring or software Redundant Array of Independent Disks (RAID) are recommended. This adapter is not supported in the PCIe Gen3 I/O drawer.

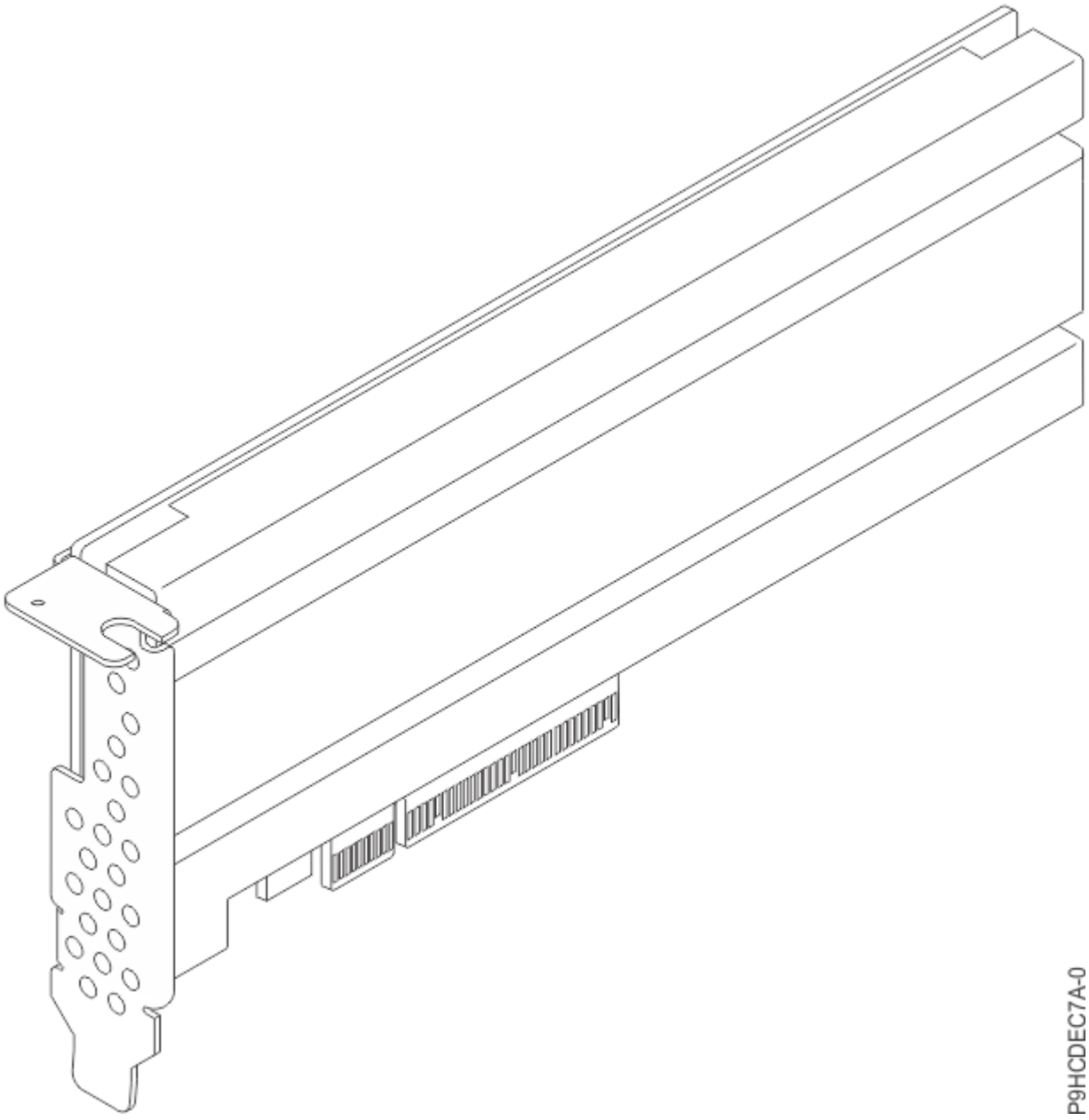


Figure 46. PCIe4 x8 NVMe 1.6 TB SSD NVMe Adapter

Specifications

Item
Description

Adapter FRU number
02DE956

I/O bus architecture
PCIe4 x8

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
3.3 V, 12 V

Form factor
Short, low-profile (FC EC7A and EC7J)

Short, with full-height tailstock (FC EC7B and EC7K)

Maximum number
For details about the maximum number of adapters that are supported, see Adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Attributes provided
1.6 TB of low latency flash memory

Non-Volatile Write Buffer

Hot Plug Capable

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the nvme-cli tool to manage NVMe devices can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe4 x8 NVMe 3.2 TB Flash Adapter (FC EC7C, EC7D, EC7L, and EC7M; CCIN 594B)

Learn about the specifications and operating system requirements for feature code FC EC7C, EC7D, EC7L, and EC7M adapters. FC EC7C and EC7L are low-profile adapters and EC7D and EC7M are full-height

adapters. FC EC7C and EC7D are supported on AIX or Linux operating systems. FC EC7L and EC7M are supported on the IBM i operating system.

Overview

The PCIe4 x8 NVMe 3.2 TB SSD NVMe adapter is a Peripheral Component Interconnect Express (PCIe) generation 4 (Gen4) x8 adapter. The adapter can be used in either a x8 or x16 PCIe (Gen4) slot in the system and uses Non-Volatile Memory Express (NVMe). NVMe is a high-performance software interface that can read or write flash memory. Compared to a Serial-attached SCSI (SAS) or Serial Advanced Technology Attachment (SATA) SSD, the NVMe adapter provides more read or write, input or output operations per second (IOPS) and larger throughput (GB/sec). The type of workload has a great impact on the maximum write capacity. If a high percentage of more sequentially oriented write operations is used instead of random write operations, the maximum write capacity will be large. To extend the life of the NVMe device, the application that is using the device must convert small random write operations to larger sequential write operations. The write operations that exceeds the maximum write capacity of the adapter continue to operate for some time, but the performance will be slow. The life of the device is not affected depending on whether the application uses sequential or random read operations from the device. A Predictive Failure Analysis message is displayed when the adapter that is enabled by the system administrator must be replaced. To monitor the percentage usage of the adapter, see Checking the amount of remaining life in NVMe devices. You can monitor the percentage used for the adapter by using the fuel gauge command or fuel gauge tool that is available in the operating system. If the maximum write capability is achieved, the adapter's replacement is not covered under IBM warranty or maintenance. This adapter has protection against single Flash channel failures. To prevent the entire adapter from failing, software RAID should be used. For high-value applications where the content in the adapter must be protected, additional NVMe Flash adapters with OS mirroring or software Redundant Array of Independent Disks (RAID) are recommended. This adapter is not supported in the PCIe Gen3 I/O drawer.

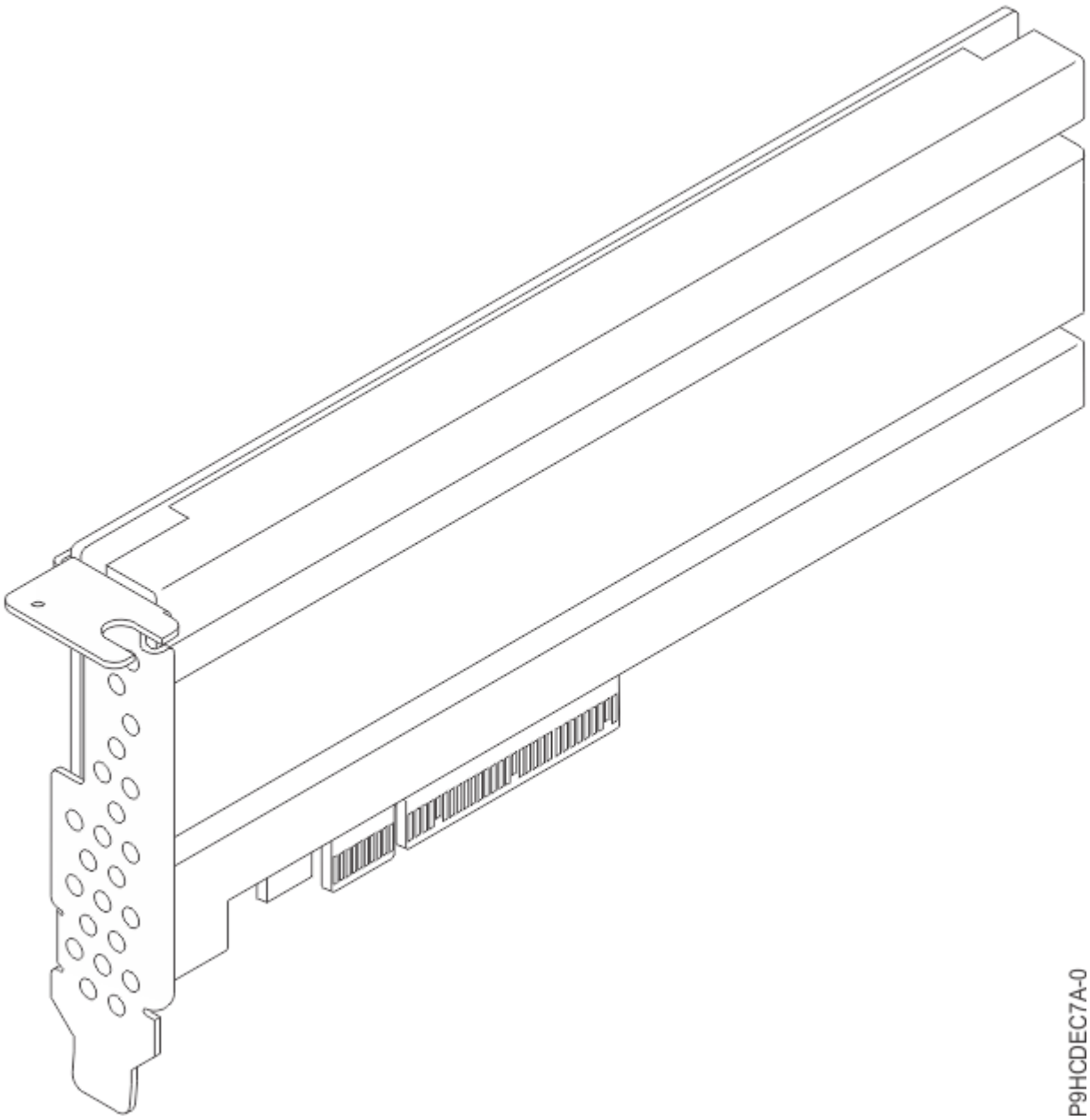


Figure 47. PCIe4 x8 NVMe 3.2 TB Flash Adapter

Specifications

Item
Description

Adapter FRU number
02DE960

I/O bus architecture
PCIe4 x8

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
3.3 V, 12 V

Form factor

Short, low-profile (FC EC7C and EC7L)

Short, with full-height tailstock (FC EC7D and EC7M)

Maximum number

For details about the maximum number of adapters that are supported, see Adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Attributes provided

3.2 TB of low latency flash memory

Non-Volatile Write Buffer

Hot Plug Capable

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the nvme-cli tool to manage NVMe devices can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe4 x8 NVMe 6.4 TB Flash Adapter (FC EC7E, EC7F, EC7N, and EC7P; CCIN 594C)

Learn about the specifications and operating system requirements for feature code EC7E, EC7F, EC7N, and EC7P adapters. FC EC7E and EC7N are low-profile adapters and EC7F and EC7P are full-height adapters. FC EC7E and EC7F are supported on AIX or Linux operating systems. FC EC7N and EC7P are supported on the IBM i operating system.

Overview

The PCIe4 x8 NVMe 6.4 TB SSD NVMe adapter is a Peripheral Component Interconnect Express (PCIe) generation 4 (Gen4) x8 adapter. The adapter can be used in either a x8 or x16 PCIe (Gen4) slot in the system and uses Non-Volatile Memory Express (NVMe). NVMe is a high-performance software interface that can read or write flash memory. Compared to a Serial-attached SCSI (SAS) or Serial Advanced Technology Attachment (SATA) SSD, the NVMe adapter provides more read or write, input or output operations per second (IOPS) and larger throughput (GB/sec). The type of workload has a great impact on the maximum write capacity. If a high percentage of more sequentially oriented write operations is used instead of random write operations, the maximum write capacity will be large. To extend the life of the NVMe device, the application that is using the device must convert small random write operations to larger sequential write operations. The write operations that exceeds the maximum write capacity of the adapter continue to operate for some time, but the performance will be slow. The life of the device is not affected depending on whether the application uses sequential or random read operations from the device. A Predictive Failure Analysis message is displayed when the adapter that is enabled by the system administrator must be replaced. You can monitor the percentage used for the adapter by using the fuel gauge command or fuel gauge tool that is available in the operating system. To monitor the

percentage usage of the adapter, see Checking the amount of remaining life in NVMe devices. If the maximum write capability is achieved, the adapter's replacement is not covered under IBM warranty or maintenance. This adapter has protection against single Flash channel failures. To prevent the entire adapter from failing, software RAID should be used. For high-value applications where the content in the adapter must be protected, additional NVMe Flash adapters with OS mirroring or software Redundant Array of Independent Disks (RAID) are recommended. This adapter is not supported in the PCIe Gen3 I/O drawer.

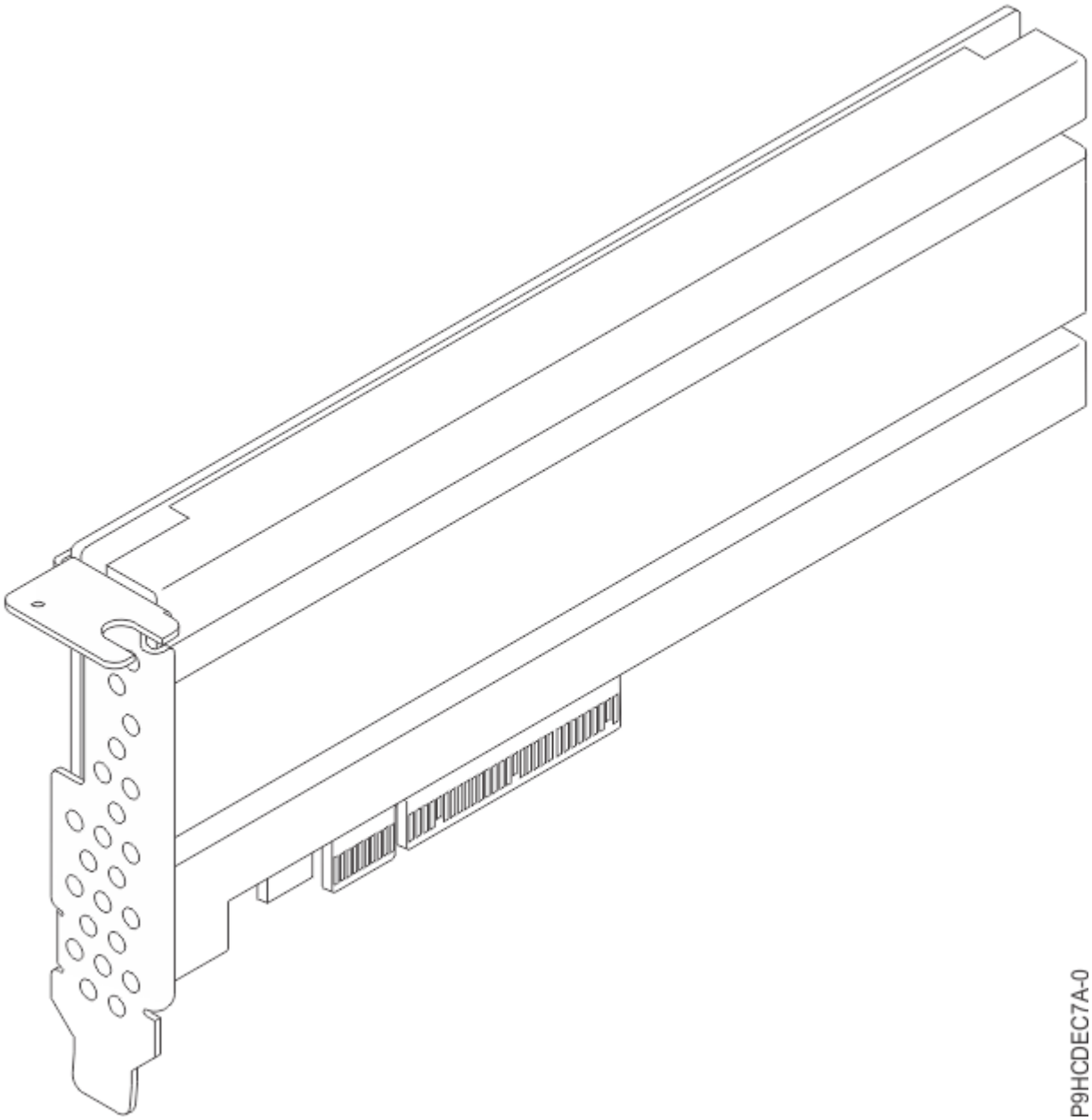


Figure 48. PCIe4 x8 NVMe 6.4 TB SSD NVMe Adapter

Specifications

Item
Description

Adapter FRU number
02DE964

I/O bus architecture
PCIe4 x8

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
3.3 V, 12 V

Form factor
Short, low-profile (FC EC7E and EC7N)

Short, with full-height tailstock (FC EC7F and EC7P)

Maximum number
For details about the maximum number of adapters that are supported, see Adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Attributes provided
6.4 TB of low latency flash memory

Non-Volatile Write Buffer

Hot Plug Capable

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the nvme-cli tool to manage NVMe devices can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe3 cable adapter (FC EJ05; CCIN 2B1C)

Learn about the specifications and operating system requirements for the feature code (FC) EJ05 adapter.

Overview

FC EJ05 is a double-wide, low-profile PCIe3 cable adapter. The adapter provides two optical ports for the attachment of two expansion drawer cables. One adapter supports the attachment of one PCIe3 6-slot fanout module in a EMX0 PCIe Gen3 I/O expansion drawer.

Note: The FC EJ05 (CCIN 2B1C) adapter only works with the CCIN 50CB PCIe3 6-slot fanout module.

Figure 49 on page 161 shows the adapter.

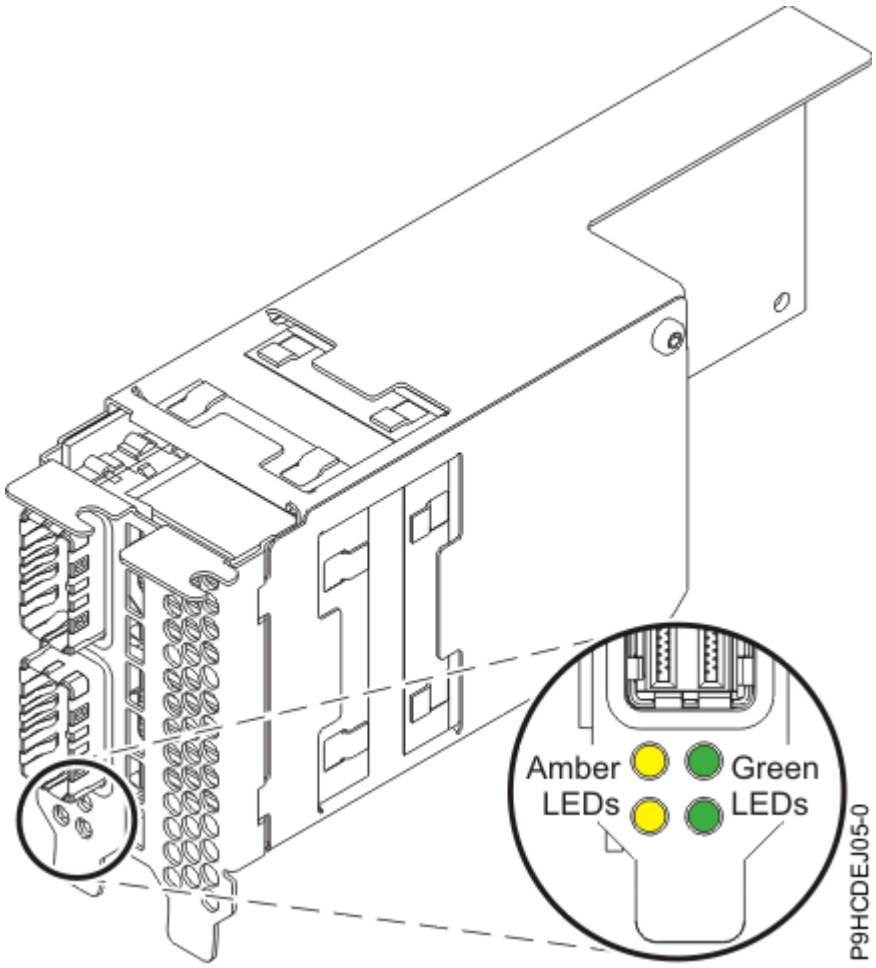


Figure 49. PCIe3 cable adapter

Note: The LEDs that are shown in Figure 49 on page 161 indicate the following states:

- The green LED indicates link status. If the green LED is on, at least one PCIe link is in the trained state.
- The amber LED indicates FRU identify. If the amber LED is on, it will blink at 2 Hz, and indicates that the adapter is in the identify function state.

Specifications

Item
Description

Adapter FRU number
000RR809

I/O bus architecture
PCIe3 x16

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
12 V

Form factor
Low profile, double-wide adapter

PCIe3 cable adapter (FC EJ07; CCIN 6B52)

Learn about the specifications and operating system requirements for the feature code (FC) EJ07 adapter.

Overview

The FC EJ07 is a double-wide, low-profile, PCIe generation 3 (PCIe3) cable adapter. The adapter provides two optical ports for the attachment of two expansion drawer cables. One adapter supports the attachment of one PCIe3 6-slot fanout module in a EMX0 PCIe Gen3 I/O expansion drawer.

Note: The FC EJ07 (CCIN 6B52) adapter only works with the CCIN 50CB PCIe3 6-slot fanout module.

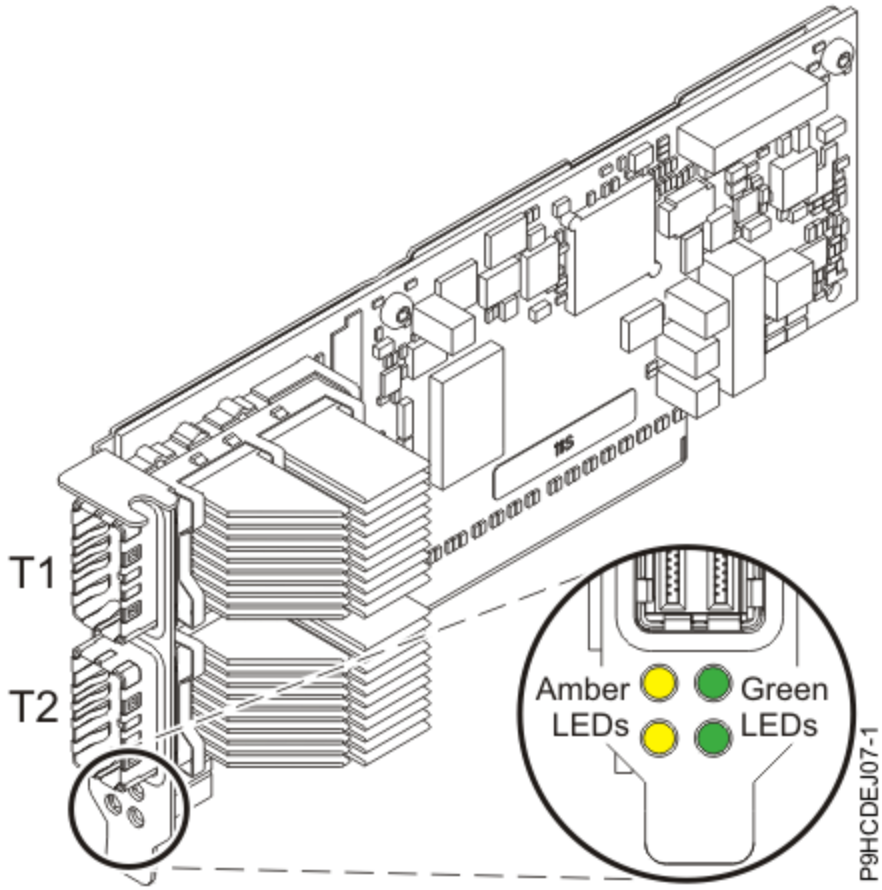


Figure 50. PCIe3 cable adapter

Note: The LEDs that are shown in Figure 50 on page 162 indicate the following states:

- The green LED indicates link status. If the green LED is on, at least one PCIe link is in the trained state.
- The amber LED indicates FRU identify. If the amber LED is on, it will blink at 2 Hz, and indicates that the adapter is in the identify function state.

Specifications

Item
Description

Adapter FRU number
000TK704.

I/O bus architecture
PCIe3 x16

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
12 V

Form factor
Full-height, full-length

PCIe3 cable adapter (FC EJ08; CCIN 2CE2)

Learn about the specifications and operating system requirements for the feature code (FC) EJ08 adapter.

Overview

The FC EJ08 is a full-height, half-length PCIe3 cable adapter. The adapter provides two optical ports for the attachment of two expansion drawer cables. One adapter supports the attachment of one PCIe3 6-slot fanout module in a EMX0 PCIe Gen3 I/O expansion drawer.

Note: The FC EJ08 (CCIN 2CE2) adapter only works with the CCIN 50CB PCIe3 6-slot fanout module.

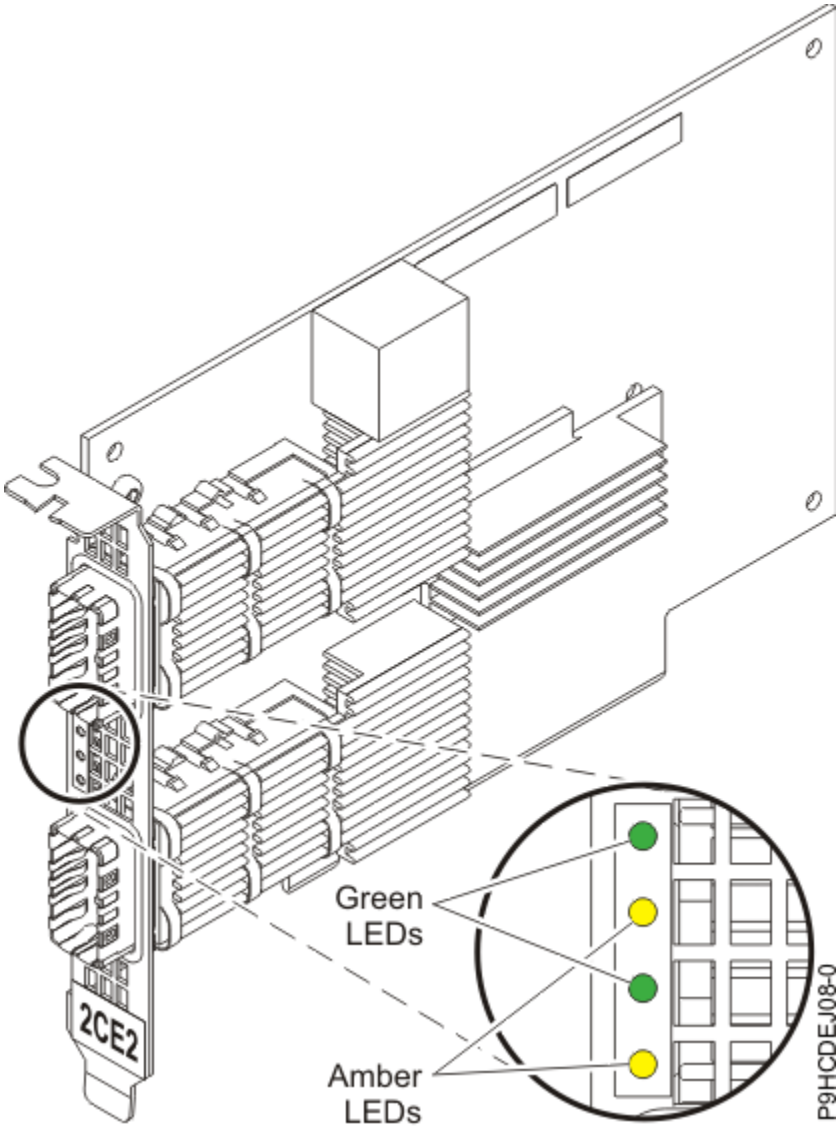


Figure 51. PCIe3 cable adapter

Note: The LEDs that are shown in Figure 51 on page 163 indicate the following states:

- The green LED indicates link status. If the green LED is on, at least one PCIe link is in the trained state.
- The amber LED indicates FRU identify. If the amber LED is on, it will blink at 2 Hz, and indicates that the adapter is in the identify function state.

Specifications

Item
Description

Adapter FRU number
041T9901

I/O bus architecture
PCIe3 x16

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
12 V

Form factor
Full-height, half-length

PCIe3 SAS RAID quad-port 6 Gb adapter (FC EJ0J and FC EL59; CCIN 57B4)

Learn about the specifications and operating system requirements for the feature code (FC) EJ0J and FC EL59 adapter.

Overview

The PCIe3 SAS RAID quad-port 6 Gb adapter is a PCI Express (PCIe), generation 3, SAS RAID adapter that has a low-profile, short-form factor, but packaged for full height installation. The adapter is used in high-performance and high-density, serial attached SCSI (SAS) applications. It supports the attachment of SAS disk and SAS tape by using four mini SAS high-density (HD) x4 connectors that allow the physical links to be used in various narrow and wide-port configurations. SAS tape attachment is only supported in a single adapter configuration and cannot be mixed with SAS disk on the same adapter. The adapter does not have write cache. Figure 52 on page 165 shows the PCIe3 SAS RAID quad-port 6 Gb adapter.

Important: There is no FCoE support on POWER9 systems.

The adapter is a 64 bit, 3.3 V, bootable SAS adapter that provides RAID 0, 5, 6, 10, 5T2, 6T2, and 10T2 capability, and system level mirroring via the operating system. The adapter provides both single and dual RAID controller configurations. Dual controller configurations (dual storage IOA) must run RAID. JBOD (512 byte) functionality is supported only in a single controller configuration based on the operating system. Best performance is achieved when multiple RAID sets are configured and optimized under a pair of adapters in a high availability, multi-initiator RAID configuration (dual storage IOA) which allows for an Active-Active mode of operation.

The adapter support a maximum of 98 attached disk devices that depends on the drive enclosure attached. A maximum of 48 devices can be solid-state devices (SSDs). Externally attached devices are designed to run at a maximum data rate of 6 Gbps for SAS disk devices and 3 Gbps for SAS tape devices. This adapter supports RAID and non-RAID DASD, and SAS tape devices. Specific device attachment support rules apply. This adapter supports the multi-initiator and high availability (dual storage IOA) configurations in AIX, IBM i, and Linux partitions. This adapter enables configuring the SAS drives as dedicated hot-spares with equal or higher capacity.

Important: See the SAS RAID controllers for AIX, SAS RAID controllers for IBM i, or SAS RAID controllers for Linux topics for more information and important considerations for multi-initiator and high availability or dual storage IOA configurations

Figure 52 on page 165 shows the adapter. The connector plug **(A)** is installed in an empty port and prevents damage to that port whenever a cable for the adjacent port connectors is plugged-in or removed.

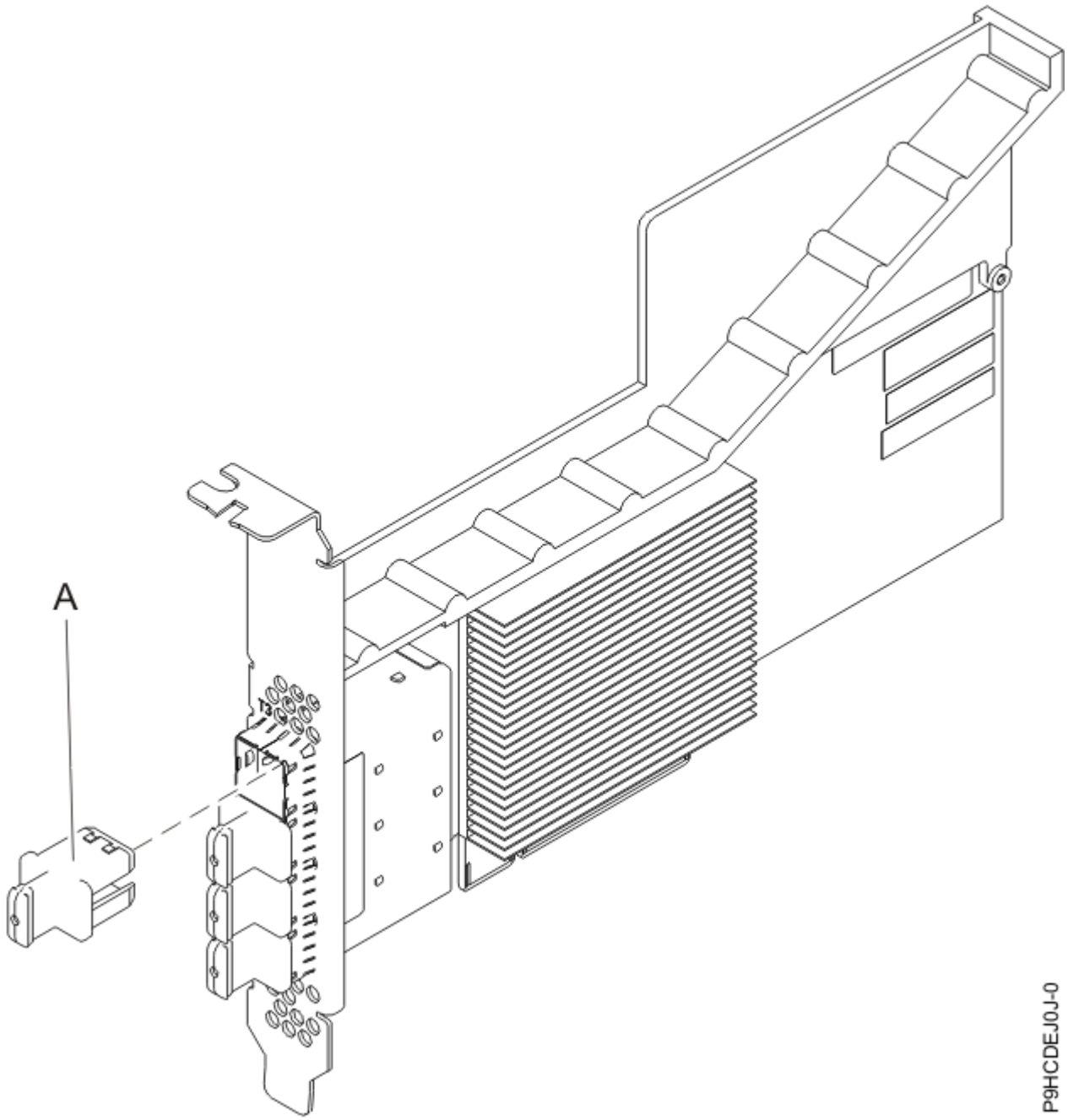


Figure 52. PCIe3 SAS RAID adapter

Specifications

Item
Description

Adapter FRU number
000FX846

Connector plug part number
00FW784 (The connector plug is installed in an empty port and prevents damage to that port whenever a cable for the adjacent port connectors is plugged-in or removed.)

I/O bus architecture
PCIe 3.0 but compatible to PCIe 2.0 or PCIe 1.0 slots.

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
3.3 V

Form factor
Short, low-profile but packaged for full-height installations.

Cables
Specific X, YO, AA, or AT SAS cable features with new narrow HD connectors are used to attach to the other adapter or disk expansion drawers.

Internal SAS device attachment on a 9040-MR9 system requires specific AZ cables that are provided with the subsystem or device features that are being attached. Special cabling is required for multi-initiator and high availability configurations. For more information, see Serial attached SCSI cable planning.

Attributes

- Four external mini SAS HD 4x connectors provide attachment of SAS device enclosures
- SAS Serial SCSI Protocol (SSP) and Serial Management Protocol (SMP)
- RAID 0, 5, 6, or 10 with hot-spare capability. System level mirroring through the operating system is also supported. JBOD functionality (512 byte) is supported in a single controller configuration only.
- Concurrent firmware update
- Removable media device (SAS Tape) are supported in a single controller configuration only and cannot be combined with disk devices attached to the same adapter. Removable media is not supported in multi-initiator and high availability (dual storage IOA) configurations
- Support for multi-initiator and high availability or single controller configurations

Other important requirements for adapter installation

If you are attaching a new or existing FC 5887 to an FC EJ0J adapter, verify that the latest System Enclosure Services (SES) code is applied to the FC 5887 before attaching to the FC EJ0J adapter. See the Power Systems Prerequisites website.

An automatic sector conversion takes place for use with the new adapter when migrating existing SAS disk enclosures and devices from existing previous PCIe SAS adapters to PCIe3 SAS adapters. For more information about the migration procedures, see Upgrading a SAS RAID storage adapter.

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).

- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

This adapter requires the following drivers:

- AIX: devices.pci.14104A0 device driver package

PCIe3 RAID SAS quad-port 6 Gb adapter (FC EJ0K; CCIN 57B4)

Learn about the specifications and operating system requirements for the feature code (FC) EJ0K adapter.

Overview

The PCIe3 RAID SAS quad-port 6 Gb adapter is a PCI Express (PCIe), generation 3, SAS RAID adapter that has a low-profile, short-form factor, but packaged for full height installation. The adapter is used in high-performance and high-density, serial attached SCSI (SAS) applications. It supports the attachment of SAS disk by using four mini SAS high-density (HD) x4 connectors that allow the physical links to be used in various narrow and wide-port configurations. The adapter does not have write cache.

The adapter is a 64 bit, 3.3 V, bootable SAS adapter that provides RAID 0, 5, 6, and 10 capability, and system level mirroring via the operating system. The adapter provides both single and dual RAID controller configurations. The exception to this is when installed in PCIe slots C09 and/or C012 of the IBM Power System E950 (9040-MR9), the adapter will only run in single controller mode. In dual controller configurations (dual storage IOA) all attached devices must run RAID. JBOD (512 byte) functionality is supported only in a single controller configuration based on the operating system. Best performance is achieved when multiple RAID sets are configured and optimized under a pair of adapters in a high availability, multi-initiator RAID configuration (dual storage IOA) which allows for an Active-Active mode of operation.

Note: Dual controller configuration (dual storage IOA) is not supported when FC EJ0K is installed in PCIe slots C09 or C012 of the 9040-MR9.

The adapter supports a maximum of 98 attached disk devices that depends on the drive enclosure attached. A maximum of 48 devices can be solid-state devices (SSDs). Externally attached devices are designed to run at a maximum data rate of 6 Gbps for SAS disk devices. Specific device attachment rules apply. This adapter supports the multi-initiator and high availability (dual storage IOA) configurations in AIX, IBM i, and Linux partitions. This adapter enables configuring the SAS drives as dedicated hot-spares with equal or higher capacity.

Note: When FC EJ0K is installed in PCIe slots C09 or C12 of the 9040-MR9 controlling the internal SAS drive bays, any external disk drive enclosures attached must be configured in zone mode 2 only.

Figure 53 on page 168 shows the adapter. The connector plug **(A)** is installed in an empty port and prevents damage to that port whenever a cable for the adjacent port connectors is plugged-in or removed.

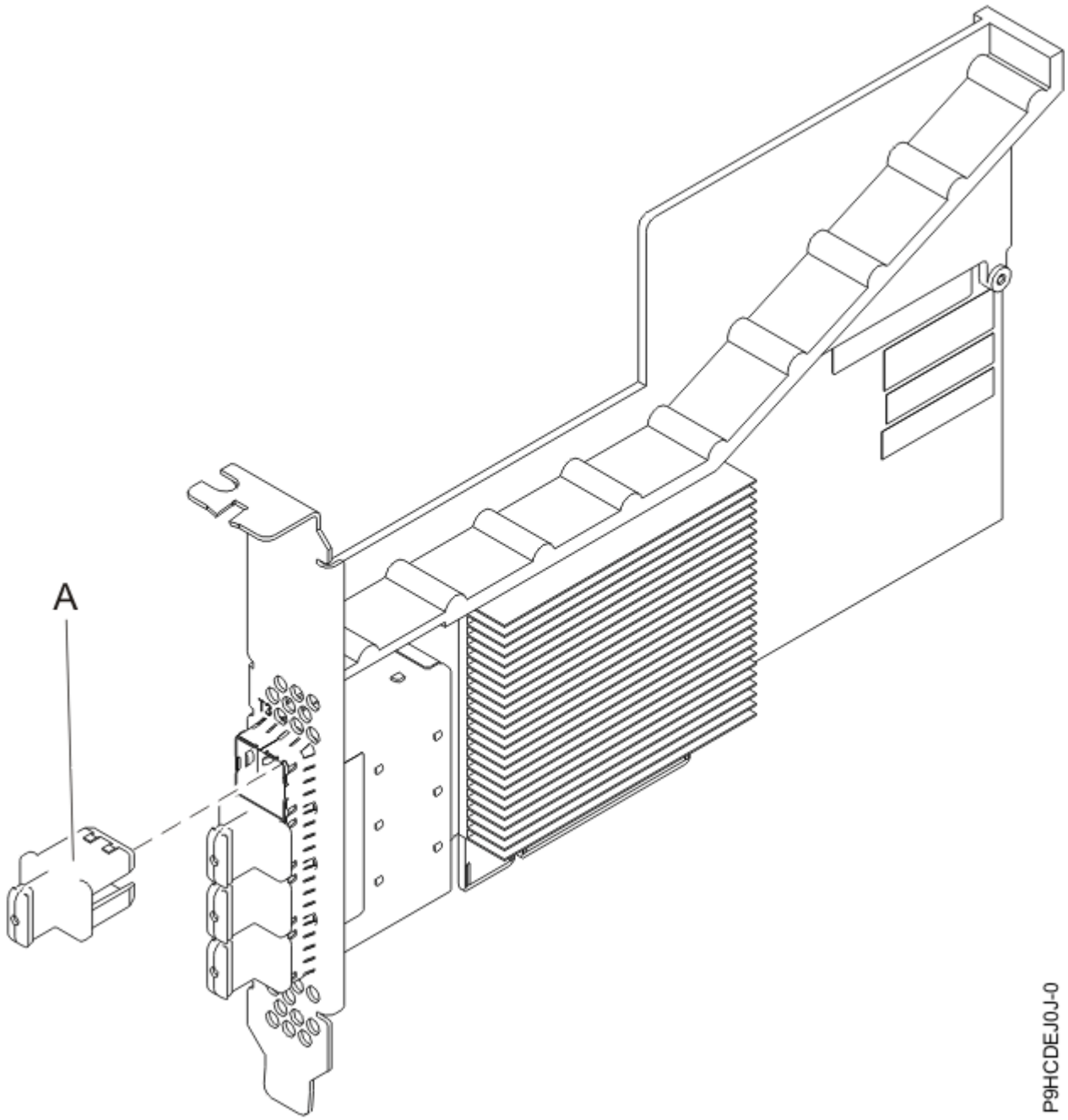


Figure 53. PCIe3 RAID SAS adapter

Specifications

Item
Description

Adapter FRU number
02DE906

Connector plug part number
00FW784 (The connector plug is installed in an empty port and prevents damage to that port whenever a cable for the adjacent port connectors is plugged-in or removed.)

I/O bus architecture
PCIe 3.0 but compatible to PCIe 2.0 or PCIe 1.0 slots.

Slot requirement
For more information about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities and select the system that you are working on.

Cables
Specific X, YO, or AA SAS cable features with new narrow HD connectors are used to attach to the other adapter or disk expansion drawers.

Internal SAS device attachment on a 9040-MR9 system requires specific AZ cables that are provided with the subsystem or device features that are being attached. Special cabling is required for multi-initiator and high availability configurations. For more information, see Serial attached SCSI cable planning.

Voltage
3.3 V

Form factor
Short, low-profile but packaged for full-height installations.

Maximum number
For the maximum adapters supported, see the PCI adapter placement topic collection for your system.

Attributes

- Four external mini SAS HD 4x connectors provide attachment of SAS device enclosures
- SAS Serial SCSI Protocol (SSP) and Serial Management Protocol (SMP)
- RAID 0, 5, 6, or 10 with hot-spare capability. System level mirroring through the operating system is also supported. JBOD functionality (512 byte) is supported in a single controller configuration only.
- Concurrent firmware update
- Support for multi-initiator and high availability or single controller configurations

Other important requirements for adapter installation

An automatic sector conversion takes place for use with the new adapter when migrating existing SAS disk enclosures and devices from existing previous PCIe SAS adapters to PCIe3 SAS adapters. For more information about the migration procedures, see Upgrading a SAS RAID storage adapter.

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

This adapter requires the following AIX driver: `devices.pciex.14104a03.device` driver package

PCIe3 12 GB Cache RAID SAS quad-port 6 Gb Adapter (FC EJ0L; CCIN 57CE)

Learn about the specifications and operating system requirements for the feature code (FC) EJ0L adapters.

Overview

The PCI Express (PCIe) generation 3, 12 GB Cache RAID SAS quad-port 6 Gb Adapter is a large cache PCIe3 SAS adapter that provides high-performance capabilities and supports the attachment of serial-attached SCSI (SAS) disks and SAS solid-state drives (SSDs) through four mini SAS high-density (HD) connectors. The feature code (FC) EJ0L has up to a 12 GB write-cache via compression. The adapter is a 64 bit, 3.3 V, bootable SAS adapter that supports RAID levels 0, 5, 6, 10, 5T2, 6T2, and 10T2 as well as system level mirroring via the operating system. The adapter must be installed in pairs and must be used in a high availability, multi-initiator RAID configuration with two adapters in dual-controller mode (dual storage IOA configuration). Two FC EJ0L adapters provide additional performance and adapter redundancy with mirrored write-cache data and mirrored RAID parity footprints between the adapters. If the FC EJ0L pairing is broken, then the write cache is disabled. Integrated flash memory with capacitors provides protection of the write cache in case of power failure, without the need for batteries as were used with some previous large cache adapters.

Figure 54 on page 171 shows the PCIe3 12 GB Cache RAID SAS quad-port 6 Gb adapter. The connector plug **(A)** is installed in an empty port and prevents damage to that port whenever a cable for the adjacent port connectors is plugged-in or removed.

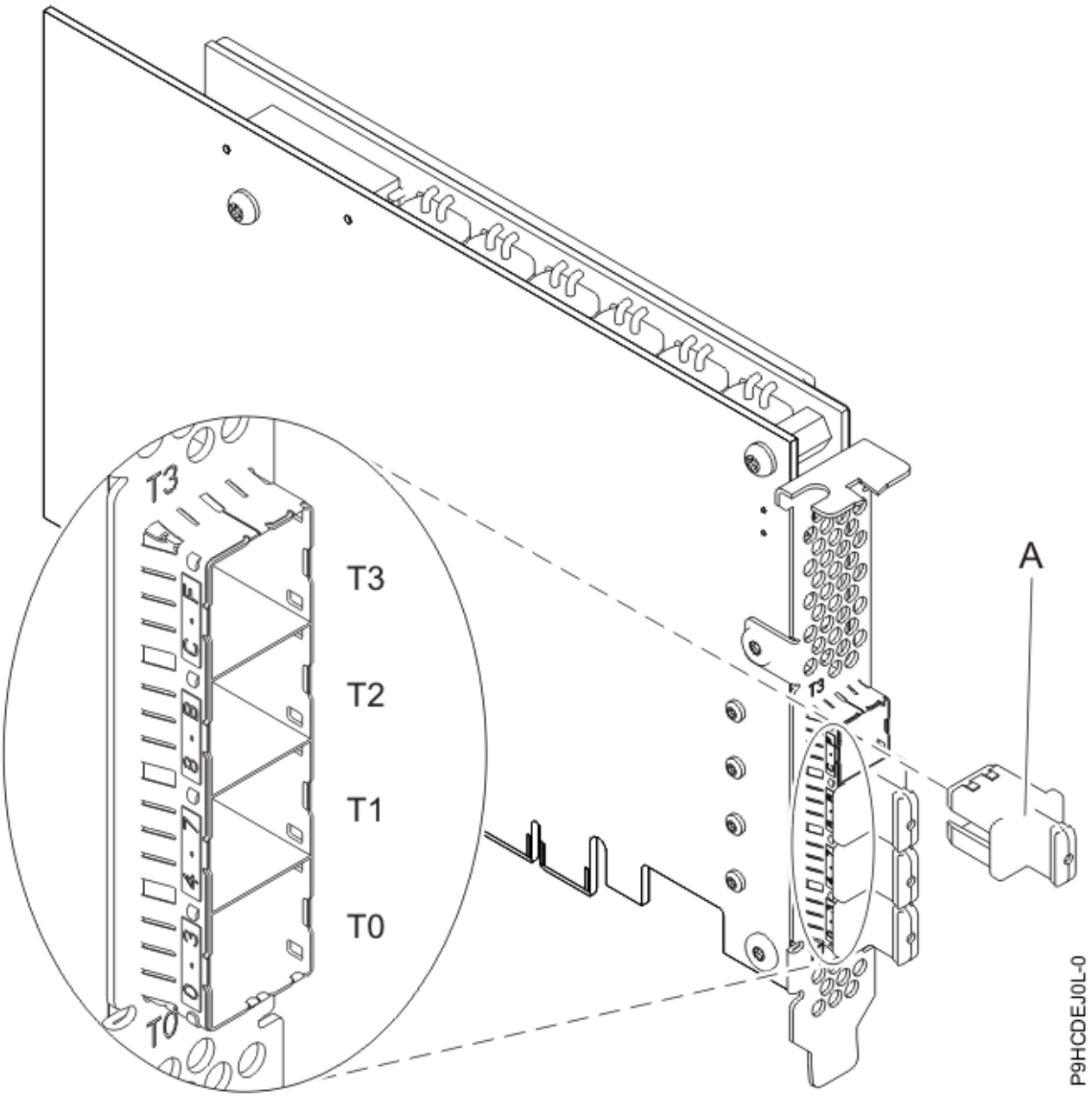


Figure 54. PCIe3 12 GB Cache RAID SAS 6 Gb Adapter

To provide the highest bandwidth between two paired feature EJ0L adapters for the mirroring of cache data and parity update footprints, two SAS Adapter-to-Adapter (AA) cables are required by default on the third and fourth adapter ports (T2, T3) until maximum device quantity attachment is required. When all connectors are attaching SAS drives, the communication between the adapter pair is performed through the SAS fabric via the I/O drawers and cabling.

The FC EJ0L is a single wide, full-height, short adapter. Figure 54 on page 171 shows the FC EJ0L adapter. Every FC EJ0L requires another FC EJ0L on this server, or on another server, which pairs with the SAS RAID adapter and enables cache functionality and the other multi-initiator high availability (dual storage IOA) functions. Best performance is achieved when multiple RAID sets are configured and optimized under a pair of adapters in a high availability, multi-initiator RAID configuration (dual storage IOA) which allows for an Active-Active mode of operation.

Systems running the AIX or Linux operating systems support either having both EJ0L features in the same system or partition, or in two separate systems or partitions. Systems running the IBM i operating system do not support the pairing of adapters on different servers or different partitions, so both the EJ0L

features must be installed on the same system and partition. The dual controllers support the Easy Tier function that enables the controllers to automatically move hot data to attached SSDs and cold data to attached HDDs in the AIX or Linux systems.

Important: See the SAS RAID controllers for AIX, SAS RAID controllers for IBM i, or SAS RAID controllers for Linux topics for more information and important considerations for multi-initiator and high availability or dual storage IOA configurations

Specifications

Item
Description

Adapter FRU number
00FX840

Connector plug part number
00FW784 (The connector plug is installed in an empty port and prevents damage to that port whenever a cable for the adjacent port connectors is plugged-in or removed.)

I/O bus architecture
PCIe 3.0 but downward compatible to 2.0 and 1.0

Slot requirement
One PCIe x8 slot per adapter.

Adapters are installed in pairs.

For higher availability, place adapters in separate enclosures where supported.

For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
3.3 V

Form factor
Short, full-height

Cables
Specific X , YO, or AA SAS cable features with new narrow HD connectors are used to attach to the other adapter or expansion drawers.

Special cabling is required for multi-initiator and high availability configurations. For more information, see Serial attached SCSI cable planning.

Attributes provided

- Support of the SAS Serial SCSI Protocol (SSP) and Serial Management Protocol (SMP).
- Provides RAID 0, RAID 5, RAID 6, RAID 10, RAID 5T2, RAID 6T2, and RAID 10T2 with hot-spare capability. System level mirroring through the operating system is also supported. JBOD functionality (512 byte) is not supported except for the initial formatting to 528 bytes of new devices, as required.

Important requirements for adapter installation

If you are attaching a new or existing FC 5887 to an FC EJ0L adapter, verify that the latest System Enclosure Services (SES) code is applied to the FC 5887 before attaching to the FC EJ0L adapter. See the Power Systems Prerequisites website.

An automatic sector conversion takes place for use with the new adapter when migrating existing SAS disk enclosures and devices from existing previous PCIe SAS adapters to PCIe3 SAS adapters. For more information about the migration procedures, see Upgrading a SAS RAID storage adapter.

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

This adapter requires the following drivers:

- AIX: devices.pci.14104A0 device driver package

PCIe3 RAID SAS quad-port 6 Gb LP Adapter (FC EL3B and FC EJ0M; CCIN 57B4)

Learn about the specifications and operating system requirements for the feature code (FC) EL3B and EJ0M adapter.

Overview

The PCIe3 RAID SAS quad-port 6 Gb LP Adapter is a PCI Express (PCIe), generation 3, RAID SAS adapter that has a low-profile and short-form factor. The adapter is used in high-performance and high-density, serial attached SCSI (SAS) applications. It supports the attachment of SAS hard disk drives (HDDs) and solid-state devices (SSDs) by using four mini SAS high-density (HD) x4 connectors that allow the physical links to be used in various narrow and wide-port configurations. The adapter does not have a non-volatile write cache. However, Linux customers can take advantage of a volatile adapter write cache of up to 1 Gb (compressed) for improved performance. This support is available with the 2.4.10 version of the **iprutils** utility available from the IBM Linux Power Tools Repository (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/yum.html) and with the latest adapter firmware available from the Fix Central website (http://www.ibm.com/support/fixcentral/).

The adapter is a 64 bit, 3.3 V, bootable SAS adapter that provides RAID 0, 5, 6, and 10 capability, and system level mirroring via the operating system. The adapter provides both single and dual RAID controller configurations. Dual controller configurations (dual storage IOA) must run RAID. JBOD (512 byte) functionality is supported only in a single controller configuration based on the operating system. Best performance is achieved when multiple RAID sets are configured and optimized under a pair of adapters in a high availability, multi-initiator RAID configuration (dual storage IOA) which allows for an Active-Active mode of operation.

The adapter supports a maximum of 96 attached disk devices that depends on the drive enclosure attached. A maximum of 48 devices can be solid-state devices (SSDs). Externally attached devices are designed to run at a maximum data rate of 6 Gbps for SAS disk devices. This adapter supports RAID and non-RAID DASD. Specific device attachment support rules apply. This adapter supports the multi-initiator and high availability (dual storage IOA) configurations in AIX, IBM i, and Linux partitions. This adapter enables configuring the SAS drives as dedicated hot-spares with equal or higher capacity.

Important: See the SAS RAID controllers for AIX, SAS RAID controllers for IBM i, or SAS RAID controllers for Linux topics for more information and important considerations for multi-initiator and high availability or dual storage IOA configurations

Figure 55 on page 174 shows the adapter. The connector plug **(A)** is installed in an empty port and prevents damage to that port whenever a cable for the adjacent port connectors is plugged-in or removed.

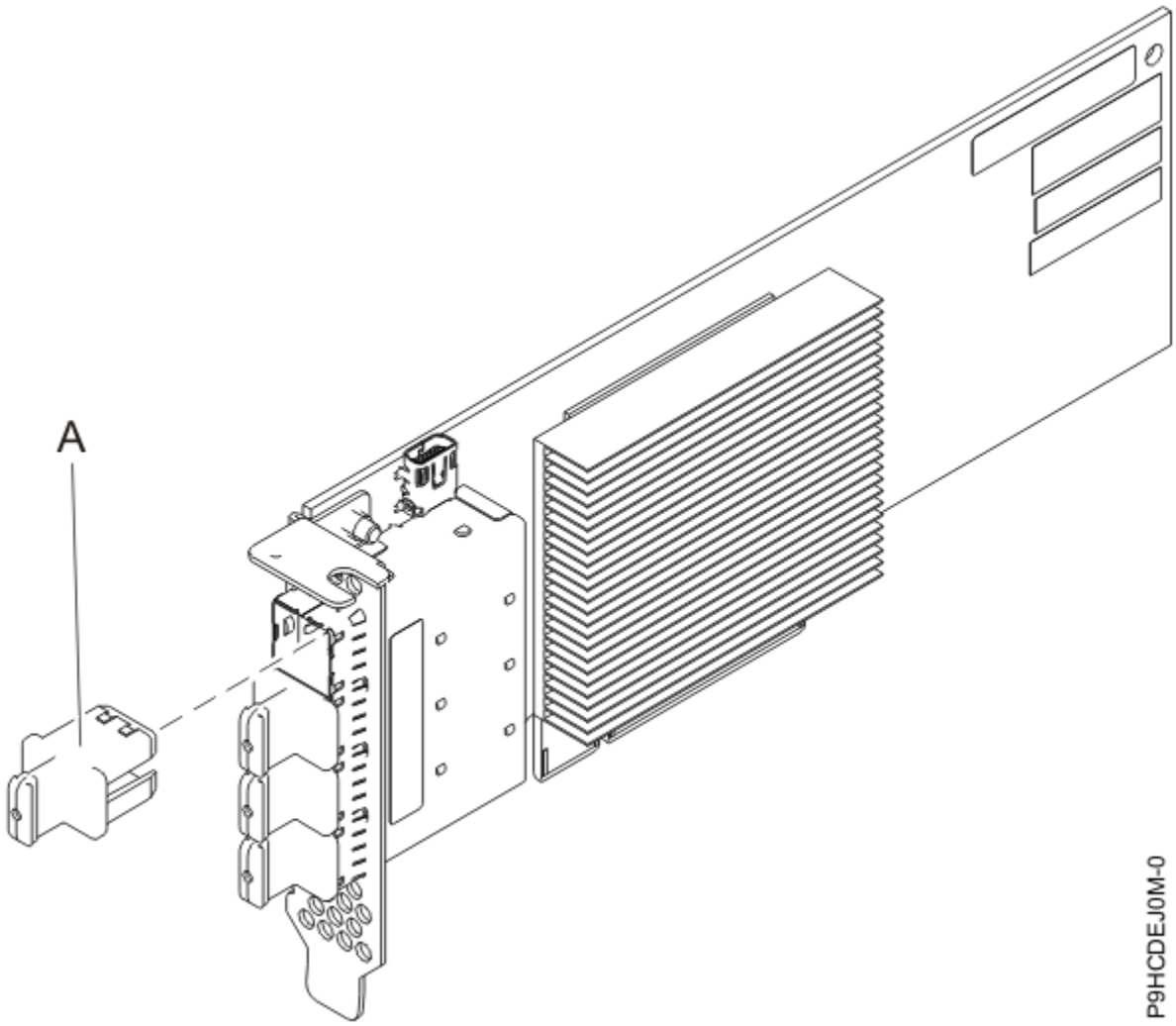


Figure 55. PCIe3 RAID SAS quad-port 6 Gb LP Adapter

Specifications

Item
Description

Adapter FRU number
000MH910

Connector plug part number
00FW784 (The connector plug is installed in an empty port and prevents damage to that port whenever a cable for the adjacent port connectors is plugged-in or removed.)

I/O bus architecture
PCIe 3.0 but compatible to PCIe 2.0 or PCIe 1.0 slots.

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
3.3 V

Form factor
Short, low-profile but packaged for full-height installations.

Cables
Specific X, YO, AA, or AT SAS cable features with new narrow HD connectors are used to attach to the other adapter or disk expansion drawers.

Internal SAS device attachment on a 9040-MR9 system requires specific AZ cables that are provided with the subsystem or device features that are being attached. Special cabling is required for multi-initiator and high availability configurations. For more information, see Serial attached SCSI cable planning.

Attributes

- Four external mini SAS HD 4x connectors provide attachment of SAS device enclosures
- SAS Serial SCSI Protocol (SSP) and Serial Management Protocol (SMP)
- RAID 0, 5, 6, or 10 with hot-spare capability. System level mirroring through the operating system is also supported. JBOD functionality (512 byte) is supported in a single controller configuration only.
- Concurrent firmware update
- Support for multi-initiator and high availability or single controller configurations

Important requirements for adapter installation

If you are attaching a new or existing 5887, ESLL, or ELLS enclosure to an FC EL3B or EJ0M adapter, verify that the latest System Enclosure Services (SES) code is applied to the enclosure before attaching to the FC EL3B or EJ0M adapter. For details, see the IBM Prerequisites website.

An automatic sector conversion takes place for use with the new adapter when migrating existing SAS disk enclosures and devices from existing previous PCIe SAS adapters to PCIe3 SAS adapters. For more information about the migration procedures, see Upgrading a SAS RAID storage adapter.

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

The EJ0M adapter requires the following drivers:

- AIX: devices.pci.14104A0 device driver package

PCIe3 4 x8 SAS Port Adapter (FC EL60, FC EL65, FC EJ10, and FC EJ11; CCIN 57B4)

Learn about the specifications and operating system requirements for the feature code (FC) EL60, FC EL65, FC EJ10, and FC EJ11 adapter.

Overview

The PCIe3 4 x8 SAS Port Adapter is a PCI Express (PCIe), generation 3, RAID SAS adapter. The adapters are short-form factor. The FC EL65 and FC EJ10 are full-height adapters and the FC EL60 and FC EJ11 are low-profile adapters. The adapter is used in high-performance and high-density, serial attached SCSI (SAS) applications. It supports the attachment of SAS DVD or SAS tape by using four mini SAS high-density (HD) x4 connectors that allow the physical links to be used in various narrow and wide-port configurations. SAS tape attachment is only supported in a single adapter configuration and cannot be mixed with SAS disk on the same adapter. The adapter does not have write cache. Figure 56 on page 177 and Figure 57 on page 178 show the PCIe3 4 x8 SAS port adapter.

A maximum of four DVD or tape drives can be attached per adapter by using four AE1 cables (FC ECBY). A maximum of eight DVD or tape drives can be attached by using four YE1 cables (ECBZ).

Externally attached devices are designed to run at a maximum data rate of 6 Gbps for SAS tape devices.

Important: See the SAS RAID controllers for AIX, SAS RAID controllers for IBM i, or SAS RAID controllers for Linux topics for more information and important considerations for multi-initiator and high availability or dual storage IOA configurations

Figure 56 on page 177 and Figure 57 on page 178 show the adapters. The connector plug **(A)** is installed in an empty port and prevents damage to that port whenever a cable for the adjacent port connectors is plugged-in or removed.

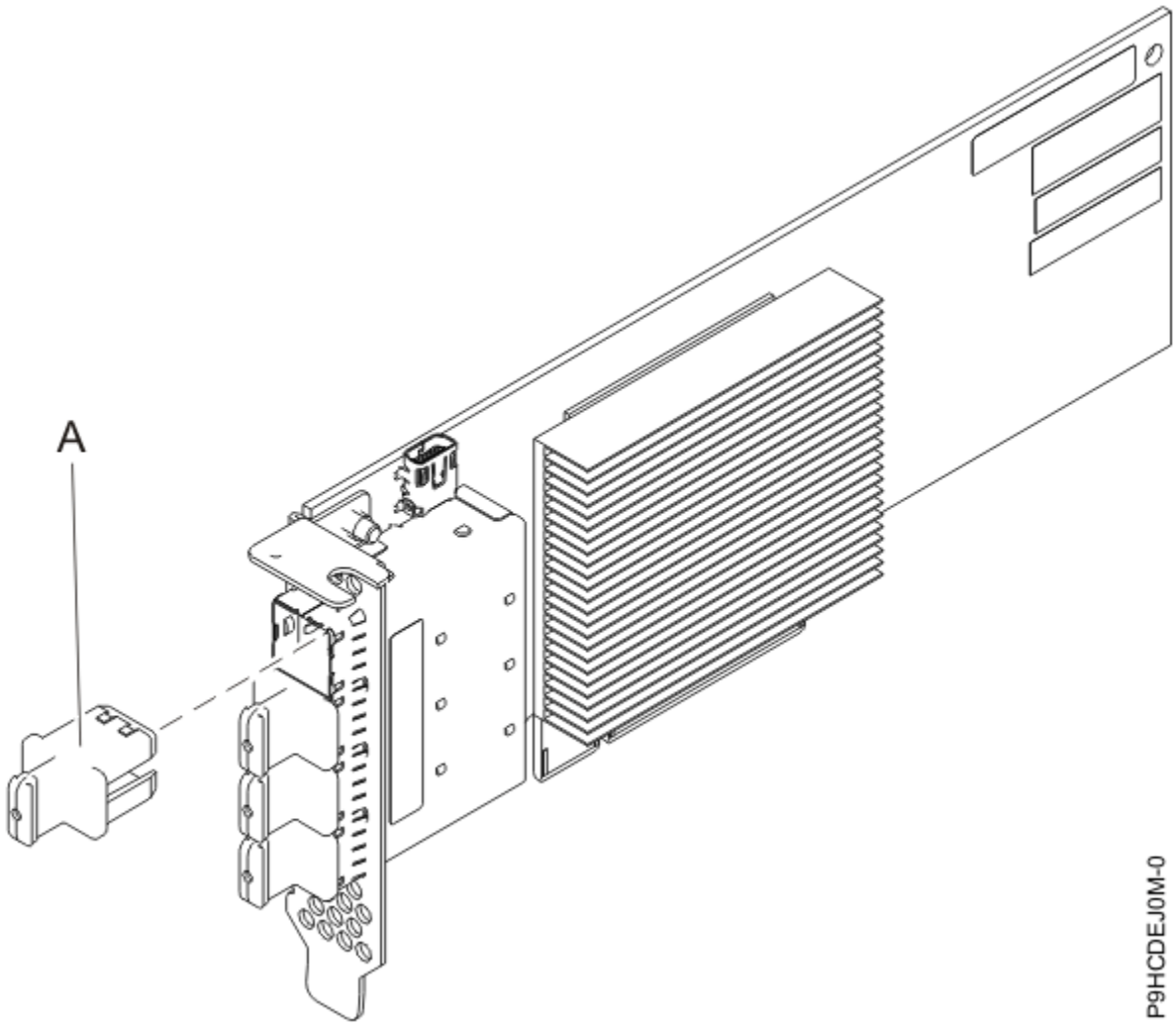


Figure 56. PCIe3 4 x8 SAS port adapter (FC EL60 and FC EJ11)

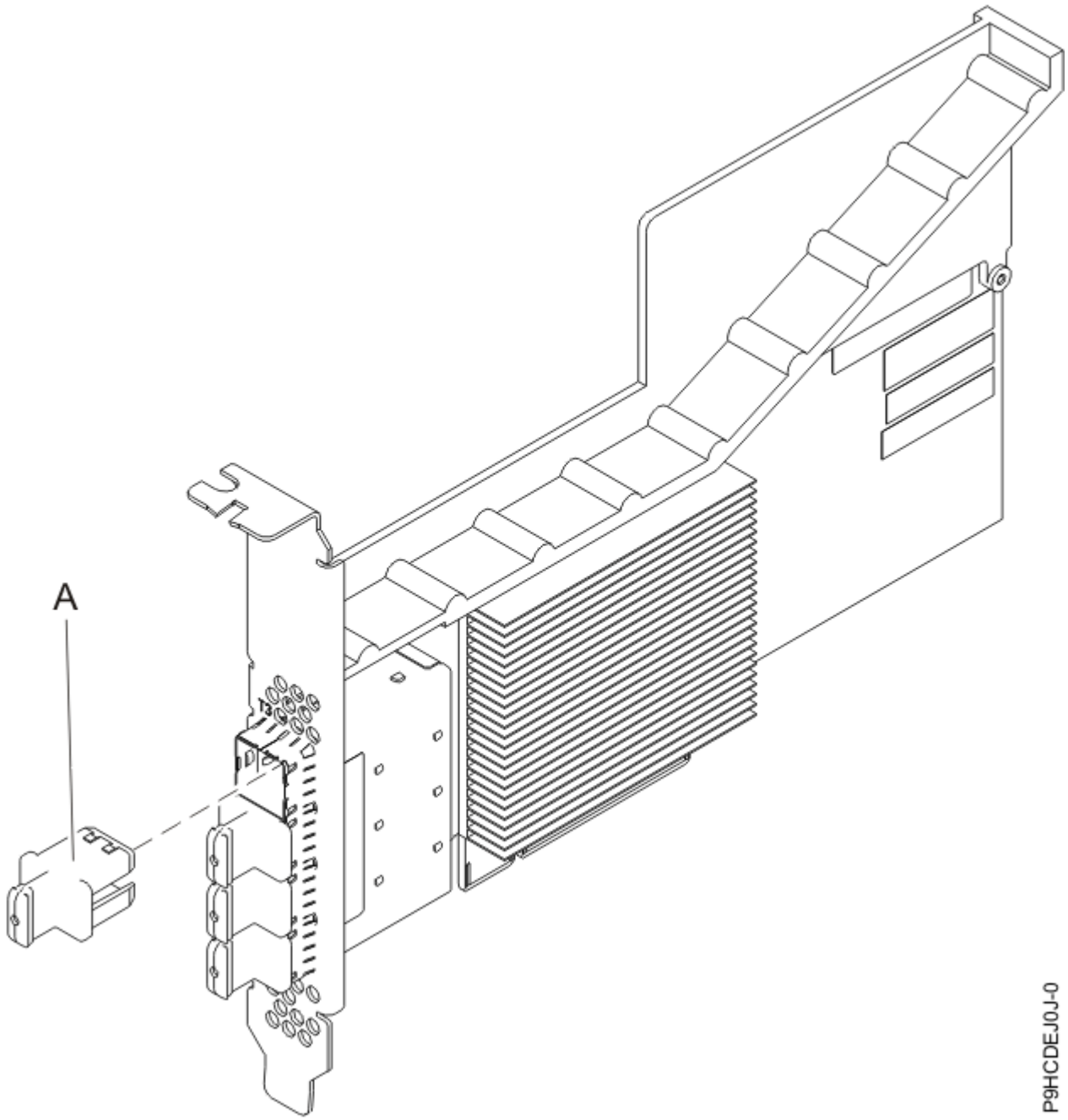


Figure 57. PCIe3 4 x8 SAS port adapter (FC EL65 and FC EJ10)

Specifications

Item
Description

Adapter FRU number
000MH959

Connector plug part number
00FW784 (The connector plug is installed in an empty port and prevents damage to that port whenever a cable for the adjacent port connectors is plugged-in or removed.)

I/O bus architecture
PCIe 3.0 but compatible to PCIe 2.0 or PCIe 1.0 slots.

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
3.3 V.

Form factor
Short form factor.

Cables
Specific AE1 or YE1 SAS cable features with narrow HD connectors are used to attach the adapter to SAS devices.

SAS device attachment requires specific cables that are provided with the subsystem or device features that are being attached. See Serial attached SCSI cable planning.

Attributes

- Four external mini SAS HD 4x connectors provide attachment of SAS devices
- SAS Serial SCSI Protocol (SSP) and Serial Management Protocol (SMP)
- Concurrent firmware update
- Removable media device (DVD and SAS tape) are supported in a single controller configuration only and cannot be combined with disk devices attached to the same adapter. Removable media is not supported in multi-initiator and high availability (dual storage IOA) configurations
- Support single controller configurations only

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

This adapter requires the following drivers:

- AIX: devices.pci.14104A0 device driver package

PCIe3 12 GB Cache RAID + SAS Adapter Quad-port 6 Gb x8 (FC EJ14; CCIN 57B1)

Learn about the specifications and operating system requirements for the feature code (FC) EJ14 adapter.

Overview

The PCIe3 4-port 12 GB Cache RAID + SAS Adapter is a PCI Express (PCIe) generation 3, x8, single-wide, full-height, short form-factor adapter that provides high-performance capabilities and supports the

attachment of SAS hard disk drive (HDD) and SAS solid-state drive (SDD). A pair of FC EJ14 adapters are required to provide additional performance, mirrored write cache data and adapter redundancy. If the FC EJ14 pairing is broken, then the write cache is disabled. Integrated flash memory with super capacitors provides protection of the write cache without batteries in case of power failure. FC EJ14 effectively provides up to 12 GB of write cache that uses compression of 4 GB of physical cache.

The adapter provides four Mini-SAS HD (high density) narrow connectors for the attachment of SAS drives in the ESLL storage enclosure (IBM EXP12SX SAS Storage Enclosure), the ESLS storage enclosure (IBM EXP24SX SAS Storage Enclosure), or the 5887 disk drive enclosure (IBM EXP24S SFF Gen2-bay Drawer) as shown in Figure 58 on page 181. Specific SAS cables with HD narrow connectors are used to attach to the storage enclosure or disk drive enclosure. To provide the highest bandwidth, two AA SAS cables with HD narrow connectors are used to attach the two paired FC EJ14 adapters on the third and fourth adapter ports (T2, T3) to communicate status and cache content information between the two adapters. Both AA SAS cables are required unless 3 or 4 ports are being used to attach the SAS drives. When all connectors are attaching SAS drives, the communication between the adapter pair is performed through the SAS fabric by way of the disk enclosures and cabling. A maximum of 96 SAS devices are supported using four ESLS storage enclosures or 5887 disk drive enclosures . The SAS devices can be all HDDs or can have up to 48 SSD + 48 HDDs (HDDs must be on the 3rd and 4th ports). They can have a maximum of 72 SSDs with no HDDs and must have an AA cable on the top port. If there are over 48 SSDs, then no HDDs can be attached.

The adapter provides RAID 0, RAID 5, RAID 6, RAID 10, RAID 5T2, RAID 6T2, RAID 10T2, and OS mirroring (LVM) for the AIX, Linux, and VIOS operating systems. Under the IBM i operating system, the adapter provides RAID 5, RAID 6, OS mirroring, and data spreading. RAID 10 is supported by IBM i Version 7.2 or later.

Important: See the SAS RAID controllers for AIX, SAS RAID controllers for IBM i, or SAS RAID controllers for Linux topics for more information and important considerations for multi-initiator and high availability or dual storage IOA configurations

Figure 58 on page 181 shows the PCIe3 12 GB Cache RAID + SAS quad-port 6 Gb adapter. The connector plug **(A)** is installed in an empty port and prevents damage to that port whenever a cable for the adjacent port connectors is plugged-in or removed.

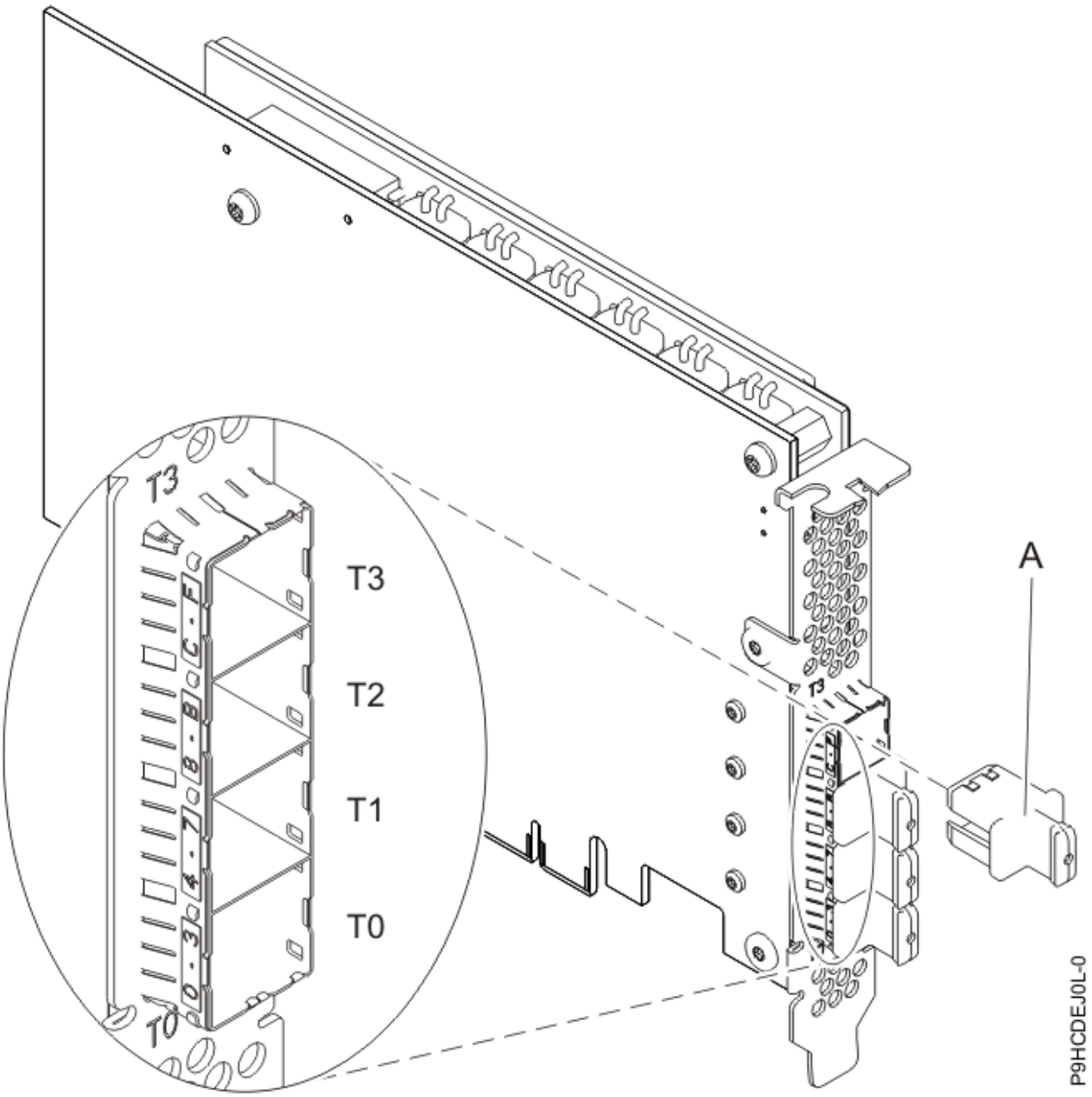


Figure 58. PCIe3 12 GB Cache RAID + SAS 6 Gb Adapter

Specifications

Item
Description

Adapter FRU number
01DH742

Connector plug part number
00FW784 (The connector plug is installed in an empty port and prevents damage to that port whenever a cable for the adjacent port connectors is plugged-in or removed)

I/O bus architecture
PCIe 3.0 (compatible with 2.0 and 1.0)

Slot requirement
One PCIe x8 slot per adapter

Adapters are installed in pairs

For higher availability, place adapters in separate enclosures where supported

For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
3.3 V

Form factor
Short, full-height

Cables
Specific X or YO SAS cable features with new narrow HD connectors are used to attach to the ESLL storage enclosure, ESLS storage enclosure, or 5887 disk drive enclosure.

Internal SAS device attachment on a 9040-MR9 system requires specific AZ cables that are provided with the subsystem or device features that are being attached. Special cabling is required for multi-initiator and high availability configurations. For more information, see Serial attached SCSI cable planning.

Attributes provided
Full high PCIe3 four port x8 adapter with up to 12 GB write cache

Important requirements for adapter installation

An automatic sector conversion takes place for use with the new adapter when migrating existing SAS disk enclosures and devices from existing previous PCIe SAS adapters to PCIe3 SAS adapters. For more information about the migration procedures, see Upgrading a SAS RAID storage adapter.

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe3 cable adapter (FC EJ19; CCIN 6B53)

Learn about the specifications and operating system requirements for the feature code (FC) EJ19 adapter.

Overview

FC EJ19 is a double-wide, low-profile, PCIe generation 3 (PCIe3) adapter. The adapter provides two optical ports for the attachment of two expansion drawer cables. One adapter supports the attachment of one PCIe3 6-slot fanout module in a EMX0 PCIe Gen3 I/O expansion drawer.

Note: The FC EJ19 (CCIN 6B53) adapter only works with the CCIN 50CD PCIe3 6-slot fanout module.

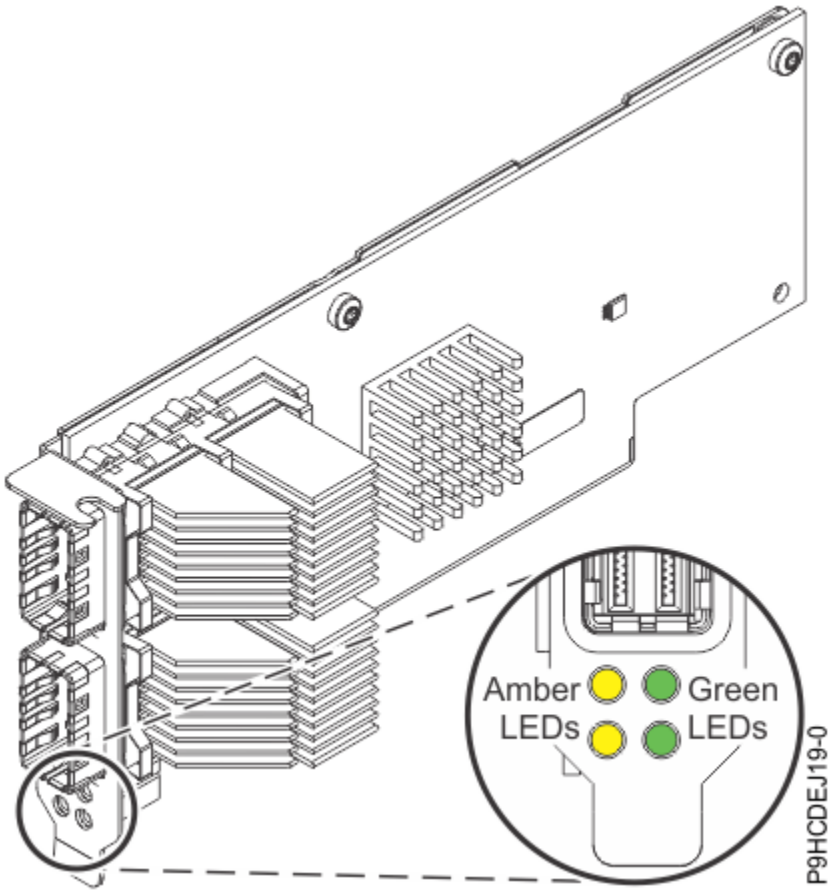


Figure 59. PCIe3 x16 GPU adapter

Note: The LEDs that are shown in Figure 59 on page 183 indicate the following states:

- The green LED indicates link status. If the green LED is on, at least one PCIe link is in the trained state.
- The amber LED indicates FRU identify. If the amber LED is on, it will blink at 2 Hz, and indicates that the adapter is in the identify function state.

Specifications

Item
Description

Adapter FRU number
02AE929

I/O bus architecture
PCIe3 x16

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
12 V

Form factor

Half-height, half-length

PCIe3 cable adapter (FC EJ20; CCIN 2CF5)

Learn about the specifications and operating system requirements for the feature code (FC) EJ20 adapter.

Overview

FC EJ20 is a full-height, half-length PCIe3 cable adapter. The adapter provides two optical ports for the attachment of two expansion drawer cables. One adapter supports the attachment of one PCIe3 6-slot fanout module in a EMX0 PCIe Gen3 I/O expansion drawer.

Note: The FC EJ20 (CCIN 2CF5) adapter only works with the CCIN 50CD PCIe3 6-slot fanout module.

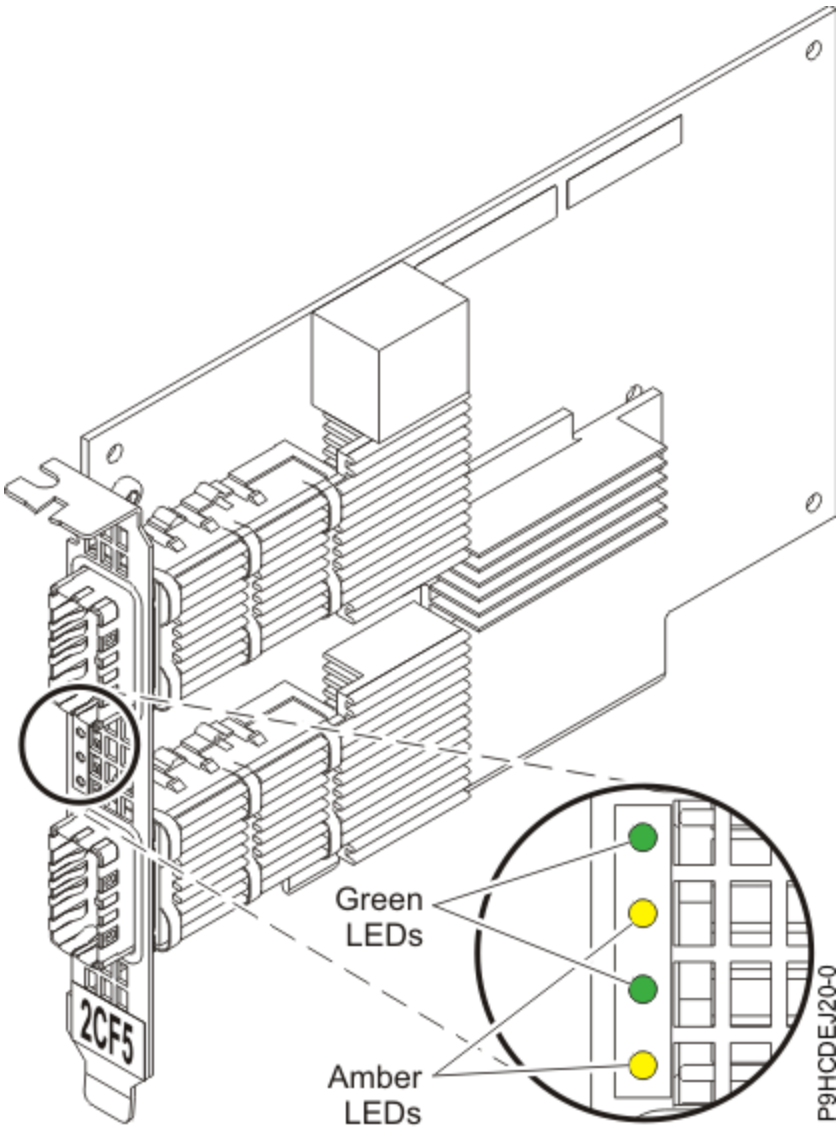


Figure 60. PCIe3 cable adapter

Note: The LEDs that are shown in Figure 60 on page 184 indicate the following states:

- The green LED indicates link status. If the green LED is on, at least one PCIe link is in the trained state.
- The amber LED indicates FRU identify. If the amber LED is on, it will blink at 2 Hz, and indicates that the adapter is in the identify function state.

Specifications

Item
Description

Adapter FRU number
02WF001

I/O bus architecture
PCIe3 x16

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
12 V

Form factor
Full-height, half-length

PCIe3 x8 SAS RAID internal adapter 6 Gb (FC EJ1C and FC EJ1E; CCIN 57D7)

Learn about the specifications and operating system requirements for the PCIe3 x8 SAS RAID internal adapter 6Gb (CCIN 57D7) that is integrated with the storage backplane (FC EJ1C) in the 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9223-42H, or 9223-42S. Adding of another PCIe3 x8 SAS RAID internal adapter 6Gb (FC EJ1E) enables the storage backplane to be configured as a split storage backplane in the 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9223-42H, or 9223-42S.

Overview

The PCIe3 x8 SAS RAID internal adapter 6 Gb is an internal PCI Express generation-3 (PCIe3), serial-attached SCSI (SAS) Random Array of Independent Disks (RAID) adapter that is integrated in the 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9223-42H, or 9223-42S. The PCIe3 x8 SAS RAID internal adapter 6 Gb is part of a composite feature of the storage backplane FC EJ1C. The adapter contains the SAS RAID controller. The PCIe3 x8 SAS RAID internal adapter 6 Gb is preinstalled in the dedicated internal PCIe3, x8 slot P1-C49 in the 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9223-42H, or 9223-42S. The internal adapter has a data read or write speed of 6 Gbps. The PCIe3 x8 SAS RAID internal adapter 6 Gb does not have a write cache.

Single adapter configuration

This configuration of the storage backplane in the 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9223-42H, or 9223-42S with one PCIe3 x8 SAS RAID internal adapter 6 Gb supports 12 numbers of 2.5 inches, small form-factor (SFF) hard disk drives (HDDs), or solid-state drives (SSDs). FC EJ1C also supports a slim DVD bay. The PCIe3 x8 SAS RAID internal adapter 6 Gb supports the drives to be used as just-a-bunch of disks (JBOD) or as a RAID. The supported RAID is RAID 0, 5, 6, and 10. Two mini-SAS HD cables connect the PCIe3 x8 SAS RAID internal adapter 6 Gb to the two SAS ports on the storage backplane. This configuration with one PCIe3 x8 SAS RAID internal adapter 6 Gb does not split the disks in the storage backplane.

Two adapters split storage backplane configuration

To enable the split storage backplane, another PCIe3 x8 SAS RAID internal adapter 6 Gb (FC EJ1E) must be installed in the other dedicated internal PCIe3 x8 slot P1-C50. The same backplane as in FC EJ1C is used in the split storage backplane configuration. The two mini-SAS HD cables connect each of the PCIe3 x8 SAS RAID internal adapter 6 Gb to the two SAS ports on the storage backplane. The 12 drives are then split into two sets of six drives (HDDs or SSDs), each controlled by one PCIe3 x8 SAS RAID internal adapter 6 Gb. The split storage backplane configuration supports the drives to be used as just-a-bunch of disks (JBOD) or as a RAID. The supported RAID is RAID 0, 5, 6, and 10. The PCIe3 x8 SAS RAID internal adapter 6 Gb in slot P1-C49 controls the slim DVD bay. The split storage backplane does not support the mixing of HDDs and SSDs in the same RAID set.

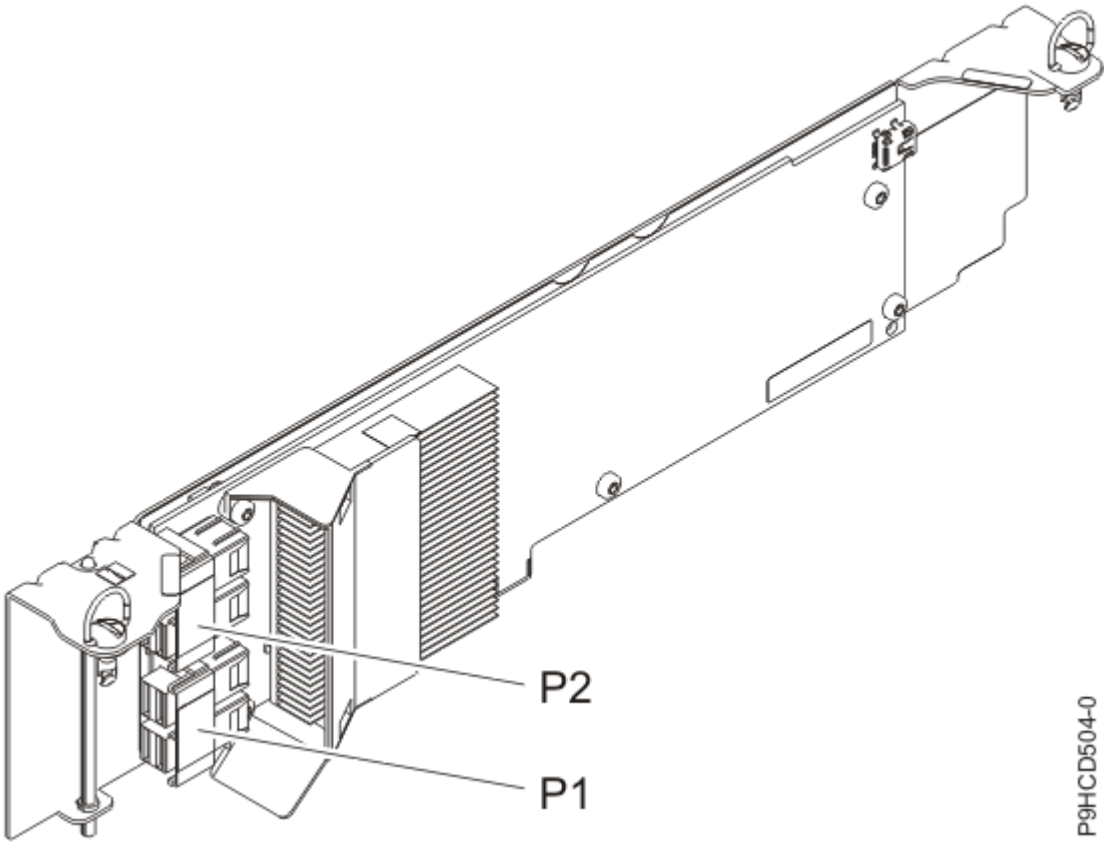


Figure 61. PCIe3 x8 SAS RAID internal adapter 6 Gb

Specifications

Item
Description

Adapter FRU number
01LK399

I/O bus architecture
PCIe3 x8

Slot requirement
Internal PCIe3 slot with x16 connector and x8 bus signaling per adapter.

Base configuration: Adapter is preinstalled in slot P1-C49.

Split storage backplane configuration: Second adapter is installed in slot P1-C50.

Cables
Two mini-SAS HD cables that are supplied with the adapter.

Voltage
12 V

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).

- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe3 x8 cache SAS RAID internal adapter 6 Gb (FC EJ1D and EJ1M; CCIN 57D8)

Learn about the specifications and operating system requirements for the expanded function PCIe3 x8 cache SAS RAID internal adapter 6 Gb (FC EJ1D and EJ1M; CCIN 57D8) that is integrated with the composite storage backplane in the 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9223-42H, or 9223-42S system.

Overview

The expanded function PCIe3 x8 cache SAS RAID internal adapter 6 Gb is an internal PCI Express generation 3 (PCIe3), serial-attached SCSI (SAS) Random Array of Independent Disks (RAID) adapter integrated in the 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9223-42H, or 9223-42S system. The PCIe3 x8 cache SAS RAID internal adapter 6 Gb (CCIN 57D8) is part of the composite feature of the expanded function storage backplane (FC EJ1D and EJ1M). The adapter contains the SAS RAID controller.

A pair of these expanded function internal adapters is pre-installed in the dedicated internal PCIe3 x8 slots P1-C49 and P1-C50 in the 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9223-42H, or 9223-42S system. The expanded function composite storage feature (FC EJ1D and EJ1M) provides the following features:

- An expanded function storage backplane (CCIN 6B64 or 2D35) that provides slots for 12 numbers of 2.5 inches small form-factor (SFF) hard disk drives (HDDs) or solid-state drives (SDDs) with an RDX drive bay, or 18 numbers of 2.5 inches small form-factor (SFF) hard disk drives (HDDs) or solid-state drives (SDDs) without a RDX drive bay
- A pair of the expanded function PCIe3 cache SAS RAID internal adapters (CCIN 57D8) that are installed in the slots P1-C49 and P1-C50.
- Two mini-SAS HD cables that attach to the expanded function storage backplane. For information, see Front SAS cable.
- FC EJ0W provides a mini-SAS HD cable with two external SAS ports that is installed in the system rear bulkhead in the slot P1-C6. For more information, see Rear SAS cable.

The PCIe3 x8 cache SAS RAID internal adapter 6 Gb has a data read-write speed of 6 Gbps and a real write cache of 1.8 GB. With a 4:1 cache compression, this expanded function adapter provides an increased cache of 7.2 GB and increases the storage system performance. The write cache contents are protected against power loss with flash memory and super capacitors and removes the need for cache battery.

The two mini-SAS HD cables connect each of the PCIe3 x8 cache SAS RAID internal adapter 6 Gb to the two SAS ports on the storage backplane. The expanded function internal adapters supports both SFF HDD and SSD drives to be used in Dual Storage IOA RAID configurations. The supported RAID configurations include: RAID 0, 5, 6, 10, 5T2, 6T2, and 10T2. JBOD disks are not supported in a Dual Storage IOA RAID configuration. The expanded function storage backplane does not support the split storage backplane configuration.

Each of the internal adapters provide a rear mini-SAS HD connector that attach to the mini-SAS HD cable which has two external SAS ports on the other end. In the 9009-41A, 9009-41G, 9009-42A, 9009-42G, 9223-42H, or 9223-42S system, the external SAS ports are installed in slot P1-C6. The external SAS

ports are used to attach a FC 5887, FC ESLS, or FC ESLL drive enclosure. Only one drive enclosure is supported by the expanded function internal adapter pair and must be in zone mode 1. The external SAS YO cables that are used to attach a FC 5887, FC ESLS, or FC ESLL disk drive enclosure to the rear SAS ports must not exceed the maximum supported length of 3 meters.

Systems running the AIX or Linux operating system support both adapters RAID controllers owned by the same or different partitions. AIX or Linux also provide mirroring (logical volume manager (LVM)) capabilities. The dual controllers support the Easy Tier® function that enables the controllers to automatically move hot data to attached SSDs and cold data to attached HDDs in the AIX or Linux systems.

Systems running the IBM i operating system do not support the two adapters being owned by different partitions, nor the Easy Tier function.

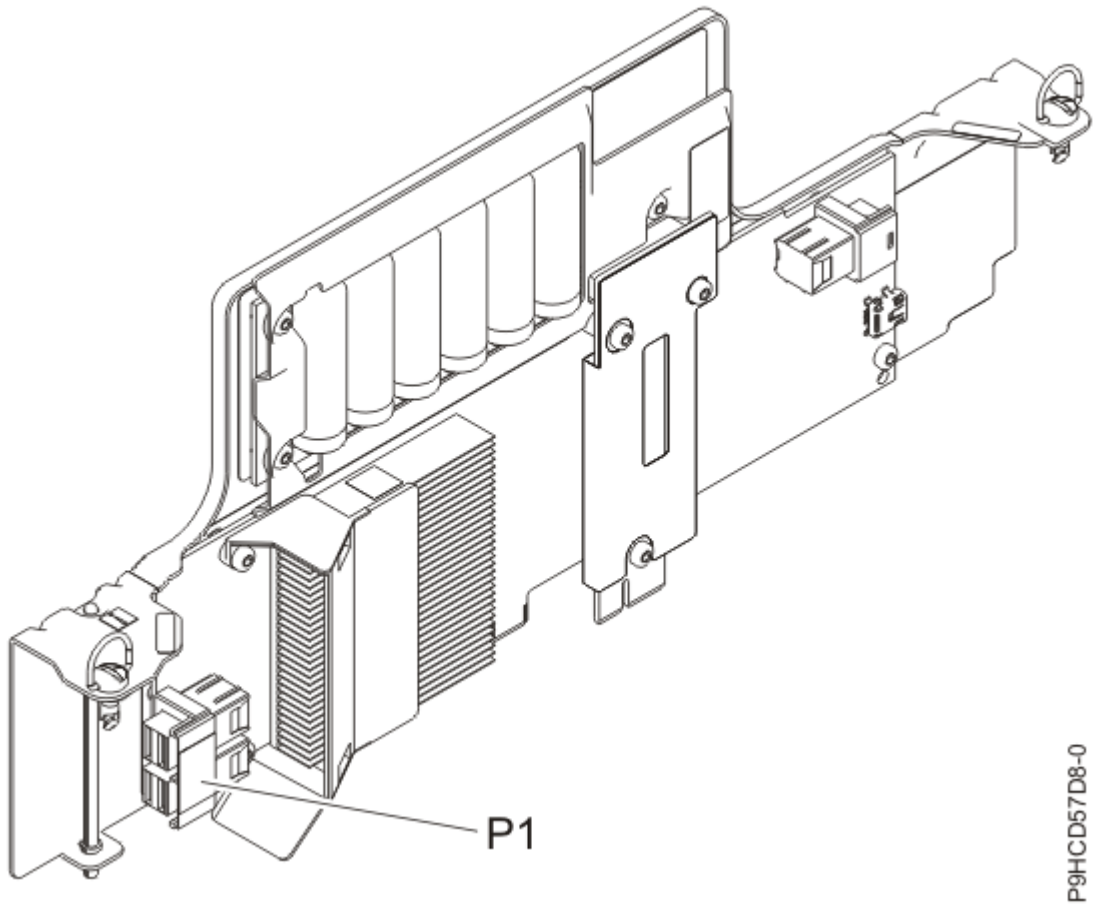


Figure 62. PCIe3 x8 cache SAS RAID internal adapter 6 Gb

Specifications

Item
Description

Adapter CCIN number
57D8

Adapter FRU number
01JC773

I/O bus architecture
PCIe3 x8

Slot requirement
Internal PCIe3 slot with x16 connector and x8 bus signaling per adapter

Expanded function configuration: Two adapters are installed in slot P1-C49 and P1-C50

Cables

Two mini-SAS HD cables (part number 01ML061) supplied with the adapter. Additional SAS cable with mini-SAS HD connectors and external SAS ports (part number 01AF778) can be attached to the expanded function internal adapters

Voltage

12 V

Important requirements for adapter installation

An automatic sector conversion takes place for use with the new adapter when migrating existing SAS disk enclosures and devices from existing previous PCIe SAS adapters to PCIe3 SAS adapters. For more information about the migration procedures, see Upgrading a SAS RAID storage adapter.

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe3 x8 SAS RAID internal adapter 6 Gb (FC EJ1F, FC EJ1H, FC EL66, and FC EL68; CCIN 57D7)

Learn about the specifications and operating system requirements for the PCIe3 x8 SAS RAID internal adapter 6 Gb (CCIN 57D7) that is integrated with the base function storage backplane (FC EJ1F) in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9223-22H, or 9223-22S system. Adding of another PCIe3 x8 SAS RAID internal adapter 6 Gb (FC EJ1H or FC EL68) enables the base function storage backplane (FC EJ1F) to be configured as a split storage backplane in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9223-22H, or 9223-22S.

Overview

The PCIe3 x8 SAS RAID internal adapter 6 Gb is an internal PCI Express (PCIe) generation 3 (Gen3), serial-attached SCSI (SAS) Random Array of Independent Disks (RAID) adapter that is integrated in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9223-22H, or 9223-22S. The PCIe3 x8 SAS RAID internal adapter 6 Gb is part of a composite feature of the base function storage backplane (FC EJ1F). The adapter contains the SAS RAID controller. The PCIe3 x8 SAS RAID internal adapter 6 Gb is preinstalled in the dedicated internal PCIe3, x8 slot P1-C49 in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9223-22H, or 9223-22S. The internal adapter has a data read or write speed of 6 Gbps.

Adapter caching

The PCIe3 x8 SAS RAID internal adapter 6 Gb does not have a non-volatile write cache. However, Linux customers can take advantage of a volatile adapter write cache of up to 1 Gb (compressed) for improved

performance. This support is available with the 2.4.10 version of IBM Power RAID adapter utilities (**iprutils**) available from the IBM Linux Power Tools Repository (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/yum.html) and with the latest adapter firmware available from the Fix Central website (http://www.ibm.com/support/fixcentral/).

Single adapter configuration

This configuration of the storage backplane in the 5105-22E, 9008-22L, 9009-22A, 9009-22G, 9223-22H, or 9223-22S with one PCIe3 x8 SAS RAID internal adapter 6 Gb (FC EJ1F) supports 8 numbers of 6.35 cm (2.5 inches), small form-factor (SFF) hard disk drives (HDDs), or solid-state drives (SSDs). The PCIe3 x8 SAS RAID internal adapter 6 Gb supports the drives to be used as just-a-bunch of disks (JBOD) or as a RAID array. The supported RAID levels are RAID 0, 5, 6, and 10. Two mini-SAS HD cables connect the PCIe3 x8 SAS RAID internal adapter 6 Gb to the two SAS ports on the storage backplane. This configuration with one PCIe3 x8 SAS RAID internal adapter 6 Gb does not split the disks in the storage backplane.

Two adapters split storage backplane configuration

To enable the split storage backplane, another PCIe3 x8 SAS RAID internal adapter 6 Gb (FC EJ1H or FC EL68) must be installed in the other dedicated internal PCIe3 x8 slot P1-C50. The same storage backplane as in FC EJ1F is used in the split storage backplane configuration. The two mini-SAS HD cables connect each of the PCIe3 x8 SAS RAID internal adapter 6 Gb to the two SAS ports on the storage backplane. The 8 drives are then split into 2 sets of 4 drives (HDDs or SSDs), each controlled by one PCIe3 x8 SAS RAID internal adapter 6 Gb. The split storage backplane configuration supports the drives to be used as just-a-bunch of disks (JBOD) or as a RAID array. The supported RAID levels are RAID 0, 5, 6, and 10. The preinstalled PCIe3 x8 SAS RAID internal adapter 6 Gb in slot P1-C49 controls drives, D1, D2, D3, and D7 on the direct access storage device (DASD) backplane. A PCIe3 x8 SAS RAID internal adapter 6 Gb in the other dedicated internal slot P1-C50, controls drives D4, D5, D6, and D8 on the DASD backplane.

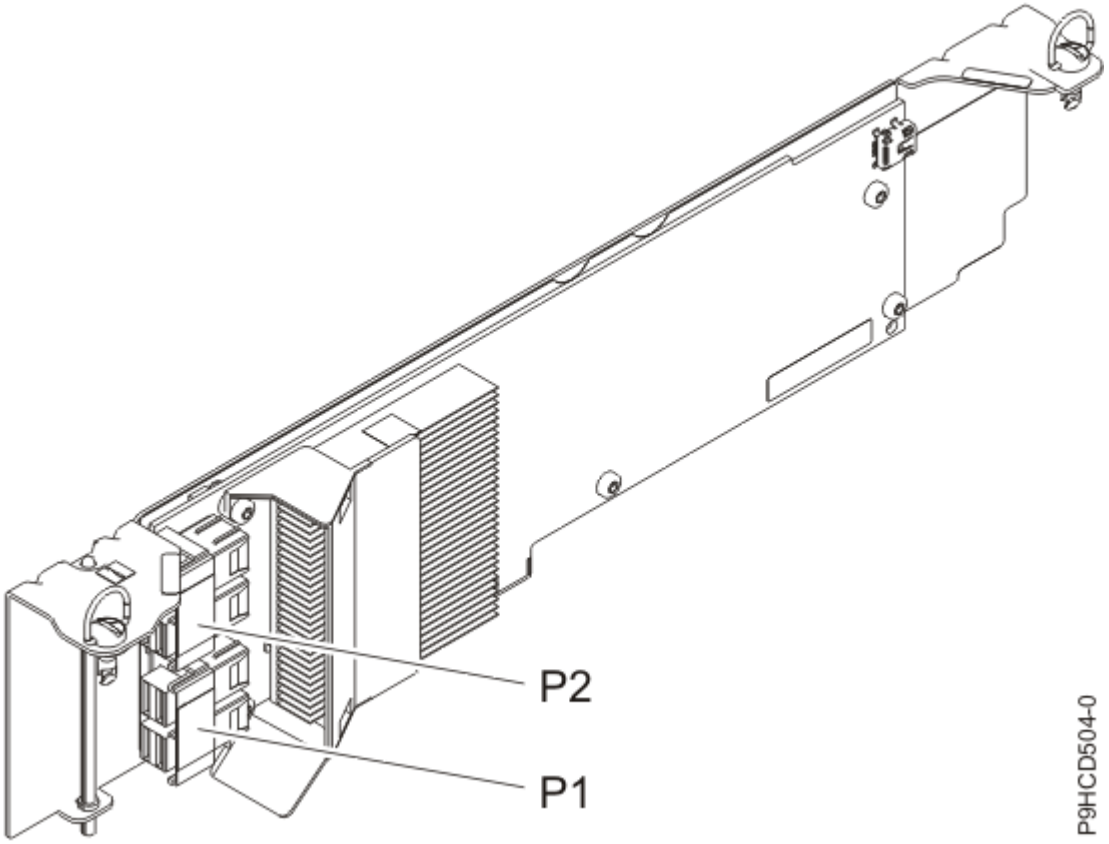


Figure 63. PCIe3 x8 SAS RAID internal adapter 6 Gb

Specifications

Item
Description

Adapter FRU number
01LK399

I/O bus architecture
PCIe3 x8

Slot requirement
Internal PCIe3 slot with x16 connector and x8 bus signaling per adapter

Base function configuration: adapter is preinstalled in slot P1-C49

Split storage backplane configuration: second adapter is installed in slot P1-C50

Cables
Two mini-SAS HD cables (part number 01GY462) that are supplied with the adapter.

Voltage
12 V

Form factor
Preinstalled in slot P1-C49

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe3 x8 cache SAS RAID Internal Adapter 6 Gb (FC EJ1G and FC EL67; CCIN 57DC)

Learn about the specifications and operating system requirements for the PCIe3 x8 cache SAS RAID internal adapter 6 Gb (FC EJ1G and FC EL67) that is integrated with the expanded function Random Array of Independent Disks (RAID) feature composite storage backplane.

Overview

The expanded function PCIe3 x8 cache SAS RAID internal adapter 6 Gb is an internal PCI Express generation 3 (PCIe3), serial-attached SCSI (SAS) RAID adapter. The adapter is part of a composite feature of the storage backplane (FC EJ1G and FC EL67) and contains the SAS RAID controller.

The high-performance internal adapter is preinstalled in the dedicated internal PCIe3 x8 slot P1-C49 and its back power module in P1-C49-E1. The composite storage feature (FC EJ1G and FC EL67) provides the following features:

- A storage backplane (CCIN 2D36) that provides slots for eight 2.5 inches small form-factor (SFF) hard disk drives (HDDs) or solid-state drives (SDDs).
- A PCIe3 cache SAS RAID internal adapter (CCIN 57DC) is installed in the slot P1-C49.
- The backup power module card is installed in slot P1-C49-E1.
- One mini-SAS HD cable that attaches to the high-performance storage backplane.
- A mini-SAS HD cable with an external SAS port that is installed in the system rear bulkhead in the slot P1-C10.

The PCIe3 x8 cache SAS RAID internal adapter 6 Gb is a single stand-alone adapter that has a data read/write speed of 6 Gb/s and a real write cache of 1.8 GB. With a 4:1 cache compression, this high-performance adapter provides an increased cache of 7.2 GB and increases the storage system performance. With this single cache adapter configuration, there is only one copy of the write cache data. The write cache contents are protected against power loss with flash memory and super capacitors that remove the need for cache battery. The super capacitors are part of the backup power module card which is installed in slot P1-C49-E1.

One mini-SAS HD cable connects the PCIe3 x8 cache SAS RAID internal adapter 6 Gb to the SAS port on the internal storage backplane. For more information, see Front SAS cable.The expanded function internal adapter supports both types of SFF drives (HDDs and SSDs). The supported RAID configurations include: RAID 0, 5, 6, 10, 5T2, 6T2, and 10T2 depending on the operating system support. For more information, see .

This internal adapter also provides a mini-SAS HD connector that attaches to a mini-SAS HD cable and provides an external SAS port on the other end. The external SAS port is installed in slot P1-C10. The external SAS port is used to attach a FC ESLS, ESLL, or migrated 5887 drive enclosure by way of a mini-SAS HD YO cable and must not exceed the maximum supported length of 3 meters. Only one external SAS drive enclosure is supported and must be in zone mode 1. For more information, see Rear SAS cable.

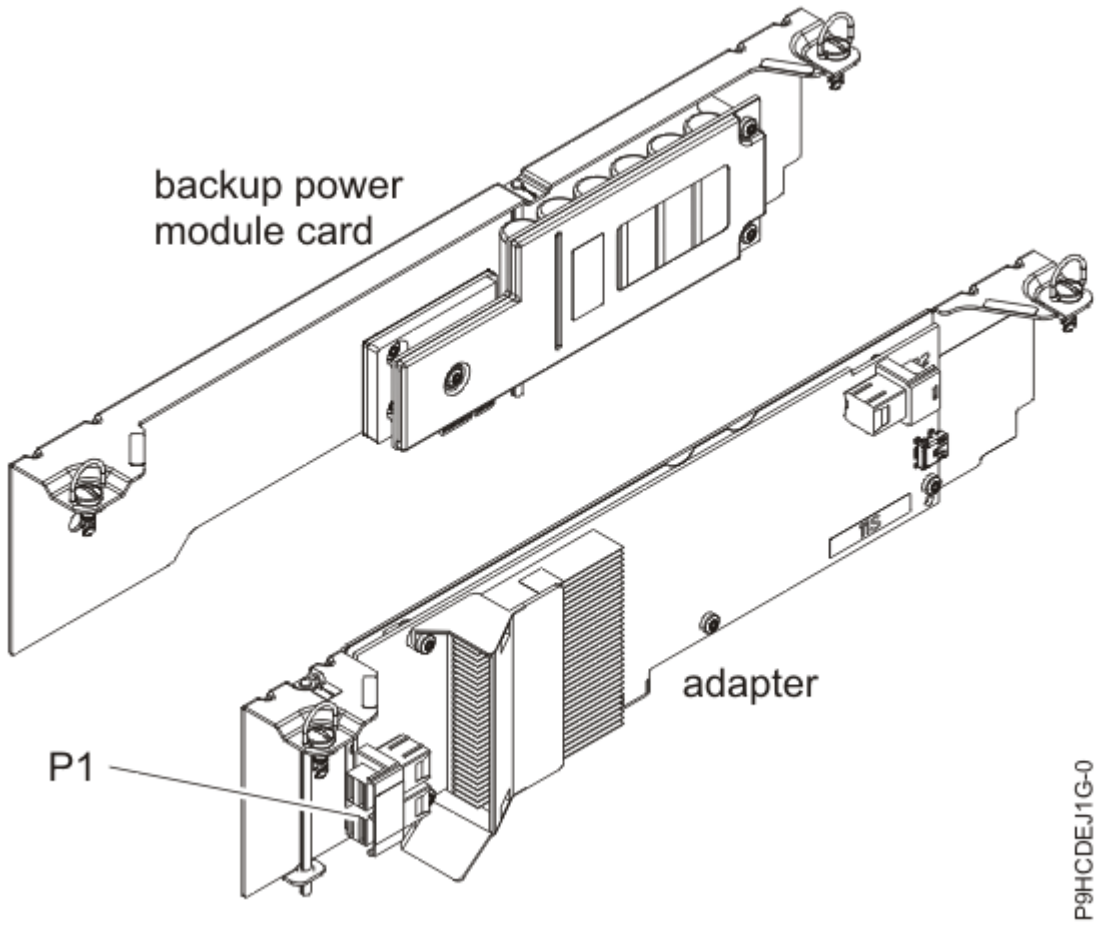


Figure 64. PCIe3 x8 cache SAS RAID internal adapter 6 Gb

Specifications

Item
Description

Adapter CCIN number
57DC

Adapter FRU number
01JC780 (includes the backup power module card)

I/O bus architecture
PCIe3 x8

Slot requirement
Internal PCIe3 slot with x16 connector and x8 bus signaling

Adapter is installed in slot P1-C49

Backup power module is installed in slot P1-49-E1

Voltage
12 V

Cables
One mini-SAS HD Y cable (part number: 01GY461) connects the two storage backplane connectors (J1 and J2) to the P1 connector on the PCIe3 x8 cache SAS RAID internal adapter 6 Gb in slot P1-C49.

One SAS cable (part number: 01ML060) with mini-SAS connectors and an external SAS port is attached to rear P2 connector of the PCIe3 x8 cache SAS RAID internal adapter 6 Gb.

Important requirements for adapter installation

An automatic sector conversion takes place for use with the new adapter when migrating existing SAS disk enclosures and devices from existing previous PCIe SAS adapters to PCIe3 SAS adapters. For more information about the migration procedures, see Upgrading a SAS RAID storage adapter.

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe1 SAS Tape/DVD Dual-port 3 Gb x8 Adapter (FC EJ1N and EJ1P; CCIN 57B3)

Learn about the specifications and operating system requirements for the feature code (FC) EJ1N and EJ1P adapters.

Overview

FC EJ1N and EJ1P are both the same adapter with different tail stock brackets. FC EJ1N is a low-profile adapter and FC EJ1P is a full-height adapter. FC EJ1N and EJ1P are functionally identical to FC 5901 and 5278, but designates to IBM configurator tools that the usages are only supported for tape and DVD, not disk.

The PCIe1 SAS Tape/DVD Dual-port 3 Gb x8 Adapter is a PCI Express (PCIe) generation 1 (Gen1), x8 adapter. The adapter is for high-performance, high-density, and serial attached SCSI (SAS) applications. It supports the attachment of SAS tape and DVD by using a pair of mini-SAS 4x connectors. The mini-SAS 4x connectors allow the adapter's eight physical links to be used in various narrow and wide-port configurations. The adapter can also be used for some external tape drive models, which are not supported on the newer and faster four-port 6 Gb PCIe3 adapters. The adapter does not have write cache.

The PCIe1 SAS Tape/DVD Dual-port 3 Gb x8 Adapter is a 64 bit, 3.3 V, bootable SAS adapter.

Externally attached devices are designed to run at a data rate of 1.5 Gbps for serial ATA (SATA) devices, and 3 Gbps for SAS devices.

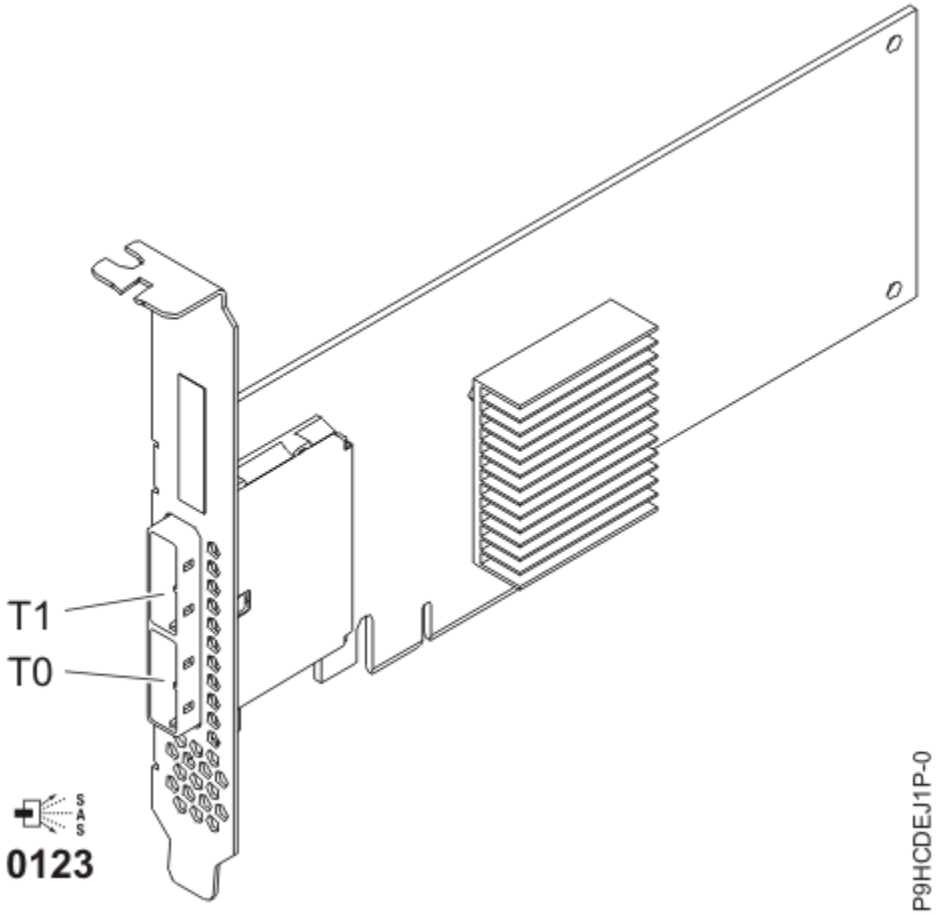


Figure 65. PCIe1 SAS Tape/DVD Dual-port 3 Gb x8 Adapter

Specifications

Item
Description

Adapter FRU number
44V4852

I/O bus architecture
PCIe1 x8

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Cables
SAS device attachment requires specific cables that are provided with the subsystem or device features being attached. See Serial attached SCSI cable planning.

Voltage
3.3 V

Form factor
Short, low-profile (FC EJ1N)

Short, with full-height tailstock (FC EJ1P)

Attributes

- Two external mini-SAS 4x connectors provide attachment of SAS and Serial Advanced Technology Attachment (SATA) device enclosures
- SAS Serial SCSI Protocol (SSP), Serial ATA Tunneling Protocol (STP), and Serial Management Protocol (SMP)
- Removable media device supported
- Concurrent firmware update
- 440-500 Mhz PowerPC® (PPC)

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe3 cable adapter (FC EJ1R; CCIN 58FF)

Learn about the specifications and operating system requirements for the feature code (FC) EJ1R adapter.

Overview

FC EJ1R is a single-wide, low-profile PCIe3 cable adapter. The adapter provides two optical ports for the attachment of two expansion drawer cables. One adapter supports the attachment of one PCIe3 6-slot fanout module in a EMX0 PCIe Gen3 I/O expansion drawer.

Note: The FC EJ1R (CCIN 58FF) adapter only works with the CCIN 50CD PCIe3 6-slot fanout module.

Figure 66 on page 197 shows the adapter.

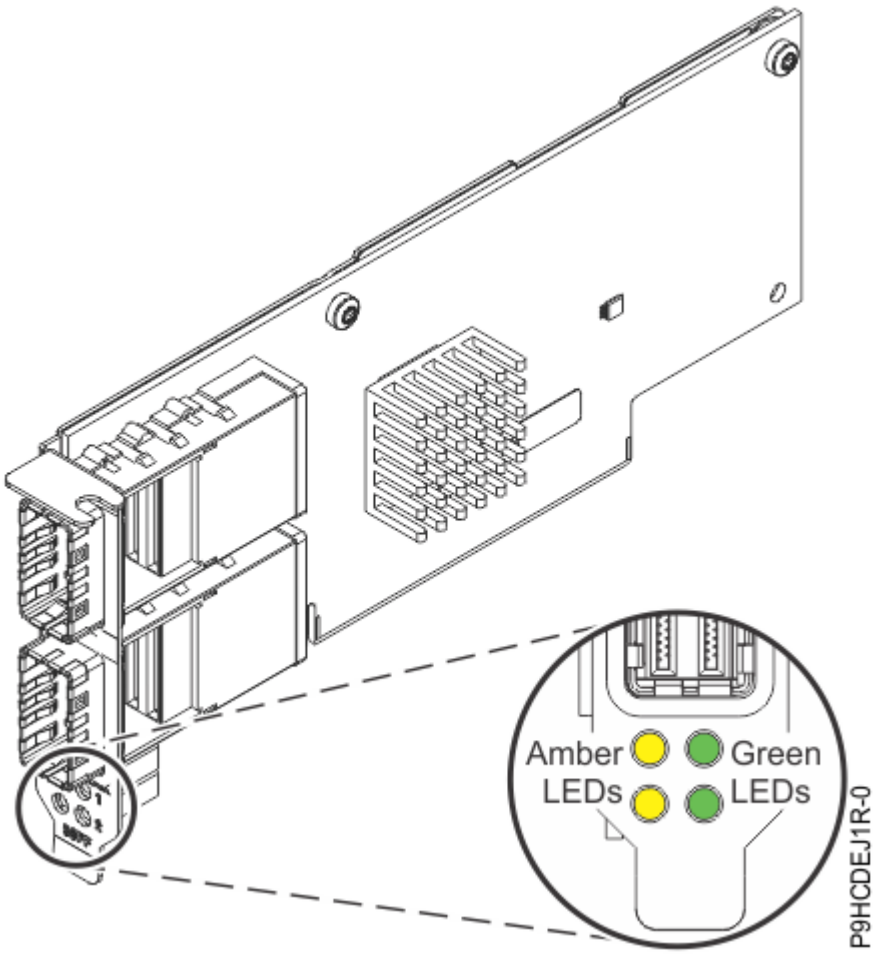


Figure 66. PCIe3 cable adapter

Note: The LEDs that are shown in Figure 66 on page 197 indicate the following states:

- The green LED indicates link status. If the green LED is on, at least one PCIe link is in the trained state.
- The amber LED indicates FRU identify. If the amber LED is on, it will blink at 2 Hz, and indicates that the adapter is in the identify function state.

Specifications

Item
Description

Adapter FRU number
02AE884

I/O bus architecture
PCIe3 x16

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
12 V

Form factor

Half-height, half-length card

PCIe Cryptographic Coprocessor (FC EJ27 and FC EJ28; CCIN 4765)

Learn about the specifications for the PCIe Cryptographic Coprocessor.

The PCIe Cryptographic Coprocessor adapters, feature codes (FC) EJ27 and FC EJ28 provide the secure-key cryptographic accelerator and the Cryptographic Coprocessor functions in a single PCIe card. The coprocessor functions are targeted to banking and finance applications. The financial personal identification number (PIN) processing and Euro pay, Mastercard, Visa (EMV) credit card functions are provided. EMV is a standard for the integrated-chip based credit cards. The secure-key accelerator functions are targeted to improving the performance of Secure Sockets Layer (SSL) transactions. The FC EJ27 and FC EJ28 provide the security and performance required to support emerging digital signature applications. The host application access to the cryptographic services of the FC EJ27 and FC EJ28 are by the Common Cryptographic Architecture (CCA) application programming interfaces (APIs) and by the Public-Key Cryptographic Standards (PKCS11). The FC EJ27 and FC EJ28 provide secure storage of cryptographic keys in a tamper-resistant hardware security module, which is designed to meet FIPS PUB 140-2 on security requirements.

The FC EJ27 and FC EJ28 are the same adapter but the different FCs indicate if a blind-swap cassette is used and the type of the cassette.

- FC EJ27 is not a blind-swap cassette
- FC EJ28 is a generation-3 blind-swap cassette

IBM PCIe Cryptographic adapter highlights:

- PCIe 4x standard height - half length
- Integrated Dual PPC processors
- ASIC (Accelerator engines)
- Supports the Common Cryptographic Architecture (CCA) application programming interfaces (APIs) and the Public-Key Cryptographic Standards (PKCS11) on the single firmware load.
- 3072, 4096 bit RSA CRT HW (including routing)
- SHA 256 required HW or firmware within secure module (including routing)
- Secure Key AES 128, 192, 256 bit keys
- Fast path – symmetric and asymmetric (secure and clear key)

For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

Specifications and requirements

FRU number:
45D7948

Placement information
To view information about the PCI adapter placement rules, see the PCI adapter placement topic collection for your system.

I/O bus architecture
PCI Express v1.1a

Storage

Shipping and storage temperature below -35°C ± 60°C (-31°F ± 140°F) or above 1°C ± 60°C (33.8°F ± 140°F) limits.

Operation (ambient in system)

This component collects and controls all the sensors to prevent the physical penetration and any abnormal environmental condition within its wide operational range of 10°C ± 35°C (50°F ± 95°F).

Tamper protection range
Outside of the tamper protection range limits of -38°C ±3°C (-41.8°F to -31°F) to +90°C ± 2°C (190.4°F to 197.6°F), the card will be permanently disable.

Handling requirements
Each PCIe Cryptographic Coprocessor includes a certified device key. This electronic key, which is stored in the adapter's battery-powered and protected memory, digitally signs status messages to confirm that the PCI Cryptographic Coprocessor is genuine and that no tampering has occurred.

If any of the secure module's tamper sensors are triggered by tampering or by accident, the PCIe Cryptographic Coprocessor erases all data in the protected memory, including the certified device key. Incorrect removal of the batteries triggers the tamper sensors and destroys the certified device keys. The PCI Cryptographic Coprocessor cannot operate without the certified device keys. To protect the keys, follow the guidelines given in the documentation provided with the coprocessor.

Attention: The batteries keep the coprocessor powered on even when it is not installed in a system. When handling, installing, or removing the adapter, do not let the adapter circuits come in contact with any conductive surface or tools. Doing so can render the adapter permanently inoperable.

Do not remove the batteries of the adapter. Data in the protected memory is lost when battery power is removed. For information about replacing the batteries, see the Installation Manual at the IBM Cryptocard website at http://www-03.ibm.com/security/cryptocards/.

Attention: While installing the coprocessor, observe the following precautions:

- The coprocessor is always powered by the batteries, even when it is not installed in the system.
- The battery power is necessary to keep the coprocessor operational.
- The loss of battery power or a voltage drop triggers a tamper event and permanently renders the coprocessor inoperable.
- Any short on the battery power distribution circuits causes a voltage drop and a tamper event.
- Do not lay the coprocessor on or cause the coprocessor to come in contact with any conductive surface.
- Do not strike the coprocessor circuits with metal or conductive tools.
- Use static-protective measures at all times when handling the coprocessor.

4767-002 Cryptographic Coprocessor (FC EJ32 and EJ33 for BSC; CCIN 4767)

Learn about the specifications and operating system requirements for the feature code (FC) EJ32 and EJ33.

Overview

The 4767-002 Cryptographic Coprocessor is a PCI Express (PCIe) generation 3 (Gen3) x4 adapter. The secure-key adapter provides both cryptographic coprocessor and cryptographic accelerator functions in a single PCIe card. The 4767-002 Cryptographic Coprocessor is suited to applications that require high-speed, security-sensitive, RSA acceleration, cryptographic operations for data encryption and digital signing. Additionally, the adapter is useful in secure management, use of cryptographic keys, or custom cryptographic applications. It provides secure storage of cryptographic keys in a tamper-resistant hardware security module that is designed to meet FIPS 140-2 level 4 security requirements. The adapter runs in dedicated mode only.

FC EJ32 and EJ33 are identical cards and have the same CCIN of 4767. The different feature codes indicate whether a blind swap cassette is used and the type of cassette. FC EJ32 is not a blind-swap cassette, while FC EJ33 indicates a generation 3 blind-swap cassette.

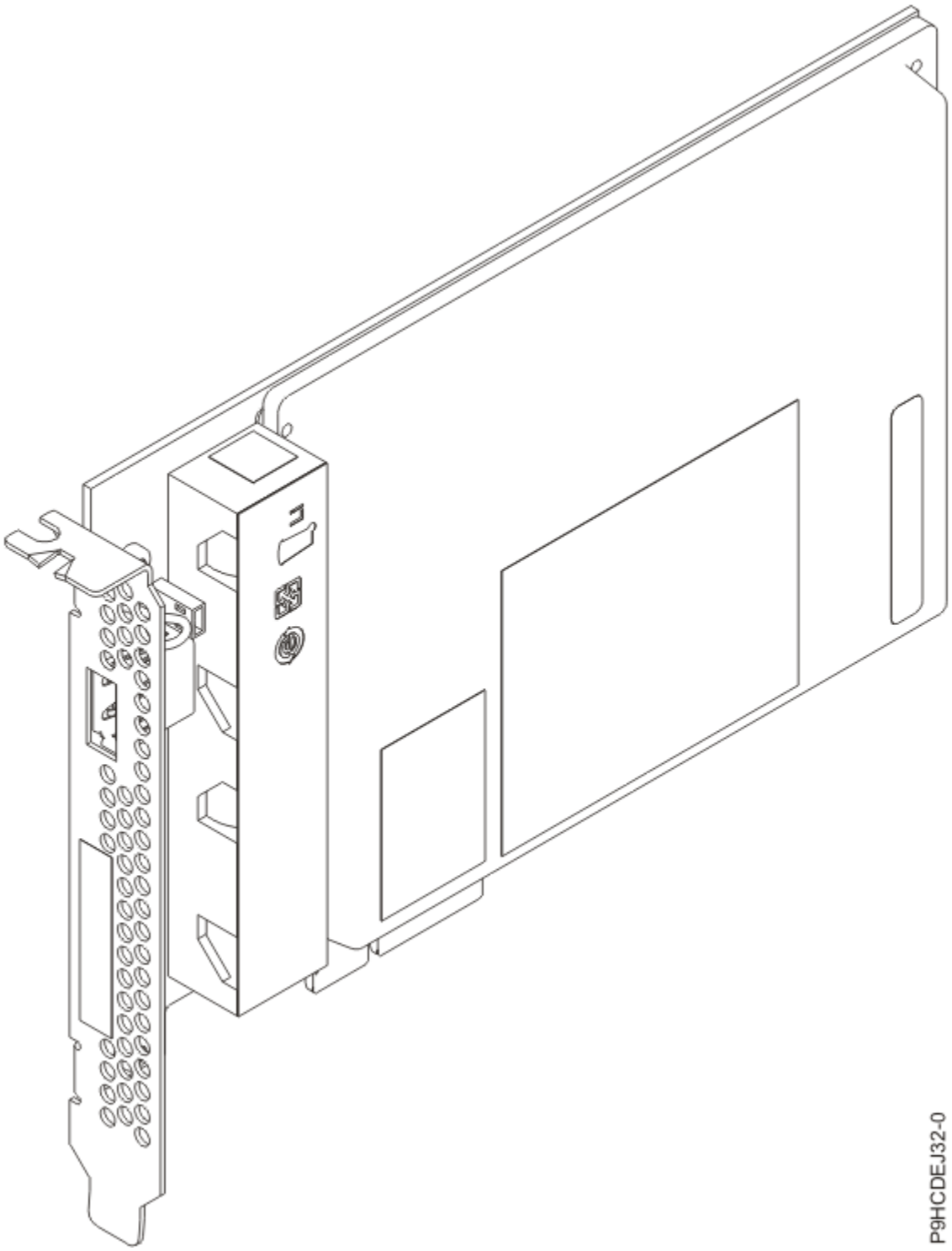


Figure 67. 4767-002 Cryptographic Coprocessor

Specifications

Item
Description

Adapter FRU number
Not applicable

I/O bus architecture
PCIe1 x4

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
3.3 V

Form factor
Half-length, with full-height tail stock

Dual card (Mother-daughter)

Attributes provided
Supported cryptographic mode: Common Cryptographic Architecture (CCA)

PPC 476 Processors run in lockstep and the outputs of each core are compared cycle by cycle

Error Checking and Correction (ECC) protection on DDR3 memory

Cryptographic key generation and random number generation

Over 300 cryptographic algorithms and modes

Byte wide parity protection on all internal registers and data paths wider than two bits

RSA/ECC engines are protected by a duplicate engine which predicts the CRC of the result

SHA, MD5, AES and DES engines are protected by running the same operation on two independent engines and the outputs are compared cycle by cycle.

Performance

Table 30. 4767-002 Cryptographic Coprocessor Operation

Operation	**Operations per second**
AES-CBC 128 bit (1KB)	> 7K
PK-CRT 1024	> 5K
PK-CRT 2048	> 3.5K
Key Gen RSA CRT 1024 bit	> 30
Key Gen RSA CRT 2048 bit	> 7
Key Gen RSA CRT 4096 bit	> 0.6
Key Gen ECC-BP 192	> 750

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).

- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

Linux driver and firmware information

The 4767-002 Cryptographic Coprocessor's Linux drivers and firmware are not provided by the Linux distribution. To install and or update the Linux drivers and firmware, the user must download the Power Systems Linux drivers and firmware package. Refer to the IBM Power Systems information on the 4767-002 Cryptographic Coprocessor and follow the Linux drivers and firmware instructions at: Power Systems Information for the 4767-002 Cryptographic Coprocessor (https://www-03.ibm.com/security/cryptocards/pciecc2/overview.shtml).

4769-001 Cryptographic Coprocessor (FC EJ35 and EJ37 for BSC; CCIN C0AF)

Learn about the specifications and operating system requirements for the feature code (FC) EJ35 and EJ37.

Overview

The 4769-001 Cryptographic Coprocessor is a PCI Express (PCIe) generation 3 (Gen3) x4 adapter. The secure-key adapter provides both cryptographic coprocessor and cryptographic accelerator functions in a single PCIe card. The 4769-001 Cryptographic Coprocessor is suited to applications that require high-speed, security-sensitive, RSA acceleration, cryptographic operations for data encryption and digital signing. Additionally, the adapter is useful in secure management, use of cryptographic keys, or custom cryptographic applications. It provides secure storage of cryptographic keys in a tamper-resistant hardware security module that is designed to meet FIPS 140-2 level 4 security requirements. The adapter runs in dedicated mode only.

FC EJ35 and EJ37 are identical cards and have the same CCIN of C0AF. The different feature codes indicate whether a blind swap cassette is used and the type of cassette. FC EJ35 is not a blind-swap cassette, while FC EJ37 indicates a generation 3 blind-swap cassette.

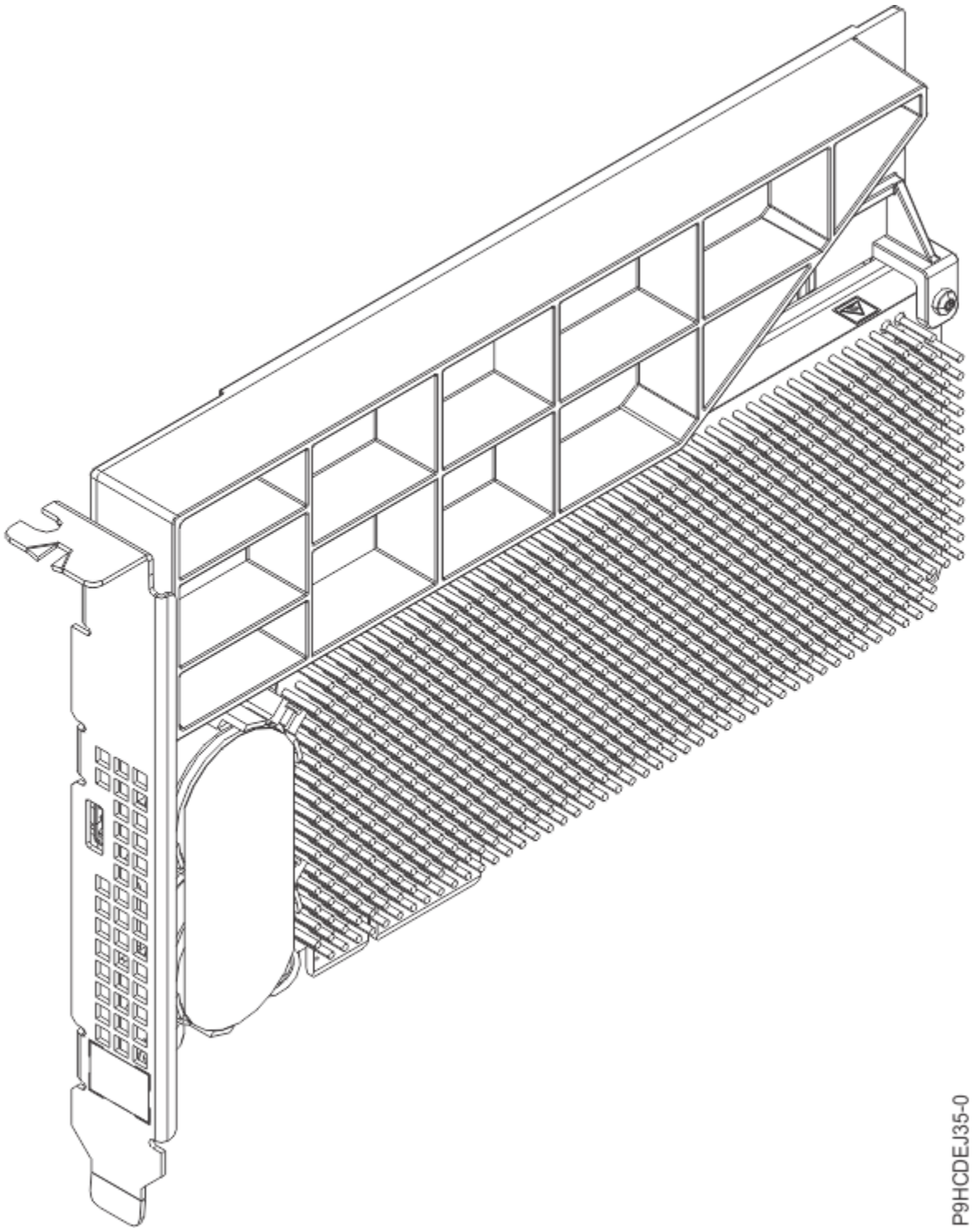


Figure 68. 4769-001 Cryptographic Coprocessor

Specifications

Item
Description

Adapter FRU number
02JD572

I/O bus architecture
PCIe3 x4

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
3.3 V

Form factor
Half-length, with full-height tail stock

Attributes provided
Supported cryptographic mode: Common Cryptographic Architecture (CCA)

PowerPC processors run in lockstep and the outputs of each core are compared cycle by cycle

Error Checking and Correction (ECC) protection on DDR4 memory

Cryptographic key generation and random number generation

Over 300 cryptographic algorithms and modes

Byte wide parity protection on all internal registers and data paths wider than two bits

RSA/ECC engines are protected by a duplicate engine which predicts the CRC of the result

SHA, MD5, AES and DES engines are protected by running the same operation on two independent engines and the outputs are compared cycle by cycle.

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe3 16 Gb 2-port Fibre Channel adapter (FC EL43, FC EL5B, FC EN0A, and FC EN0B; CCIN 577F)

Learn about the specifications and operating system requirements for the feature code (FC) EL43, EL5B, FC EN0A, and FC EN0B adapter.

Overview

The PCIe3 16 Gb 2-port Fibre Channel adapter is an x8, generation 3 (gen3), PCIe adapter. This adapter is a high-performance x8 short form adapter also referred to as a PCIe Host Bus Adapter (HBA). The adapter provides two ports of 16 Gb Fibre Channel capability using SR optics. Each port can provide up to 16 Gb Fibre Channel functions simultaneously.

The FC EL43 and FC EN0B adapters are short, low-profile adapters and the FC EL5B and FC EN0A are short, regular height adapters.

Each port provides single initiator capability over a fibre link or with NPIV, multiple initiator capability is provided. The ports are SFP+ and include an optical SR transceiver. The ports have little connector-type (LC) and utilize shortwave laser optics. The adapter operates at link speeds of 4, 8 and 16 Gbps and will automatically negotiate to the highest speed possible. LEDs on each port provide information on the status and link speed of the port.

The adapter connects to a Fibre Channel switch at 4 Gb, 8 Gb or 16 Gb. It can directly attach to a device without a switch at 16 Gb. Attachment without a switch is not supported at 4 Gb or 8 Gb.

N_Port ID Virtualization (NPIV) capability is supported through VIOS.

The adapter has the following features:

- The adapter is compliant with the PCIe base and Card Electromechanical (CEM) 2.0 specifications with the following characteristics:
  - Provides an x8 lane link interface at 14.025 Gbps, 8.5 Gbps, or 4.25 Gbps (automatic negotiation with system)
  - Provides support for one Virtual Channel (VC0) and one Traffic Class (TC0)
  - Provides configuration and I/O memory read and write, completion, and messaging capabilities
  - Provides support for 64-bit addressing
  - Provides error correction code (ECC) and error protection functions
  - Provides link cyclic redundancy check (CRC) on all PCIe packets and message information
  - Provides a large payload size of 2048 bytes for read and write functions
  - Provides a large read request size of 4096 bytes
- The adapter is compatible with 4, 8, and 16 Gb Fibre Channel interface with the following characteristics:
  - Provides for automatic negotiation between 4 Gb, 8 Gb, or 16 Gb link attachments
  - Provides support for the following Fibre Channel topologies: point-to-point (16Gb only) and fabric
  - Provides support for Fibre Channel class 3
  - Provides a maximum Fibre Channel throughput that is achieved by using full duplex hardware support
- The adapter provides an end-to-end data path parity and CRC protection, including internal data path random-access memory (RAM)
- Provides architectural support for multiple upper layer protocols
- Provides comprehensive virtualization capabilities with support for N_Port ID Virtualization (NPIV) and virtual fabric (VF)
- Provides support for message signaled interrupts extended (MSI-X)
- Provides support for 255 VFs and 1024 MSi-X
- Provides an internal, high-speed static random-access memory (SRAM) memory
- Provides ECC protection of local memory that includes single-bit correction and double-bit protection
- Provides an embedded shortwave optical connection with diagnostics capability
- Provides support for an on-board context management by firmware:
  - Up to 8192 FC port logins
  - I/O multiplexing down to the Fibre Channel frame level
- Provides data buffers capable of supporting 64+ buffer-to-buffer (BB) credits per port for shortwave applications
- Provides link management and recovery that is handled by firmware
- Provides on-board diagnostic capability accessible by an optional connection
- Provides a performance up to 16 Gbps full duplex

The following figures show the adapter.

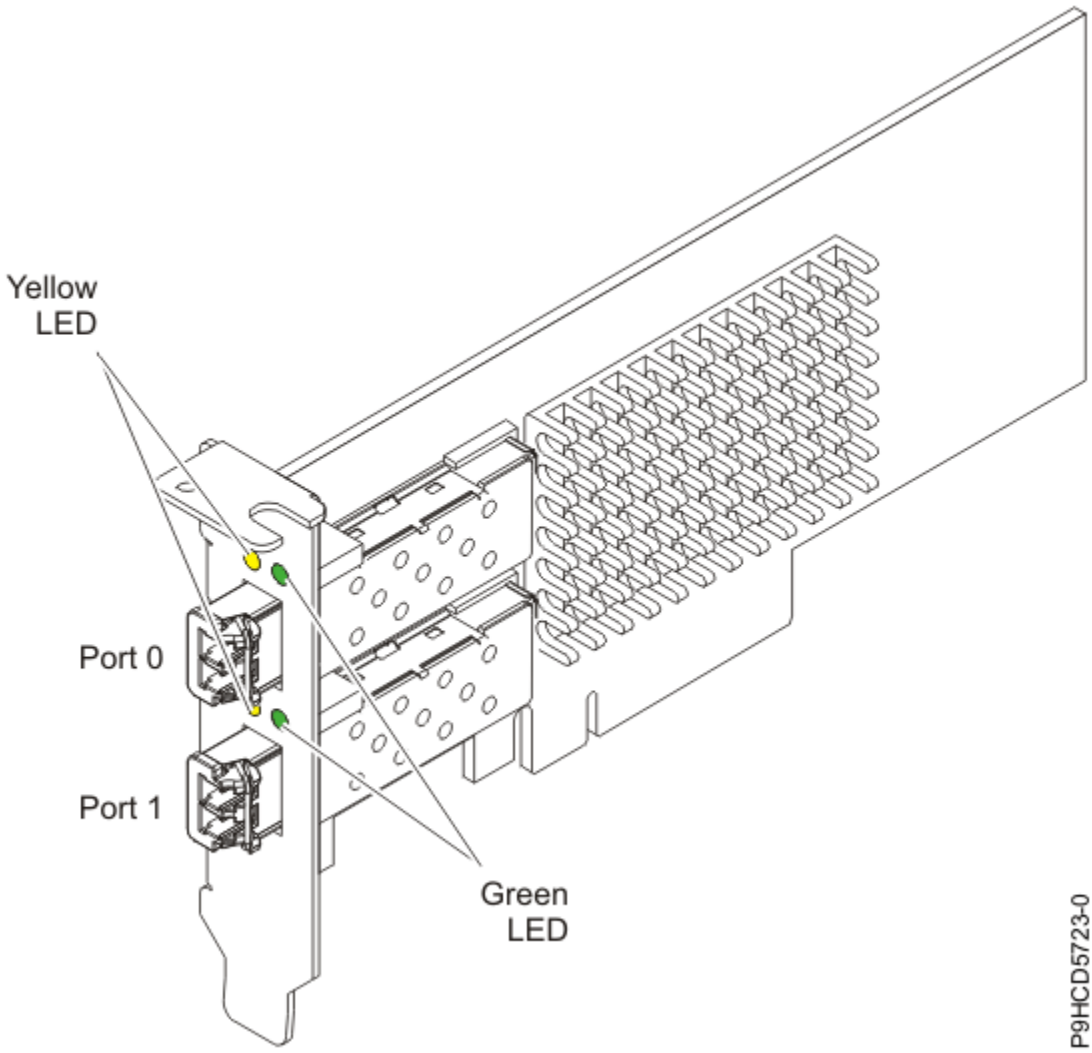


Figure 69. PCIe3 16 Gb 2-port Fibre Channel adapter (FC EL43 and EN0B)

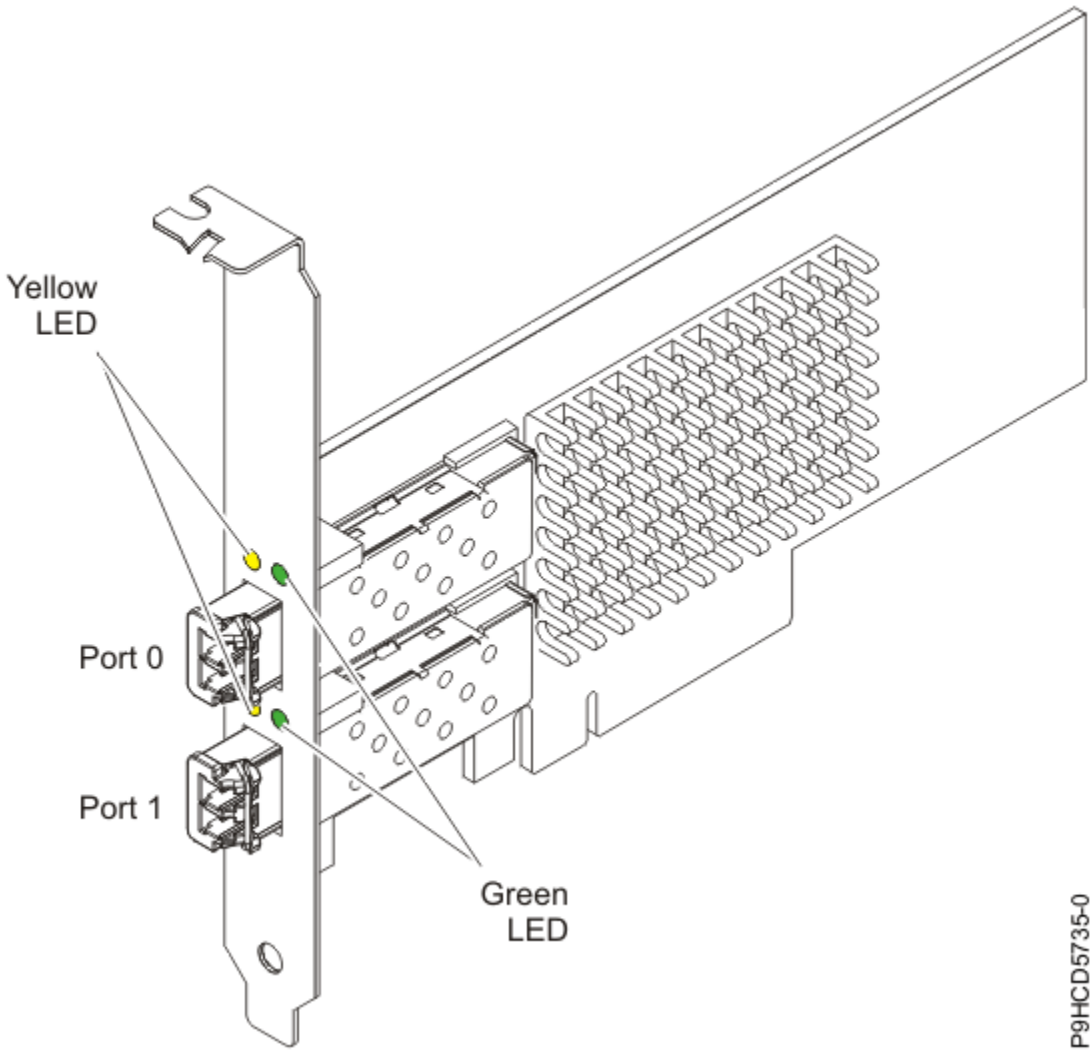


Figure 70. PCIe3 16 Gb 2-port Fibre Channel adapter (FC EL5B and EN0A)

Specifications

Item
Description

Adapter FRU number
00E3496

Wrap plug FRU number
12R9314

Note: The wrap plug is included with the card, and can also be purchased from IBM.

I/O bus architecture
PCIe base and CEM 3.0, x8 PCIe bus interface

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
3.3 V, 12 V

Form factor
Short, MD2

FC compatibility
4, 8, 16 Gb

Cables
Cables are the responsibility of the customer. Use multimode fiber optic cables with shortwave lasers that adhere to the following specifications:

- OM4: Multimode 50/125 micron fiber, 4700 MHz x km bandwidth
- OM3: Multimode 50/125 micron fiber, 2000 MHz x km bandwidth
- OM2: Multimode 50/125 micron fiber, 500 MHz x km bandwidth
- OM1: Multimode 62.5/125 micron fiber, 200 MHz x km bandwidth

Because core sizes are different, OM1 cables can only be connected to other OM1 cables. For best results, OM2 cables must not be connected to OM3 cables. However, if an OM2 cable is connected to an OM3 cable, the characteristics of the OM2 cable apply to the entire length of the cables.

The following table shows the supported distances for the different cable types at the different link speeds.

Table 31. Supported distances for cables

Header	**Cable type and distance**			
Rate	OM1	OM2	OM3	OM4
4 Gbps	0.5 - 70 m (1.64 - 229.65 ft)	0.5 - 150 m (1.64 - 492.12 ft)	0.5 - 380 m (1.64 - 1246.71 ft)	0.5 - 400 m (1.64 - 1312.34 ft)
8 Gbps	0.5 - 21 m (1.64 - 68.89 ft)	0.5 - 50 m (1.64 - 164.04 ft)	0.5 - 150 m (1.64 - 492.12 ft)	0.5 - 190 m (1.64 - 623.36 ft)
16 Gbps	0.5 - 15 m (1.64 - 49.21 ft)	0.5 - 35 m (1.64 - 114.82 ft)	0.5 - 100 m (1.64 - 328.08 ft)	0.5 - 125 m (1.64 - 410.10 ft)

Adapter LED states

Green and yellow LEDs can be seen through openings in the mounting bracket of the adapter. Green indicates firmware operation, and yellow signifies port activity. Table 32 on page 209 summarizes normal LED states. A 1 Hz pause occurs when the LED is off between each group of fast flashes (2, 3 or 4). Observe the LED sequence for several seconds to ensure that you correctly identify the state.

Table 32. Normal LED states

Green LED	**Yellow LED**	**State**
On	2 fast flashes	4 Gbps link rate: normal, link active
On	3 fast flashes	8 Gbps link rate: normal, link active
On	4 fast flashes	16 Gbps link rate: normal, link active

Power-on-self-test (POST) conditions and results are summarized in Table 33 on page 209. These states can be used to identify abnormal states or problems.

Table 33. POST conditions and results

Green LED	**Yellow LED**	**State**
Off	Off	Wake-up failure of the adapter board

Table 33. POST conditions and results (continued)		
Green LED	**Yellow LED**	**State**
Off	On	POST failure of the adapter board
Off	Slow flash	Wake-up failure monitor
Off	Fast flash	Failure in post
Off	Flashing	Postprocessing in progress
On	Off	Failure while functioning
On	On	Failure while functioning
Slow flash	Off	Normal, link down
Slow flash	On	Not defined
Slow flash	Slow flash	Offline for download
Slow flash	Fast flash	Restricted offline mode, waiting for restart
Slow flash	Flashing	Restricted offline mode, test active
Fast flash	Off	Debug monitor in restricted mode
Fast flash	On	Not defined
Fast flash	Slow flash	Debug monitor in test fixture mode
Fast flash	Fast flash	Debug monitor in remote debug mode
Fast flash	Flashing	Not defined

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe2 8 Gb 2-port Fibre Channel adapter (FC EL5Y, FC EL5Z, FC EN0F, and FC EN0G; CCIN 578D)

Learn about the specifications and operating system requirements for feature codes (FC) EL5Y, FC EL5Z, FC EN0F, and FC EN0G adapters.

Overview

FC EL5Y and FC EN0F is a low-profile adapter and FC EL5Z and FC EN0G is a full-height adapter.

The PCIe2 8 Gb 2-port Fibre Channel adapter is a PCI Express (PCIe) generation 2 (Gen2), high-performance, x8 short form factor pluggable plus (SFP+) Host Bus. This adapter enables multiple logical (virtual) connections to share the same physical port. Each logical connection has its own resources and the ability to be managed independently. Each port provides single initiator capability over a fiber link or provides multiple initiator capability with N_Port ID Virtualization (NPIV). The ports are connected by using LC type connectors. These connectors use shortwave laser optics. The adapter operates at link speeds of 2, 4, and 8 gigabits per second (Gbps) and automatically negotiates to the highest speed possible. LEDs on each port provide information about the connection status and link speed of the port. The adapter connects to a Fibre Channel switch.

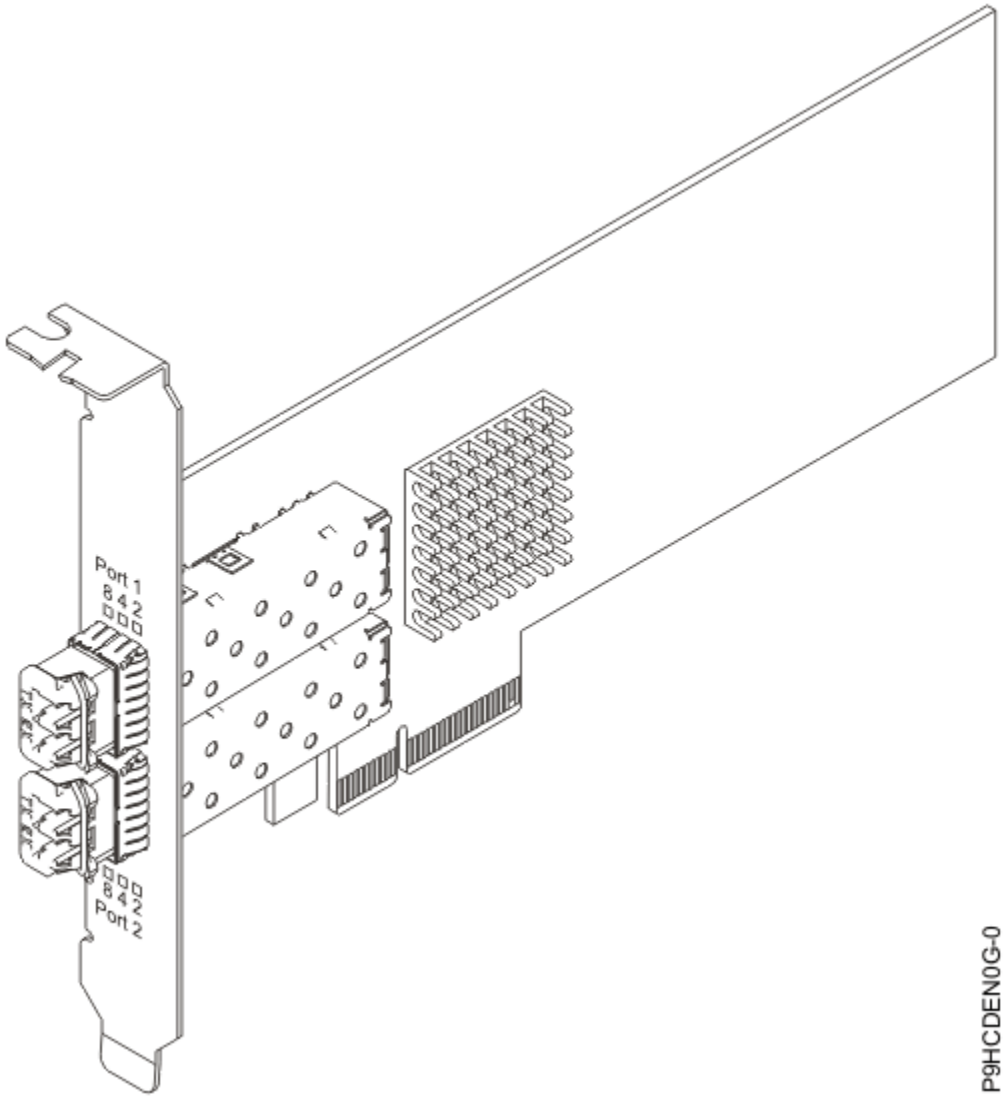


Figure 71. PCIe2 8 Gb 2-port Fibre Channel adapter (FC EL5Z and FC EN0G)

Specifications

Item
Description

Adapter FRU number
00WT111

I/O bus architecture
PCIe2.0 x8

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

FC compatibility
2, 4, 8 Gigabit

Cables
Cables are the responsibility of the customer.

Use multimode fiber optic cables with shortwave lasers that adhere to the following specifications:

- OM3: Multimode 50/125 micron fiber, 2000 MHz x km bandwidth
- OM2: Multimode 50/125 micron fiber, 500 MHz x km bandwidth
- OM1: Multimode 62.5/125 micron fiber, 200 MHz x km bandwidth

Because core sizes are different, OM1 cables can only be connected to other OM1 cables. For best results, OM2 cables should not be connected to OM3 cables. However, if an OM2 cable is connected to an OM3 cable, the characteristics of the OM2 cable apply to the entire length of the cables. The following table shows the supported distances for the different fiber optic cable types at different link speeds.

Table 34. Supported distances for multimode fiber optic cables

Header	**Cable Type and Distance**		
Rate	OM1	OM2	OM3
2.125 Gbps	0.5 meters to 150 meters (1.64 feet to 492.12 feet)	0.5 meters to 300 meters (1.64 feet to 984.25 feet)	0.5 meters to 500 meters (1.64 feet to 1640.41 feet)
4.25 Gbps	0.5 meters to 70 meters (1.64 feet to 229.65 feet)	0.5 meters to 150 meters (1.64 feet to 492.12 feet)	0.5 meters to 380 meters (1.64 feet to 1246.71 feet)
8.5 Gbps	0.5 meters to 21 meters (1.64 feet to 68.89 feet)	0.5 meters to 50 meters (1.64 feet to 164.04 feet)	0.5 meters to 150 meters (1.64 feet to 492.12 feet)

Voltage
12 V

Form factor
Short, low-profile (FC EL5Y and FC EN0F)

Short, with full-height tailstock (FC EL5Z and FC EN0G)

Maximum number
For details about the maximum number of adapters that are supported, see Adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Attributes provided
NPIV capability is supported through VIOS

Requires a PCI Express Gen2 x8 slot for all ports to operate at full speed

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

Adapter LED

Table 35. LED States

Hardware State	Yellow LED (8 Gbps)	Green LED (4 Gbps)	Amber LED (2 Gbps)	Comments
Power Off	Off	Off	Off	
Power On (before firmware initialization)	On	On	On	
Power On (after firmware initialization)	Flash	Flash	Flash	All flash at the same time.
Firmware Fault	Flash in sequence	Flash in sequence	Flash in sequence	Flashing in sequence of yellow LED, green LED, amber LED, then back to yellow LED.
2 Gbps Link UP/ACT	Off	Off	On/Flash	On for link up and flash if I/O activity.
4 Gbps Link UP/ACT	Off	On/Flash	Off	On for link up and flash if I/O activity.
8 Gbps Link UP/ACT	On/Flash	Off	Off	On for link up and flash if I/O activity.
Beacon	Flash	Off	Flash	All flashing at the same time.

PCIe3 4-port (2x10 Gb FCoE, 2x1 GbE) SFP+ adapter (FC EL38, FC EL56, FC EN0H, and FC EN0J; CCIN 2B93)

Learn about the specifications and operating system requirements for the feature code (FC) EL38, FC EL56, FC EN0H, and FC EN0J adapters.

Overview

The FC EL38 and FC EN0J are low-profile adapters. The FC EL56 and FC EN0H are full-height adapters that are low-profile capable.

The PCIe3 4-port (2x10 Gb FCoE, 2x1 GbE) SFP+ adapter is a PCI Express (PCIe) generation 3 adapter. The adapter has four-ports and is a Fibre Channel over Ethernet (FCoE) converged network adapter (CNA). This adapter provides a PCIe 3.0 host bus interface. The adapter is a high-performance adapter that consolidates traffic for networking and Fibre Channel storage. The adapter is optimized for cloud computing, virtualization, storage, and other data center applications. Both FCoE and network interface controller (NIC) functions are available for both FCoE ports. Use of the FCoE requires that you use convergence enhanced Ethernet (CEE) switches. The link aggregation and failover features of the adapter make it suitable for critical network applications that require redundancy and high availability.

Important: There is no FCoE support on POWER9 systems.

The four-port adapter provides two 10 Gb FCoE small form-factor pluggable (SFP+) SR optical ports and two 1 Gb RJ45 Ethernet ports. The two 10 Gb FCoE ports are connected by little connector-type (LC) connectors. Each FCoE port provides Ethernet connectivity with a nominal data rate of 10 Gbps (gigabits per second). Each of the 1 Gb ports provides Ethernet connectivity at a data rate of 1 Gbps and is connected with Ethernet cables. A 10 Mb data rate is not supported. Figure 72 on page 215 shows the FC EN0H adapter.

Restriction: The 1 Gb Ethernet ports do not support data rates of 10 Mbps (megabits per second).

The adapter provides the following features:

- The adapter is a PCIe3 FCoE or NIC network convergence adapter.
- The 10 Gb SFP+ ports can function in the NIC or FCoE mode.
- The adapter supports the Single Root IO Virtualization (SRIOV) function.
- The adapter can function as a Boot adapter.

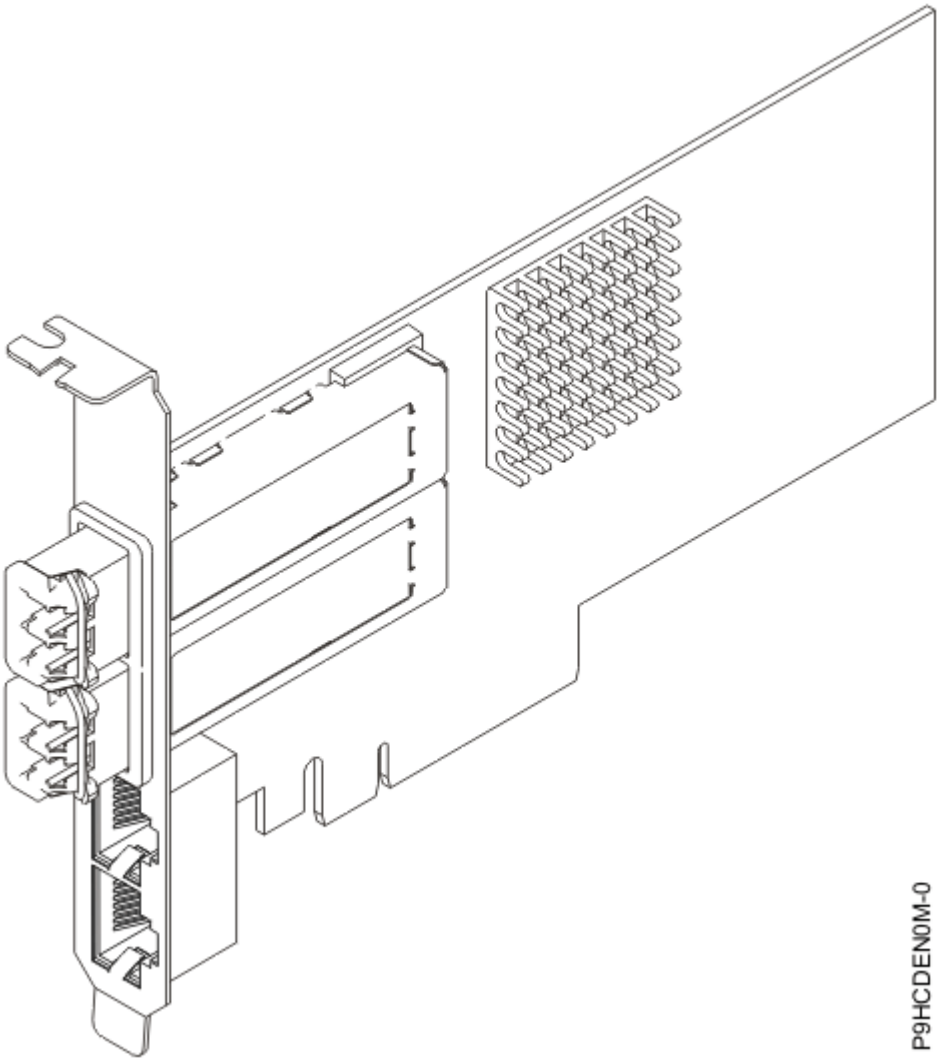


Figure 72. PCIe3 4-port (2x10 Gb FCoE, 2x1 GbE) SFP+ full-hight adapter (FC EL56 and FC EN0H)

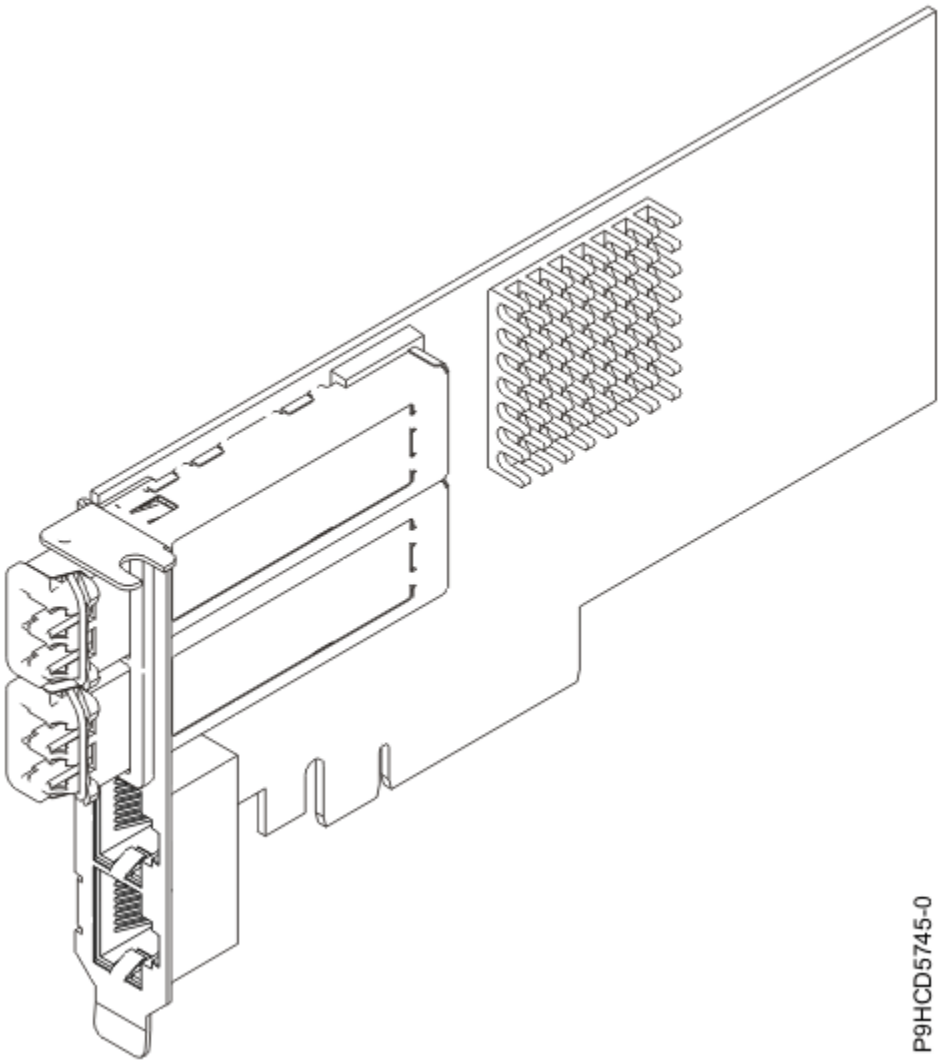


Figure 73. PCIe3 LP 4-port (2x10 Gb FCoE, 2x1 GbE) SFP+ low-profile adapter (FC EL38 and FC EN0J)

Specifications

Item
Description

Adapter FRU number
00E3498

Wrap plug FRU number
12R9314 (for Fibre LC connector).

10N7405 (for RJ45 connector).

Note: These wrap plugs are not included with the card. 12R9314 (FC ECW0) is the only wrap plug that can be purchased from IBM.

I/O bus architecture
PCIe3 x8.

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
3.3 V, 12 V.

Form factor
Short, regular sized bracket. EL38 and EN0J are low-profile, EL56 and EN0H are full-height, low-profile capable.

Cables
SR SFP+ optical fiber cables and Cat5 Ethernet cables.

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe3 4-port (10 Gb FCoE and 1 GbE) Copper and RJ45 Adapter (FC EL3C, FC EL57, FC EN0K, and FC EN0L; CCIN 2CC1)

Learn about the specifications and operating system requirements for the feature code (FC) EL3C, EL57, EN0K, or EN0L adapters.

Overview

The FC EL3C and FC EN0L are low-profile adapters. The FC EL57 and FC EN0K are regular-height adapters that are low-profile capable.

The PCIe3 4-port (10 Gb FCoE and 1 GbE) Copper and RJ45 Adapter is a PCI Express (PCIe) generation 3 adapter. The adapter has four-ports and is a Fibre Channel over Ethernet (FCoE) converged network adapter (CNA). This adapter provides a PCIe 3.0 host bus interface. The adapter is a high-performance adapter that consolidates traffic for networking and Fibre Channel storage. The adapter is optimized for cloud computing, virtualization, storage, and other data center applications. The 10 Gb ports have the CNA (both the NIC and the FCoE) functionality. The 1 Gb ports have the Ethernet capability. Use of the FCoE requires that you use convergence enhanced Ethernet (CEE) switches. The link aggregation and failover features of the adapter make it suitable for critical network applications that require redundancy and high availability.

Important: There is no FCoE support on POWER9 systems.

The four-port adapter provides two 10 Gb FCoE Copper Twin-axial ports and two 1 Gb RJ45 Ethernet ports. The 10 Gb ports are SFP+ ports and do not include a transceiver for the regular-height adapters. The two 10 Gb FCoE ports are connected by little connector-type (LC) connectors for the low-profile adapters. Each FCoE port provides Ethernet connectivity with a nominal data rate of 10 Gbps (gigabits per second). Each of the 1 Gb ports provides Ethernet connectivity at a data rate of 1 Gbps and is connected with Ethernet cables. A 10 Mb data rate is not supported. Figure 74 on page 218 shows the FC EL57 and EN0K adapter. Figure 75 on page 219 shows the FC EL3C and FC EN0L adapter.

Restriction: The 1 Gb Ethernet ports do not support data rates of 10 Mbps (megabits per second).

The regular-height adapter is Single Root I/O Virtualization (SR-IOV) capable. The adapter can function as a boot adapter. The adapter supports all Fibre Channel and Ethernet topologies.

The low-profile adapter provides the following features:

- The adapter supports all Fibre Channel and Ethernet topologies.
- The 10 Gb SFP+ ports can function in the NIC or FCoE mode.
- The adapter supports the SR-IOV (Single Root I/O Virtualization) NIC capability.
- The adapter can function as a Boot adapter.

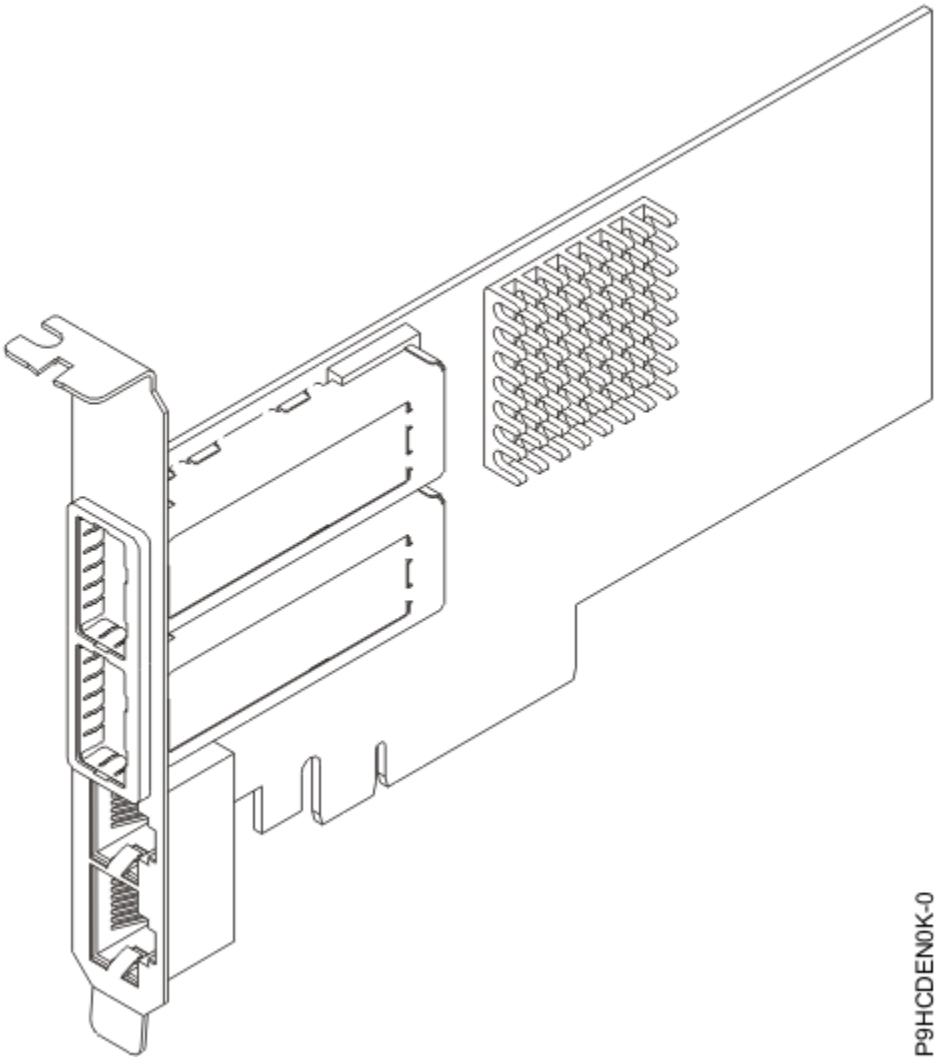


Figure 74. PCIe3 4-port (10 Gb FCoE and 1 GbE) Copper and RJ45 Adapter

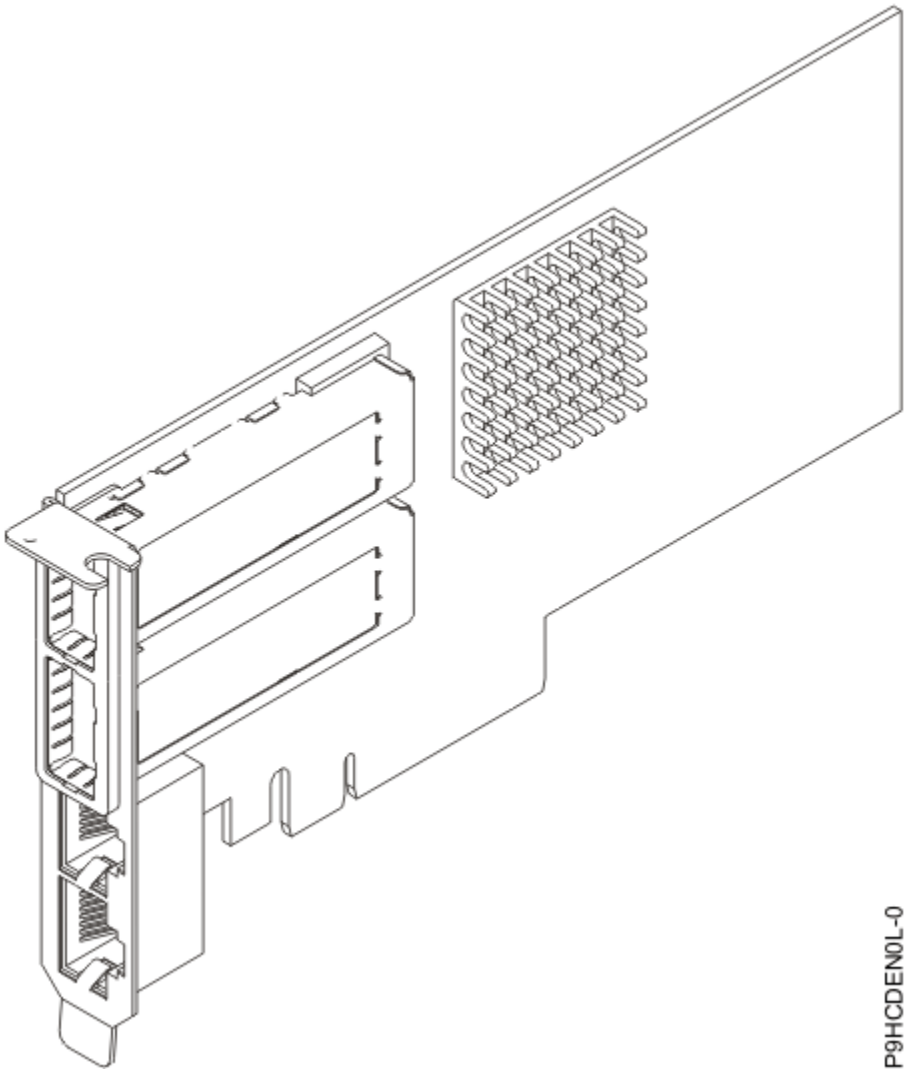


Figure 75. PCIe3 LP 4-port (10 Gb FCoE and 1 GbE) Copper and RJ45 Adapter

Specifications

Item
Description

Adapter FRU number
00E8140: Full-height

00E3502: Low-profile

Low-profile bracket part number 00ND496

Wrap plug FRU number
74Y7010

10N7405

Note: These wrap plugs are not included with the card. 12R9314 (FC ECW0) is the only wrap plug that can be purchased from IBM.

I/O bus architecture
PCIe3 x8

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Cables
See “Cables” on page 220 for details

Voltage
3.3 V, 12 V

Form factor
Short, low-profile

Cables
See “Cables” on page 220 for details

Cables

This adapter feature requires the use of compatible SFP+, 10 Gbps, copper, twinaxial, active, Ethernet cables. See Figure 76 on page 220 for a view of the cable top and cable bottom. These cables are compliant with industry standard specifications SFF-8431 Rev 4.1 and SFF-8472 Rev 10.4, and all applicable IBM requirements.

Note: These cables are EMC Class A compliant.

See Table 36 on page 220 for details about the feature codes.

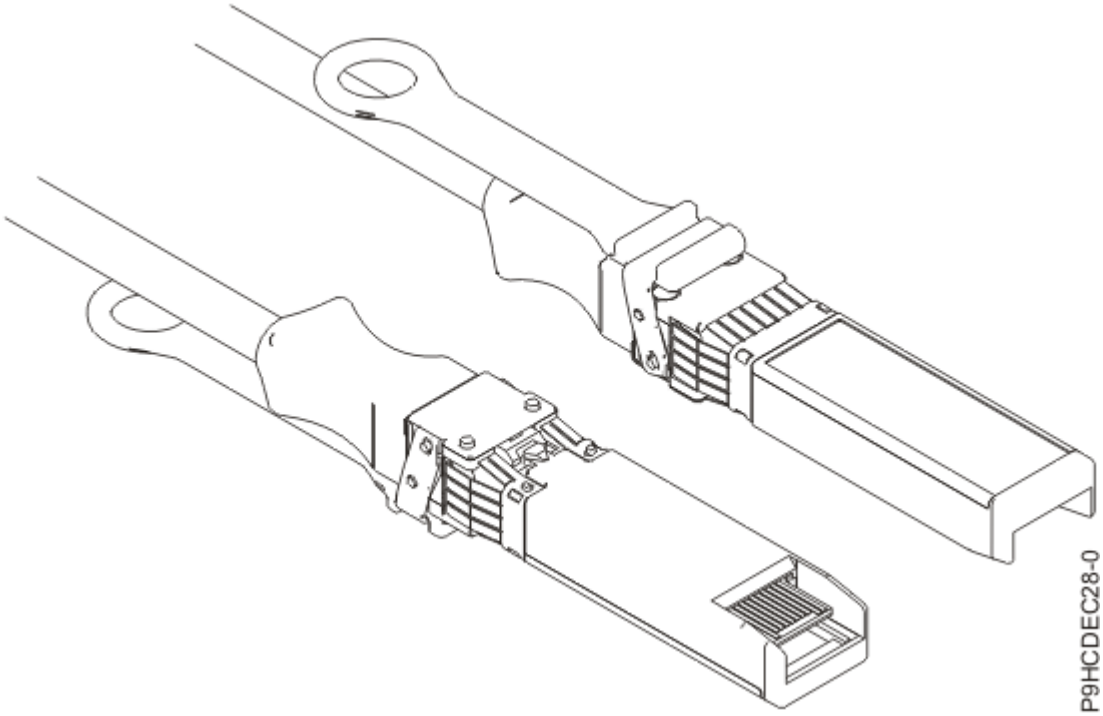


Figure 76. Top and bottom view of the cable

Table 36. Feature code, CCIN, and part number for varying lengths of the cable

Cable length	Feature code	CCIN	Part number
1 m (3.28 ft)	EN01	EF01	46K6182
3 m (9.84 ft)	EN02	EF02	46K6183
5 m (16.4 ft)	EN03	EF03	46K6184

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached

devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe3 LP 4-port (10 Gb FCoE and 1 GbE) copper and RJ45 adapter (FC EL3C or FC EN0L; CCIN 2CC1)

Learn about the specifications and operating system requirements for the feature code (FC) EL3C or FC EN0L adapter.

Overview

The PCIe3 LP 4-port (10 Gb FCoE and 1 GbE) copper and RJ45 adapter is a PCI Express (PCIe) generation 3, low-profile adapter. The adapter has four-ports and is a Fibre Channel over Ethernet (FCoE) converged network adapter (CNA). This adapter provides a PCIe 3.0 host bus interface. The adapter is a high-performance adapter that consolidates traffic for networking and Fibre Channel storage. The adapter is optimized for cloud computing, virtualization, storage, and other data center applications. Both the FCoE and network interface controller (NIC) functions are available for all the four ports. Use of the FCoE requires that you use convergence enhanced Ethernet (CEE) switches. The link aggregation and failover features of the adapter make it suitable for critical network applications that require redundancy and high availability.

Important: There is no FCoE support on POWER9 systems.

The four-port adapter provides two 10 Gb FCoE Copper Twin-axial ports and two 1 Gb RJ45 Ethernet ports. The two 10 Gb FCoE ports are connected by little connector-type (LC) connectors. Each FCoE port provides Ethernet connectivity with a nominal data rate of 10 Gbps (gigabits per second). Each of the 1 Gb ports provides Ethernet connectivity at a data rate of 1 Gbps and is connected with Ethernet cables. A 10 Mb data rate is not supported. Figure 77 on page 222 shows the FC EN0L adapter.

Restriction: The 1 Gb Ethernet ports do not support data rates of 10 Mbps (megabits per second).

The adapter provides the following features:

- The adapter supports all Fibre Channel and Ethernet topologies.
- The 10 Gb SFP+ ports can function in the NIC or FCoE mode.
- The adapter supports the SR-IOV (Single Root I/O Virtualization) NIC capability.
- The adapter can function as a Boot adapter.

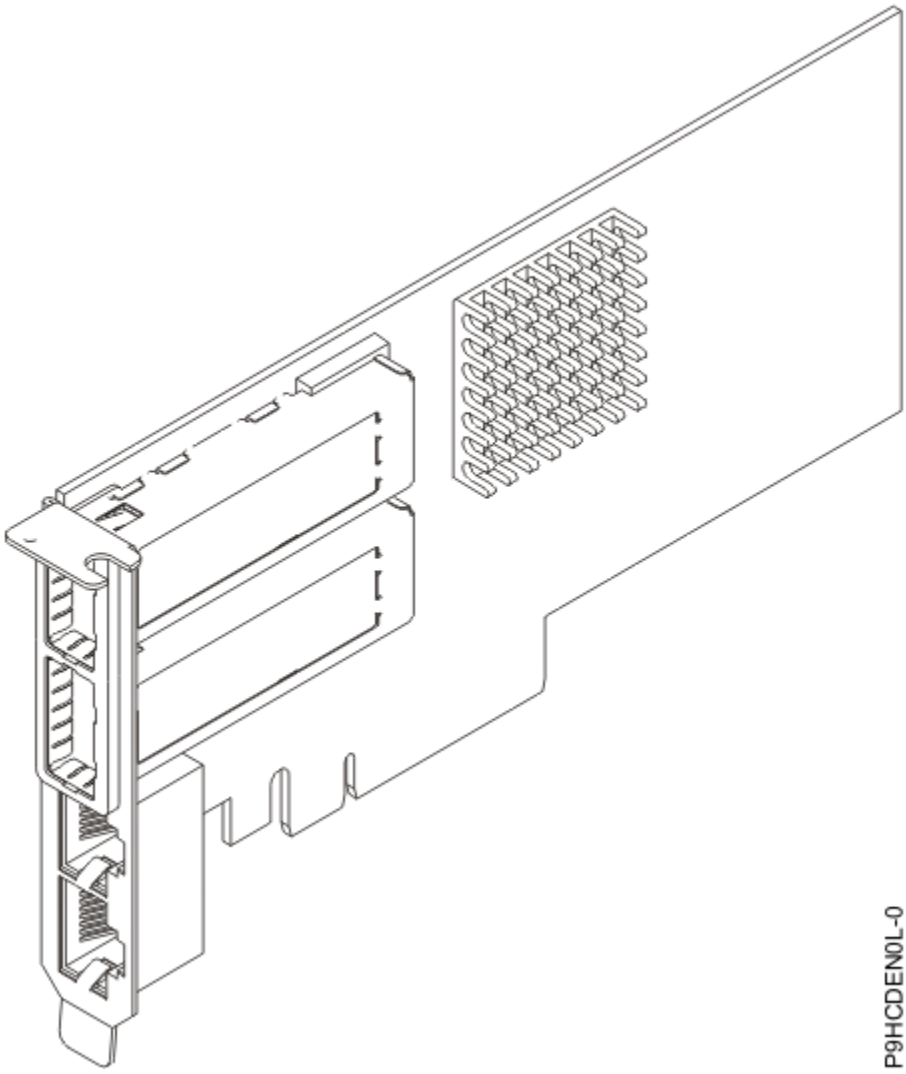


Figure 77. PCIe3 LP 4-port (10 Gb FCoE and 1 GbE) Copper and RJ45 Adapter

Specifications

Item
Description

Adapter FRU number
00E3502

Low-profile bracket part number 00ND496

Wrap plug FRU number
74Y7010

10N7405

Note: These wrap plugs are not included with the card. 12R9314 (FC ECW0) is the only wrap plug that can be purchased from IBM.

I/O bus architecture
PCIe3 x8

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
3.3 V, 12 V

Form factor
Short, low-profile

Cables
See “Cables” on page 223 for details

Cables

This adapter feature requires the use of compatible SFP+, 10 Gbps, copper, twinaxial, active, Ethernet cables. See Figure 78 on page 223 for a view of the cable top and cable bottom. These cables are compliant with industry standard specifications SFF-8431 Rev 4.1 and SFF-8472 Rev 10.4, and all applicable IBM requirements.

Note: These cables are EMC Class A compliant.

See Table 37 on page 223 for details about the feature codes.

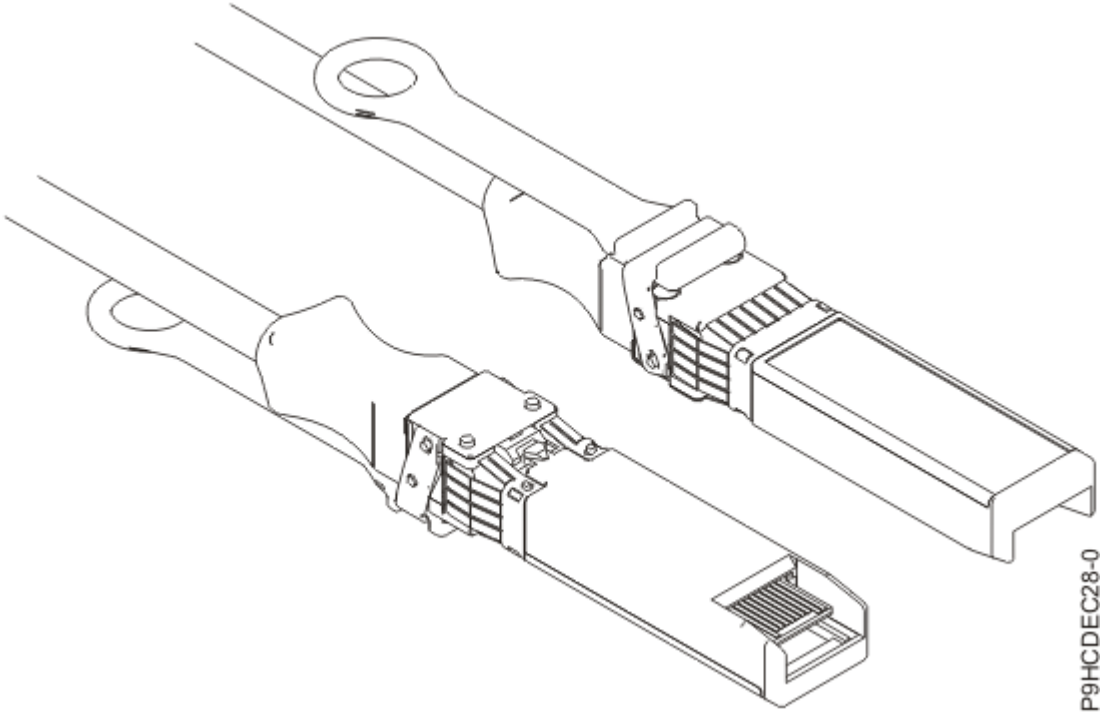


Figure 78. Top and bottom view of the cable

Table 37. Feature code, CCIN, and part number for varying lengths of the cable

Cable length	Feature code	CCIN	Part number
1 m (3.28 ft)	EN01	EF01	46K6182
3 m (9.84 ft)	EN02	EF02	46K6183
5 m (16.4 ft)	EN03	EF03	46K6184

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe3 4-port (10 Gb FCoE and 1 GbE) LR and RJ45 adapter (FC EN0M and FC EN0N; CCIN 2CC0)

Learn about the specifications and operating system requirements for the feature code (FC) EN0M and FC EN0N adapters.

Overview

The PCIe3 4-port (10 Gb FCoE and 1 GbE) LR and RJ45 Adapter is a PCI Express (PCIe) generation 3, x8, adapter. The FC EN0M is a regular-height adapter and the FC EN0N is a low-profile adapter. The adapter has four-ports and is a Fibre Channel over Ethernet (FCoE) converged network adapter (CNA). This adapter provides a PCIe 3.0 host bus interface. The adapter is a high-performance adapter that consolidates traffic for networking and Fibre Channel storage. The adapter is optimized for cloud computing, virtualization, storage, and other data center applications. Both the FCoE and network interface controller (NIC) functions are available for all the four ports. Use of the FCoE requires that you use convergence enhanced Ethernet (CEE) switches. The link aggregation and failover features of the adapter make it suitable for critical network applications that require redundancy and high availability.

Important: There is no FCoE support on POWER9 systems.

The four-port adapter provides two 10 Gb FCoE Long Range (LR) optical ports and two 1 Gb RJ45 Ethernet ports. The two 10 Gb FCoE ports provide an SFP+ optical transceiver and have little connector (LC) duplex-type connectors. Each FCoE port provides Ethernet connectivity with a nominal data rate of 10 Gbps (gigabits per second). The optical transceiver uses shortwave laser optics and is attached with MMF-850nm fiber cabling with LC connectors. See Cables for more information about the optical cables. An FCoE switch is required to be attached for any FCoE traffic on this adapter.

Each of the 1 Gb ports provides Ethernet connectivity at a data rate of 1 Gbps and is connected with Ethernet cables. Figure 79 on page 225 shows the FC EN0M adapter.

Restriction: The 1 Gb Ethernet ports do not support data rates of 10 Mbps (megabits per second).

The adapter provides the following features:

- The adapter supports both the dedicated mode and SR-IOV (Single Root I/O Virtualization) mode to function as a NIC.
- The adapter can function as a boot adapter.
- The adapter supports all Fibre Channel and Ethernet topologies.
- The adapter provides end-to-end data path parity and cyclic redundancy check

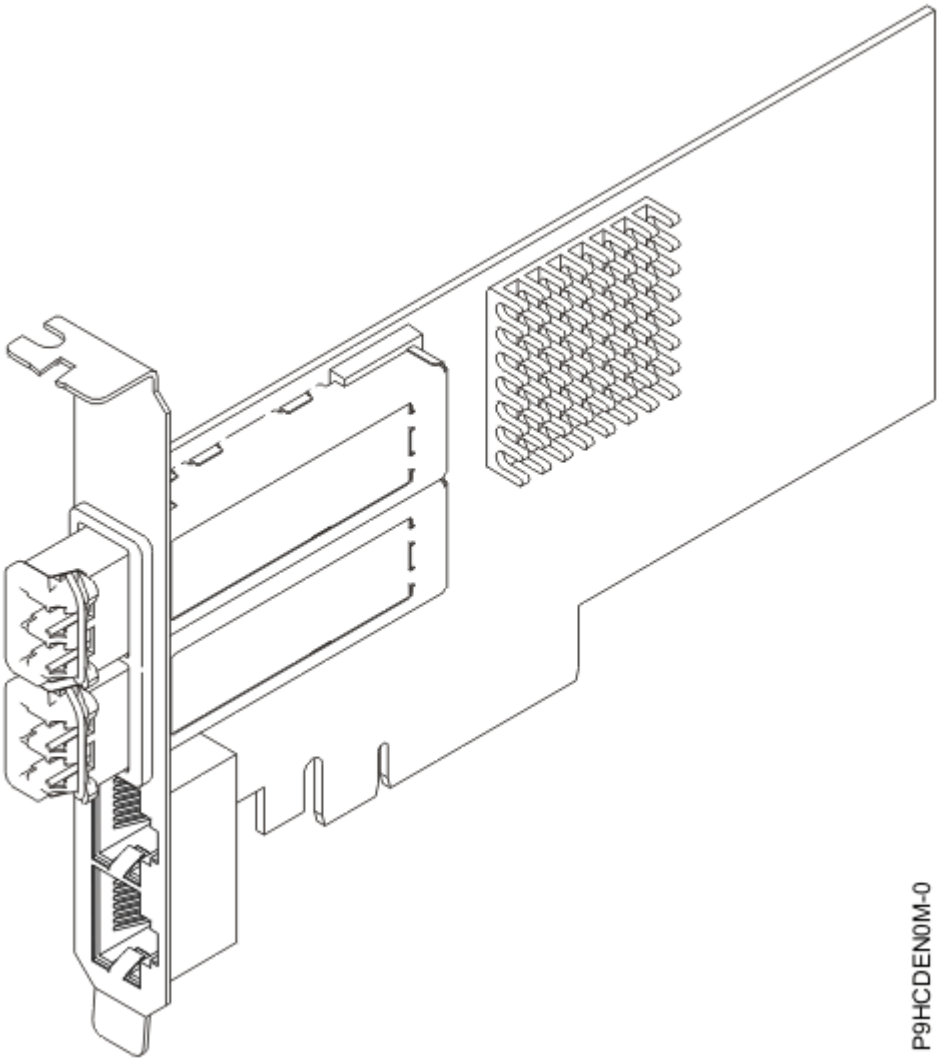


Figure 79. PCIe3 4-port (10 Gb FCoE and 1 GbE) LR and RJ45 adapter (FC EN0M)

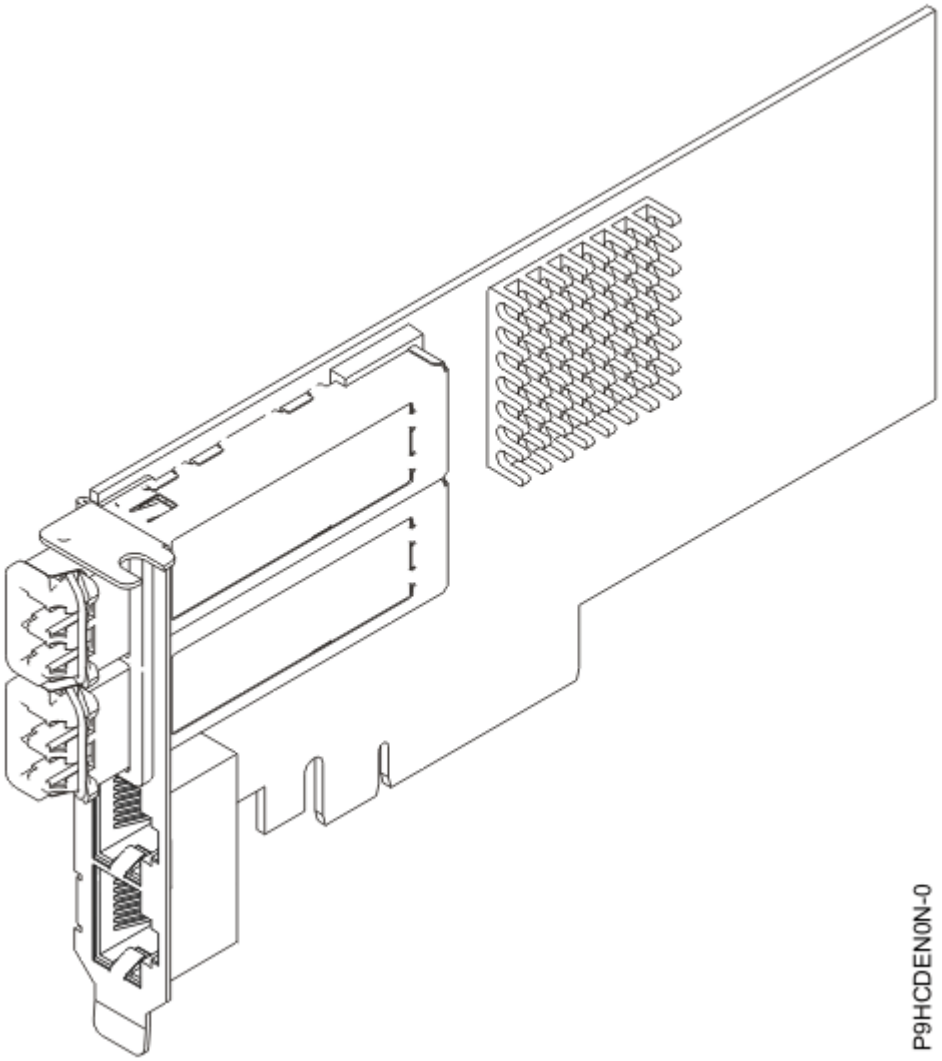


Figure 80. PCIe3 LP 4-port (10 Gb FCoE and 1GbE) LR and RJ45 adapter (FC EN0N)

Specifications

Item
Description

Adapter FRU number
FC EN0M: 00E8144

FC EN0N: 00E8143

Low-profile tailstock part number: 00E8163

Wrap plug FRU number
12R9314 (for Fibre LC connector)

10N7405

Note: These wrap plugs are not included with the card. 12R9314 (FC ECW0) is the only wrap plug that can be purchased from IBM.

I/O bus architecture
PCIe3 x8

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
12 V

Form factor
Short, regular-height

Cables

The 10 Gb ports are SFP+ ports and include an optical LR transceiver. The ports have LC Duplex type connectors and utilize longwave laser optics and 1310 nm fiber cabling. With 9 micron OS1, up to 10 kilometer length fiber cables.

For the 1 Gb RJ45 ports, 4-pair CAT-5 Unshielded Twisted Pair (UTP) cable or higher is supported for a distance of up to 100 meters.

Table 38. Cable type

Fiber cable type	Connector type	Operating range in meters
9 µm SMF	LC	10 km

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe2 4-port (10 Gb + 1 GbE) SR / Copper SFP +RJ45 adapter (FC EN0S, FC EN0T, FC EN0U, and FC EN0V; CCIN 2CC3)

Learn about the specifications and operating system requirements for the feature code (FC) EN0S, FC EN0T, FC EN0U, and FC EN0V adapters.

Overview

The PCIe2 4-port (10 Gb + 1 GbE) SR / Copper SFP +RJ45 adapter is a PCI Express (PCIe) generation 2 (Gen2) x8, short form-factor adapter.

- The FC EN0S and EN0U are short, full height adapters. FC EN0S is an SR adapter whereas FC EN0U is a Copper SFP adapter.
- The FC EN0T and EN0V are short, low-profile adapters. FC EN0T is an SR adapter whereas FC EN0V is a Copper SFP adapter.

The adapter provides two 10 Gb SR optical ports and two 1 Gb RJ45 ports. This adapter provides a PCIe 2.0 host bus interface. The adapter supports the Ethernet network interface controller (NIC) function. The adapter is a high-performance adapter that consolidates traffic for networking. The link aggregation and failover features of the adapter make it suitable for critical network applications that require redundancy and high availability.

The four-port adapter provides two 10 Gb small form-factor pluggable (SFP+) optical SR transceiver ports and two 1 Gb RJ45 Ethernet ports. The two 10 Gb SR ports have little connector (LC) duplex-type connectors. The optical transceiver uses shortwave laser optics and is attached with MMF-850nm fiber cabling with LC connectors. See “Cables” on page 231 for more information about the optical cables. Each 10 Gb port provides Ethernet connectivity with a nominal data rate of 10 Gbps (gigabits per second). Figure 81 on page 229 shows the FC EN0S and FC EN0U adapter. Figure 82 on page 230 shows the FC EN0T and FC EN0V adapter.

Each of the 1 Gb RJ45 port provides Ethernet connectivity at a data rate of 1 Gbps. Each of the 1 Gb ports is connected with a 4-pair, CAT-5 unshielded twisted pair (UTP) cable or with a cable of higher specification, and is supported for distances of up to 100 meters. In addition to 1 Gb (1000 Mb) networks, 100 Mb networks are also supported.

The adapter provides the following features:

- The adapter is a PCIe2 NIC network convergence adapter.
- The 10 Gb SR ports can function in the NIC mode.
- The adapter can be used as the host local area network (LAN) adapter.
- The adapter supports interrupt moderation to deliver increased performance while significantly reducing processor utilization
- The adapter supports dual port operation in any PCIe4 or PCIe3 slot
- The adapter supports auto-negotiation, full-duplex only.
- The adapter supports multiple media-access control (MAC) per interface.
- The adapter supports integrated media-access control (MAC) and physical layer (PHY).
- The adapter supports the following standards for the different ports and functions:
  - IEEE 802.3ae in the 10 GbE ports
  - 802.3ab in the 1 GbE ports
  - Ether II and IEEE 802.3 for encapsulated frames
  - 802.1p for setting up priority levels in tagged VLAN frames
  - 802.1Q for VLAN tagging
  - 802.3x for flow control
  - 802.3ad for load-balancing and failover
  - IEEE 802.3ad and 802.3 for link aggregation
- The adapter provides message signal interrupts (MSI), MSI-X, and support of legacy pin interrupts.
- The adapter supports jumbo frames up to 9.6 KB.
- The adapter supports gigabit EtherChannel (GEC) with the existing software.
- The adapter supports TCP checksum offload transmission control protocol (TCP), user datagram protocol (UDP), TCP segmentation Offload (TSO) for IPv4 and IPv6.
- Supports TCP segmentation or large send offload
- Supports EEPROM-SPI and single EEPROM

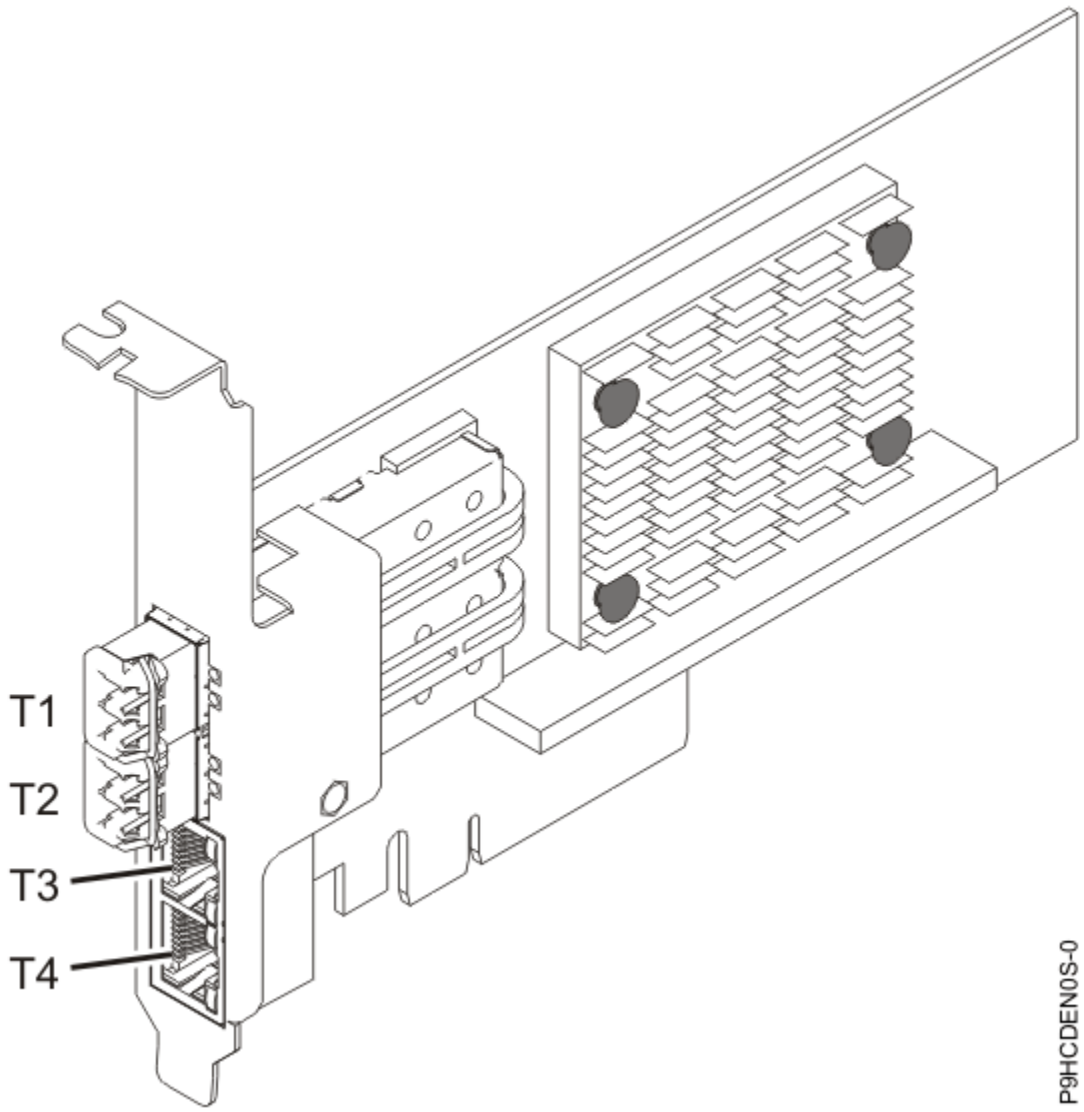


Figure 81. PCIe2 4-Port (10 Gb + 1 GbE) SR / Copper SFP +RJ45 adapter (FC EN0S and FC EN0U)

Note: The ports are numbered from top to bottom as T1, T2, and so on for the AIX and IBM i operating systems.

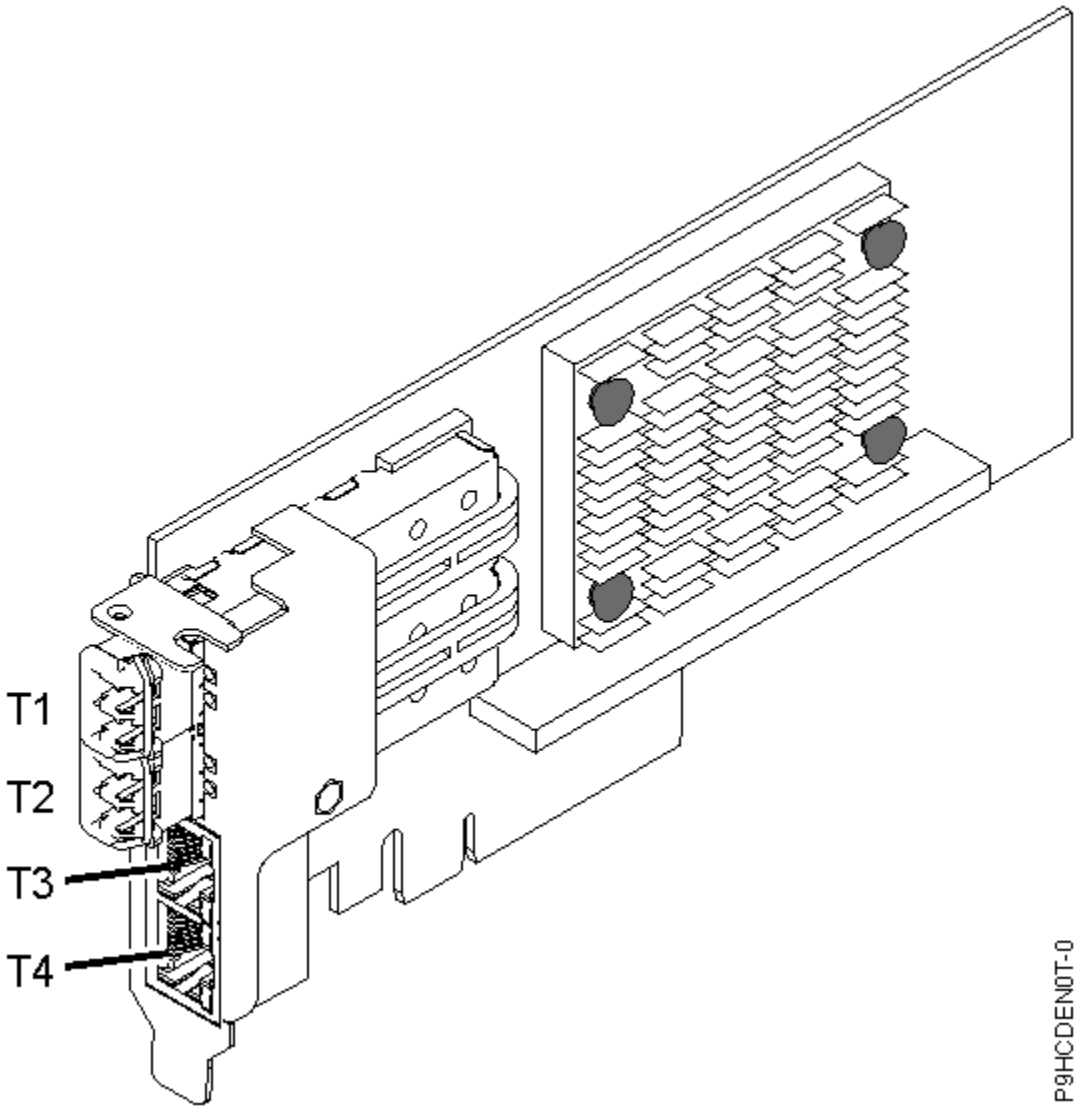


Figure 82. PCIe2 LP 4-port (10Gb+1GbE) SR / Copper SFP +RJ45 adapter (FC EN0T and FC EN0V)

Note: The ports are numbered from top to bottom of the adapter as T1, T2, and so on for the AIX and IBM i operating systems.

Specifications

Item
Description

Adapter FRU number
00E2715

Regular-height tailstock part number: 00E2863

Low-profile tailstock part number: 00E2720

Wrap plug FRU number
12R9314 (SFP+ SR wrap plug)

10N7405 (1 Gb UTP wrap plug)

Note: These wrap plugs are not included with the card. 12R9314 (FC ECW0) is the only wrap plug that can be purchased from IBM.

I/O bus architecture
PCIe2 x8

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
3.3 V

Form factor
Short, with full-height tailstock

Cables
See "Cables" on page 231 for details.

Cables

Use multimode fiber optic cables with shortwave lasers that adhere to the following specifications:

- OM3 or OM4: Multimode 50/125 micron fiber, 2000 MHz x km bandwidth
- OM2: Multimode 50/125 micron fiber, 500 MHz x km bandwidth
- OM1: Multimode 62.5/125 micron fiber, 200 MHz x km bandwidth

Because core sizes are different, OM1 cables only can be connected to other OM1 cables. For best results, OM2 cables must not be connected to OM3 or OM4 cables. However, if an OM2 cable is connected to an OM3 or OM4 cable, the characteristics of the OM2 cable apply to the entire length of the cables. The following table shows the supported distances for the different fiber optic cable types at different link speeds.

Table 39. Supported distances for multimode fiber optic cables

Header	**Cable Type and Distance**		
Rate	OM1	OM2	OM3
10 Gbps	0.5 meters to 33 meters (1.64 feet to 108.26 feet)	0.5 meters to 82 meters (1.64 feet to 269.02 feet)	0.5 meters to 300 meters (1.64 feet to 984.25 feet)

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

This adapter requires the following drivers:

- AIX: `devices.pciex.e4148a1614109304` for SFP+ optical ports and `devices.pciex.e4148a1614109404` for RJ45 ports

- Linux: bnx2x driver

PCIe2 2-port 10 GbE BaseT RJ45 adapter (FC EL3Z, FC EL55, FC EN0W, and FC EN0X; CCIN 2CC4)

Learn about the specifications and operating system requirements for the feature code (FC) EL3Z, FC EL55, FC EN0W, or FC EN0X adapter.

Overview

The PCIe2 2-port 10 GbE BaseT RJ45 adapter is a PCI Express (PCIe) generation 2, x8 adapter. The FC EL3Z and FC EN0X are short form-factor, low-profile adapters. The FC EL55 and FC EN0W are regular height adapters that are low profile capable. The adapters provide two 10 Gb RJ45 ports and a PCIe 2.0 host bus interface. The adapters support the Ethernet network interface controller (NIC) function. The adapters are high-performance adapters that consolidate traffic for networking. The link aggregation and failover features of the adapters make them suitable for critical network applications that require redundancy and high availability.

The ports default to auto negotiate the highest speed either at 10 Gb (10G BaseT), 1Gb (1000 BaseT), or 100 Mb (100 BaseT) full duplex. Each RJ45 port can be configured independent of the other port. The RJ45 ports use 4-pair CAT-6A cabling for distances of up to 100 meters or CAT-6 cabling for distances up to 37 meters. CAT-5 cabling is not supported.

The adapter provides the following features:

- The adapter is a PCIe2 NIC network convergence adapter.
- The 10 Gb RJ45 ports can function in the NIC mode.
- The adapter can be used as the host local area network (LAN) adapter.
- The adapter supports interrupt moderation to deliver increased performance while significantly reducing processor utilization
- The adapter supports dual port operation in any PCIe3 or PCIe2 slot.
- The adapter supports auto-negotiation, full-duplex only.
- The adapter supports multiple media-access control (MAC) per interface.
- The adapter supports integrated media-access control (MAC) and physical layer (PHY).
- The adapter supports the following standards for the different ports and functions:
  - IEEE 802.3ae in the 10 GbE ports
  - 802.3ab in the 1 GbE ports
  - Ether II and IEEE 802.3 for encapsulated frames
  - 802.1p for setting up priority levels in tagged VLAN frames
  - 802.1Q for VLAN tagging
  - 802.3x for flow control
  - 802.3ad for load-balancing and failover
  - IEEE 802.3ad and 802.3 for link aggregation
- The adapter provides message signal interrupts (MSI), MSI-X, and support of legacy pin interrupts.
- The adapter supports jumbo frames up to 9.6 KB.
- The adapter supports gigabit EtherChannel (GEC) with the existing software.
- The adapter supports TCP checksum offload transmission control protocol (TCP), user datagram protocol (UDP), TCP segmentation Offload (TSO) for IPv4 and IPv6.
- Supports TCP segmentation or large send offload
- Supports EEPROM-SPI and single EEPROM

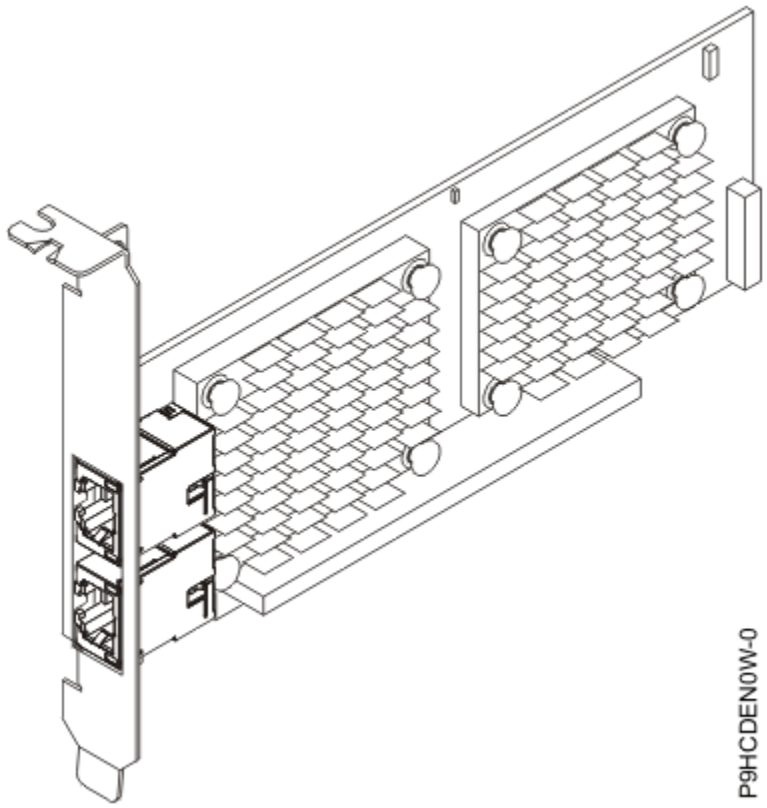


Figure 83. PCIe2 2-port 10 GbE BaseT RJ45 adapter (FC EL55 or FC EN0W)

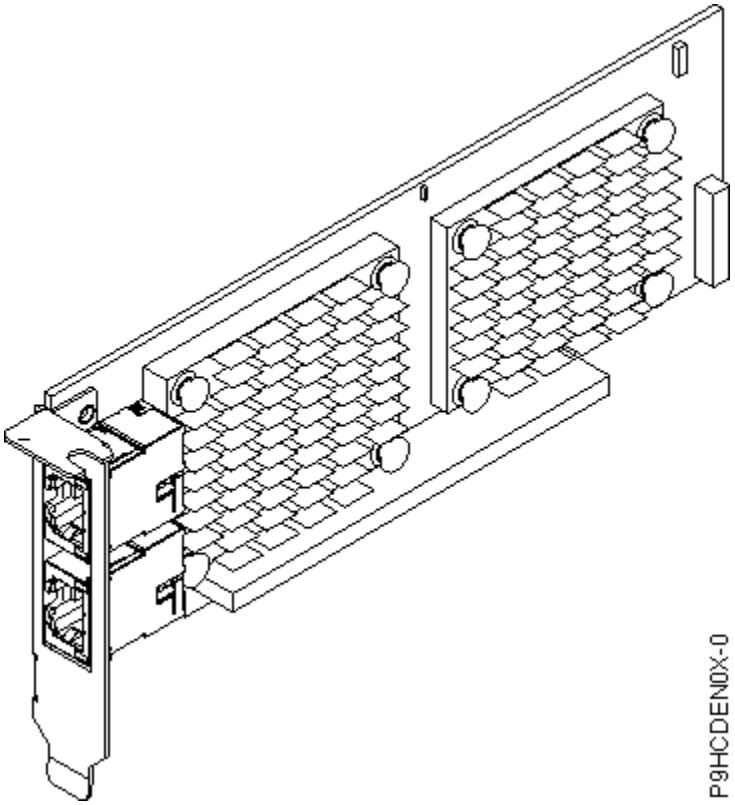


Figure 84. PCIe2 LP 2-port 10 GbE BaseT RJ45 adapter (FC EL3Z or FC EN0X)

Specifications

Item
Description

Adapter FRU number
00E2714

Regular-height tailstock part number: 00E2862.

Low-profile tailstock part number: 00E2721.

Wrap plug FRU number
10N7405 (RJ45 wrap plug).

Note: Wrap plugs are not included with the card and cannot be purchased from IBM.

I/O bus architecture
PCIe2 x8.

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Cables
CAT-6 cable.

CAT-6A cable.

Voltage
3.3 V.

Form factor
Short, low-profile.

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

This adapter requires the following drivers:

- AIX: `devices.pciex.e4148e1614109204`
- Linux: `bnx2x driver`

PCIe2 LP 8 Gb 4-port Fibre Channel Adapter (FC EN0Y; CCIN EN0Y)

Learn about the specifications and operating system requirements for the feature code (FC) EN0Y adapter.

Overview

The PCIe2 LP 8 Gb 4-port Fibre Channel Adapter is a PCI Express (PCIe) generation-2, low-profile, high-performance, x8 short form factor plus (SFF+) Host Bus Adapter (HBA). This adapter enables multiple logical (virtual) connections to share the same physical port. Each logical connection has its own resources and the ability to be managed independently. Each port provides single initiator capability over a fiber link or provides multiple initiator capability with N_Port ID Virtualization (NPIV). The ports are connected by using mini little connectors (mini-LC) type connectors. These connectors use shortwave laser optics. The adapter operates at link speeds of 2, 4, and 8 gigabits per second (Gbps) and automatically negotiates to the highest speed possible. LEDs on each port provide information about the connection status and link speed of the port. The adapter connects to a Fibre Channel switch.

The LEDs on the adapter indicate the TX/RX and link status as shown in Table 40 on page 236.

Figure 85 on page 236 shows the adapter.

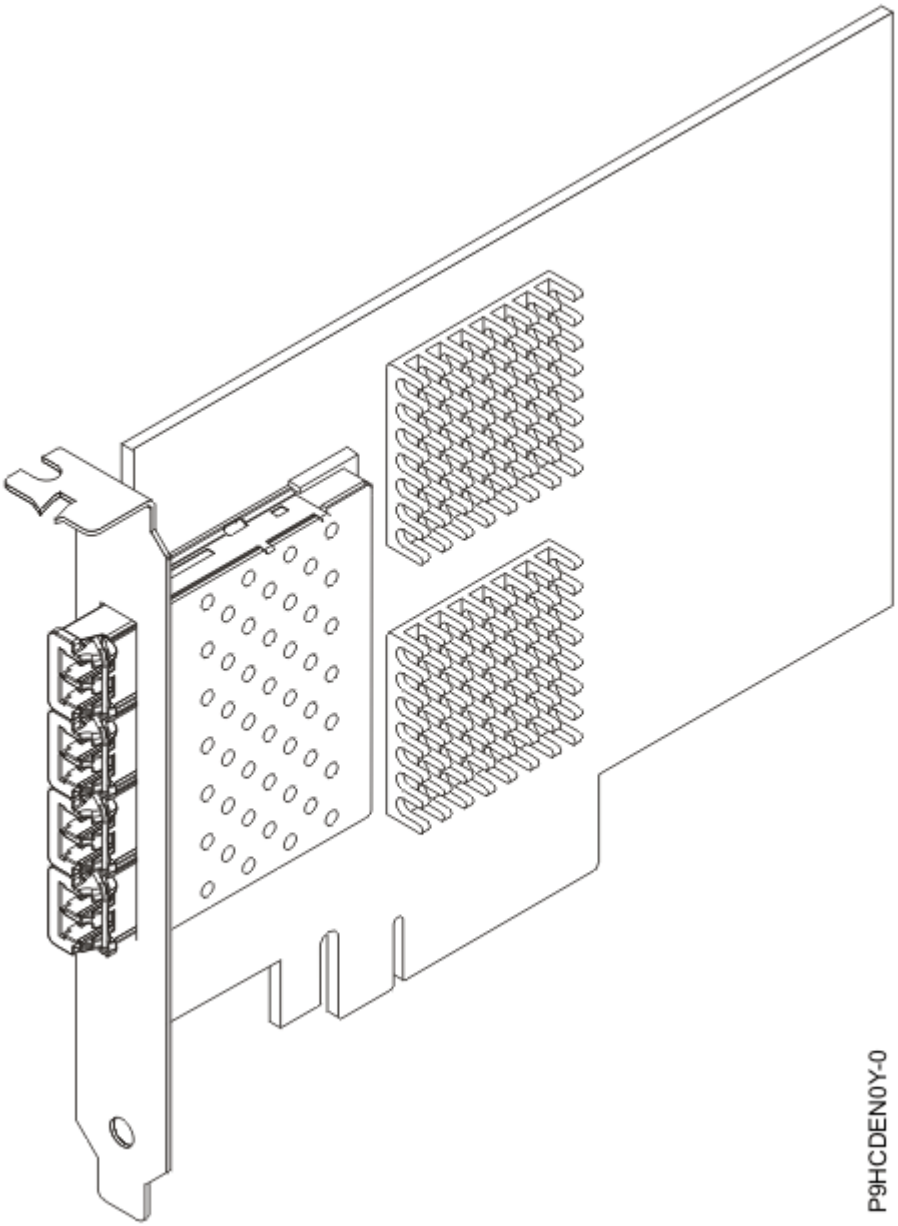


Figure 85. PCIe2 LP 8 Gb 4-port Fibre Channel Adapter

Table 40. LED indications

Hardware State	Yellow LED (8 Gbps)	Green LED (4 Gbps)	Amber LED (2 Gbps)	Comments
Power Off	Off	Off	Off	
Power On (before firmware initialization)	On	On	On	
Power On (after firmware initialization)	Flash	Flash	Flash	All flash at the same time.

Table 40. LED indications (continued)				
Hardware State	**Yellow LED (8 Gbps)**	**Green LED (4 Gbps)**	**Amber LED (2 Gbps)**	**Comments**
Firmware Fault	Flash in sequence	Flash in sequence	Flash in sequence	Flashing in sequence of yellow LED, green LED, amber LED, then back to yellow LED.
2 Gbps Link UP/ACT	Off	Off	On/Flash	On for link up and flash if I/O activity.
4 Gbps Link UP/ACT	Off	On/Flash	Off	
8 Gbps Link UP/ACT	On/Flash	Off	Off	
Beacon	Flash	Off	Flash	All flashing at the same time.

Specifications

Item
Description

Adapter FRU number
74Y3923

Wrap plug FRU number
12R9314

Note: The wrap plug is included with the card, and can also be purchased from IBM.

I/O bus architecture
PCIe2.0 x8

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
3.3 V and 12.0 V

Form factor
Short, low-profile

Cables
For information about the cables, see “Cables” on page 237

Attributes provided

- NPIV capability is supported through VIOS.
- Requires a PCI Express generation-2 x8 slot for all four ports to operate at full speed.

Cables

Use multimode fiber optic cables with shortwave lasers that adhere to the following specifications:

- OM3: Multimode 50/125 micron fiber, 2000 MHz x km bandwidth
- OM2: Multimode 50/125 micron fiber, 500 MHz x km bandwidth
- OM1: Multimode 62.5/125 micron fiber, 200 MHz x km bandwidth

Because core sizes are different, OM1 cables can only be connected to other OM1 cables. For best results, OM2 cables should not be connected to OM3 cables. However, if an OM2 cable is connected to an OM3 cable, the characteristics of the OM2 cable apply to the entire length of the cables. The following table shows the supported distances for the different fiber optic cable types at different link speeds.

Table 41. Supported distances for multimode fiber optic cables

Header	**Cable Type and Distance**		
Rate	OM1	OM2	OM3
2.125 Gbps	0.5 meters to 150 meters (1.64 feet to 492.12 feet)	0.5 meters to 300 meters (1.64 feet to 984.25 feet)	0.5 meters to 500 meters (1.64 feet to 1640.41 feet)
4.25 Gbps	0.5 meters to 70 meters (1.64 feet to 229.65 feet)	0.5 meters to 150 meters (1.64 feet to 492.12 feet)	0.5 meters to 380 meters (1.64 feet to 1246.71 feet)
8.5 Gbps	0.5 meters to 21 meters (1.64 feet to 68.89 feet)	0.5 meters to 50 meters (1.64 feet to 164.04 feet)	0.5 meters to 150 meters (1.64 feet to 492.12 feet)

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe2 FH 4-port 8 Gb Fibre Channel Adapter (FC EN12, CCIN EN0Y)

Learn about the specifications and operating system requirements for the feature code (FC) EN12 adapter.

Overview

The PCIe2 FH 4-port 8 Gb Fibre Channel Adapter is a PCI Express (PCIe) generation-2, full-height, high-performance, x8 short form factor plus (SFF+) Host Bus Adapter (HBA). This adapter enables multiple logical (virtual) connections to share the same physical port. Each logical connection has its own resources and the ability to be managed independently. Each port provides single initiator capability over a fiber link or provides multiple initiator capability with N_Port ID Virtualization (NPIV). The ports are connected by using LC type connectors. These connectors use shortwave laser optics. The adapter operates at link speeds of 2, 4, and 8 gigabits per second (Gb/s) and automatically negotiates to the highest speed possible. LEDs on each port provide information about the connection status and link speed of the port. The adapter connects to a Fibre Channel switch.

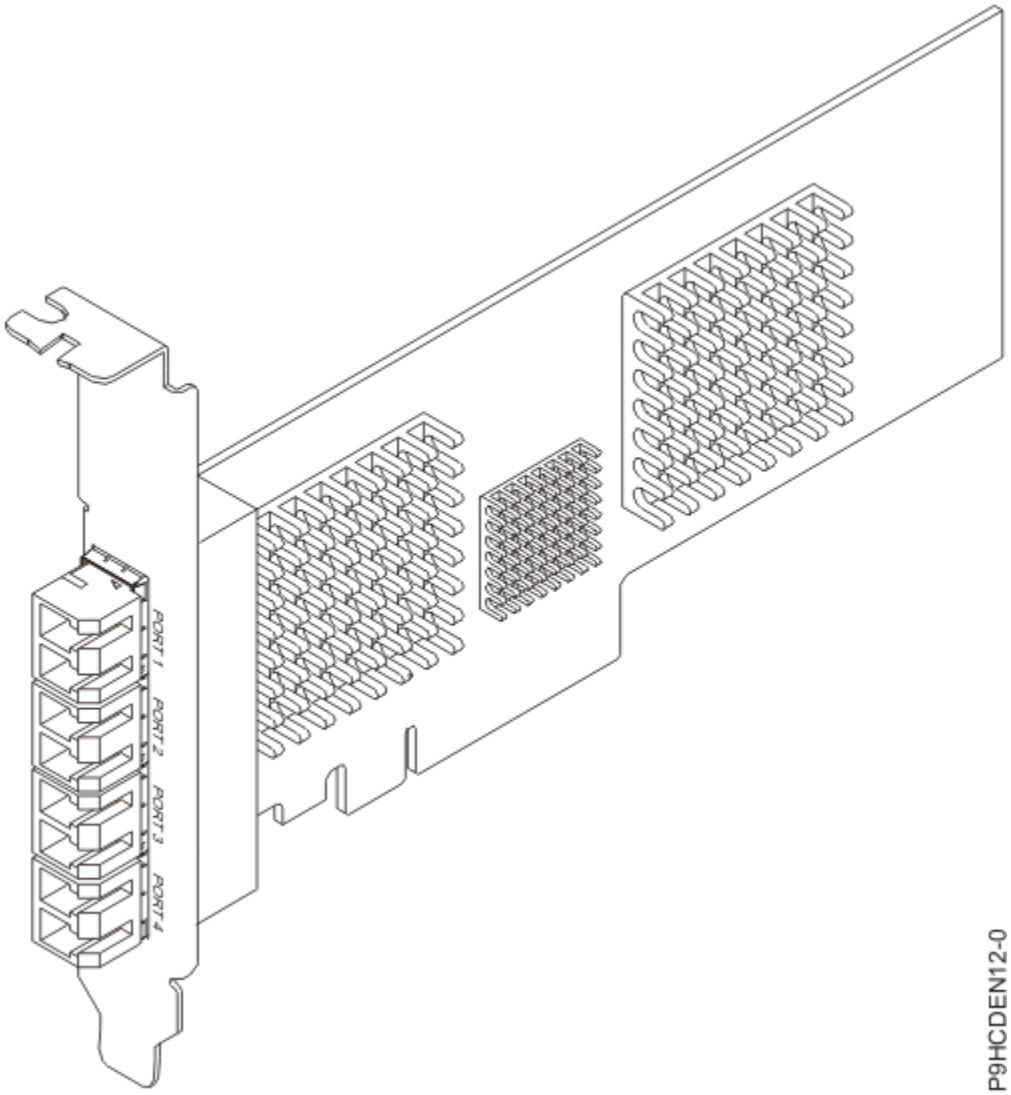


Figure 86. PCIe2 FH 4-port 8 Gb Fibre Channel Adapter

Specifications

Item
Description

Adapter FRU number
00WT107

I/O bus architecture
PCIe2.0 x8

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
3.3 V, 12 V

Form factor
Short

Cables
For information about the cables, see “Cables” on page 240.

Attributes provided

- NPIV capability is supported through VIOS.
- Requires a PCI Express generation-2 x8 slot for all four ports to operate at full speed.

Cables

Use multimode fiber optic cables with shortwave lasers that adhere to the following specifications:

- OM3: Multimode 50/125 micron fiber, 2000 MHz x km bandwidth
- OM2: Multimode 50/125 micron fiber, 500 MHz x km bandwidth
- OM1: Multimode 62.5/125 micron fiber, 200 MHz x km bandwidth

Because core sizes are different, OM1 cables can only be connected to other OM1 cables. For best results, OM2 cables should not be connected to OM3 cables. However, if an OM2 cable is connected to an OM3 cable, the characteristics of the OM2 cable apply to the entire length of the cables. The following table shows the supported distances for the different fiber optic cable types at different link speeds.

Table 42. Supported distances for multimode fiber optic cables

Header	**Cable Type and Distance**		
Rate	OM1	OM2	OM3
2.125 Gbps	0.5 meters to 150 meters (1.64 feet to 492.12 feet)	0.5 meters to 300 meters (1.64 feet to 984.25 feet)	0.5 meters to 500 meters (1.64 feet to 1640.41 feet)
4.25 Gbps	0.5 meters to 70 meters (1.64 feet to 229.65 feet)	0.5 meters to 150 meters (1.64 feet to 492.12 feet)	0.5 meters to 380 meters (1.64 feet to 1246.71 feet)
8.5 Gbps	0.5 meters to 21 meters (1.64 feet to 68.89 feet)	0.5 meters to 50 meters (1.64 feet to 164.04 feet)	0.5 meters to 150 meters (1.64 feet to 492.12 feet)

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe3 4-port 10 GbE SR Adapter (FC EN15 and FC EN16; CCIN 2CE3)

Learn about the specifications and operating system requirements for the feature code (FC) EN15 and EN16 adapter.

Overview

The FC EN15 and EN16 are the same adapter. FC EN15 is a full-height adapter, and FC EN16 is a low-profile adapter. The names of these two adapters are:

- FC EN15: PCIe3 4-port 10 GbE SR Adapter
- FC EN16: PCIe3 LPX 4-port 10 GbE SR Adapter

The PCIe3 4-port 10 GbE SR Adapter is a PCI Express (PCIe) generation 3, x8, short form-factor adapter. The adapter provides four 10 Gb small form-factor pluggable (SFP+) optical SR transceiver ports, as shown in Figure 87 on page 242. The ports have little connector (LC) duplex-type connectors and utilize shortwave laser optics and MMF-850nm fiber cabling. See “Cables” on page 243 for more information about the optical cables. The adapter supports the Ethernet network interface controller (NIC) function and also provides SR-IOV NIC support. SR-IOV capability for the NIC function is supported with the appropriate firmware and operating system level for any of the four ports. Enabling the SR-IOV function requires an HMC.

The adapter provides the following features:

- Four 10 Gb ports that can function in the NIC mode
- AIX Network Installation Management (NIM) support
- The adapter supports interrupt moderation to deliver increased performance while significantly reducing processor utilization
- The adapter supports multiple media-access control (MAC) per interface.
- The adapter supports integrated media-access control (MAC) and physical layer (PHY).
- The adapter supports the following standards for the different ports and functions:
  - IEEE 802.3ae in the 10 GbE ports
  - 802.3ab in the 1 GbE ports
  - Ether II and IEEE 802.3 for encapsulated frames
  - 802.1p for setting up priority levels in tagged VLAN frames
  - 802.1Q for VLAN tagging
  - 802.3x for flow control
  - 802.3ad for load-balancing and failover
  - IEEE 802.3ad and 802.3 for link aggregation
- The adapter provides message signal interrupts (MSI), MSI-X, and support of legacy pin interrupts.
- The adapter supports jumbo frames up to 9.6 KB.
- The adapter supports TCP checksum offload transmission control protocol (TCP), user datagram protocol (UDP), TCP segmentation Offload (TSO) for IPv4 and IPv6.
- Supports TCP segmentation or large send offload
- Supports EEPROM-SPI and single EEPROM

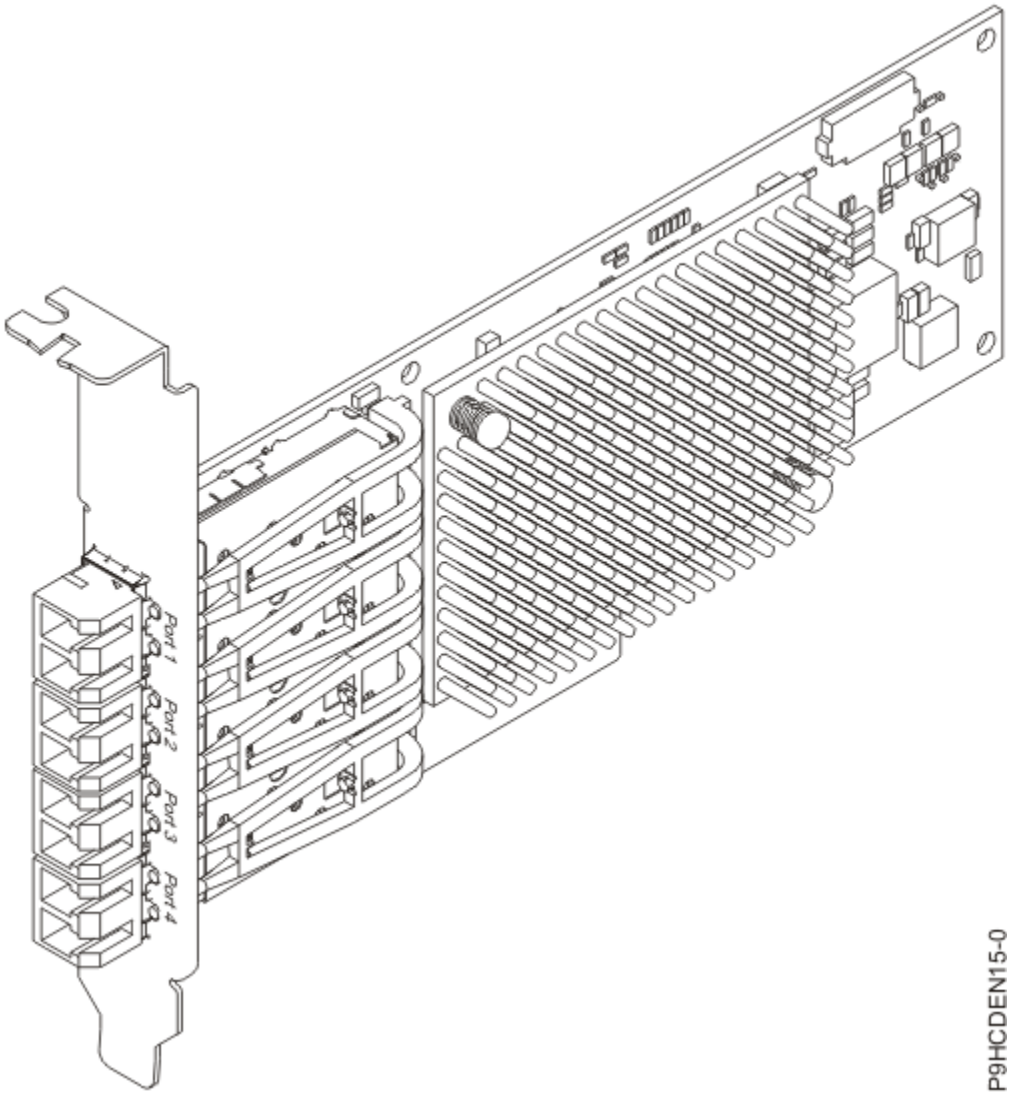


Figure 87. FPCIe3 4-port 10 GbE SR Adapter

Specifications

Item
Description

Adapter FRU number
00ND466

Full-height tailstock part number: 00ND462

Wrap plug FRU number
12R9314 (SFP+ SR wrap plug)

Note: The wrap plug is not included with the card, but can be purchased from IBM.

I/O bus architecture
PCIe3 x8

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Cables
See “Cables” on page 243 for details.

Voltage
3.3 V

Form factor
Short, full-height tailstock, low-profile capable

Cables

Use multimode fiber optic cables with shortwave lasers that adhere to the following specifications:

- OM3 or OM4: Multimode 50/125 micron fiber, 2000 MHz x km bandwidth
- OM2: Multimode 50/125 micron fiber, 500 MHz x km bandwidth
- OM1: Multimode 62.5/125 micron fiber, 200 MHz x km bandwidth

Because core sizes are different, OM1 cables only can be connected to other OM1 cables. For best results, OM2 cables must not be connected to OM3 or OM4 cables. However, if an OM2 cable is connected to an OM3 or OM4 cable, the characteristics of the OM2 cable apply to the entire length of the cables. The following table shows the supported distances for the different fiber optic cable types at different link speeds.

Table 43. Supported distances for multimode fiber optic cables

Header	**Cable Type and Distance**		
Rate	OM1	OM2	OM3
10 Gbps	0.5 meters to 33 meters (1.64 feet to 108.26 feet)	0.5 meters to 82 meters (1.64 feet to 269.02 feet)	0.5 meters to 300 meters (1.64 feet to 984.25 feet)

Adapter LED

Green and yellow LEDs can be seen through openings in the mounting bracket of the adapter. The green LED indicates link activity and the yellow LED signifies the link state. Table 44 on page 243 summarizes the LED states for this adapter.

Table 44. LED states

Green LED	**Yellow LED**	**State**
Off	Off	No Power or Normal Link Down
Off	On	POST Failure or Invalid SFP Configuration
Off	On	Normal Link Up with No activity on the link
Blink	On	Normal Link Up with activity on the link

Attributes provided
PowerVM SR-IOV support. For more information see, PowerVM® SR-IOV FAQs.

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).

- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe3 4-port 10 GbE SFP+ Copper Adapter (FC EN17 and FC EN18; CCIN 2CE4)

Learn about the specifications and operating system requirements for the feature code (FC) EN17 and FC EN18 adapter.

Overview

The FC EN17 and EN18 are the same adapter. FC EN17 is a full-height adapter, and FC EN18 is a low-profile adapter. The names of these two adapters are:

- FC EN17: PCIe3 4-port 10 GbE SFP+ Copper Adapter
- FC EN18: PCIe3 LPX 4-port 10 GbE SFP+ Copper Adapter

The PCIe3 4-port 10 GbE SFP+ copper adapter is a PCI Express (PCIe) generation 3, x8, short form-factor adapter. The adapter provides four 10 Gb small form-factor pluggable (SFP+) ports into which copper twinax transceivers will be placed. See Figure 88 on page 245. Active copper twinax cables up to 5 meter in length are supported such as provided by feature codes EN01, EN02 or EN03. A transceiver is included with these cables. See “Cables” on page 246 for details. The adapter supports the Ethernet network interface controller (NIC) function and also provides SR-IOV NIC support. SR-IOV capability for the NIC function is supported with the appropriate firmware and operating system level for any of the four ports. Enabling the SR-IOV function requires an HMC.

The adapter provides the following features:

- Four 10 Gb ports that can function in the NIC mode
- AIX Network Installation Management (NIM) support
- The adapter supports interrupt moderation to deliver increased performance while significantly reducing processor utilization
- The adapter supports multiple media-access control (MAC) per interface.
- The adapter supports integrated media-access control (MAC) and physical layer (PHY).
- The adapter supports the following standards for the different ports and functions:
  - IEEE 802.3ae in the 10 GbE ports
  - 802.3ab in the 1 GbE ports
  - Ether II and IEEE 802.3 for encapsulated frames
  - 802.1p for setting up priority levels in tagged VLAN frames
  - 802.1Q for VLAN tagging
  - 802.3x for flow control
  - 802.3ad for load-balancing and failover
  - IEEE 802.3ad and 802.3 for link aggregation
- The adapter provides message signal interrupts (MSI), MSI-X, and support of legacy pin interrupts.
- The adapter supports jumbo frames up to 9.6 KB.

- The adapter supports TCP checksum offload transmission control protocol (TCP), user datagram protocol (UDP), TCP segmentation Offload (TSO) for IPv4 and IPv6.
- Supports TCP segmentation or large send offload
- Supports EEPROM-SPI and single EEPROM

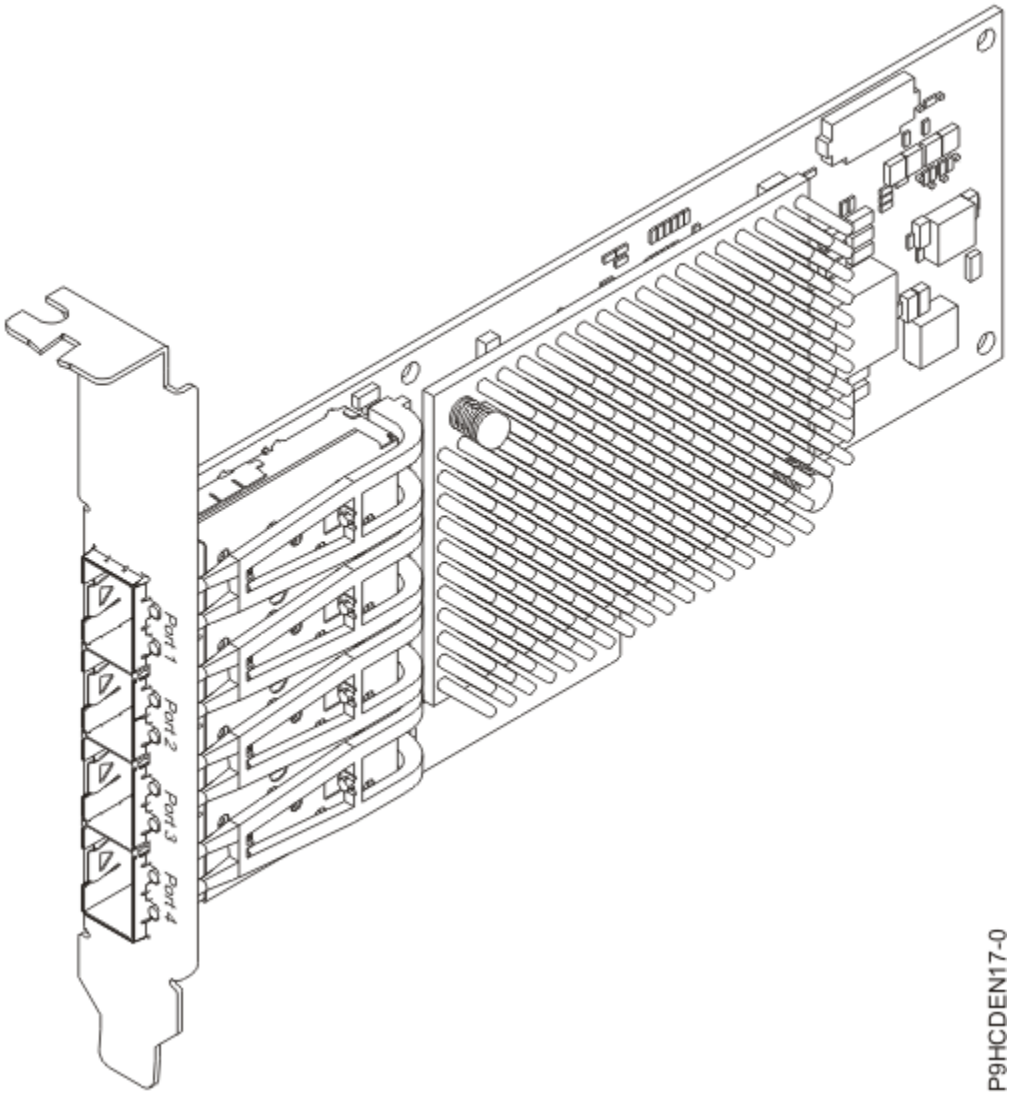


Figure 88. PCIe3 4-port 10 GbE SFP+ copper adapter (FC EN17)

Specifications

Item
Description

Adapter FRU number
00ND463

Full-height tailstock part number: 00ND465

Wrap plug FRU number
74Y7010 (Twinax wrap plug)

I/O bus architecture
PCIe3 x8

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
3.3 V

Form factor
Short, full-height tailstock, low-profile capable

Cables
See "Cables" on page 246 for details.

Cables

This adapter feature requires the use of compatible SFP+, 10 Gbps, copper, twinaxial, active, Ethernet cables. See Figure 89 on page 246 for a view of the cable top and cable bottom. These cables are compliant with industry standard specifications SFF-8431 Rev 4.1 and SFF-8472 Rev 10.4, and all applicable IBM requirements.

Note: These cables are EMC Class A compliant.

See Table 45 on page 246 for details about the feature codes.

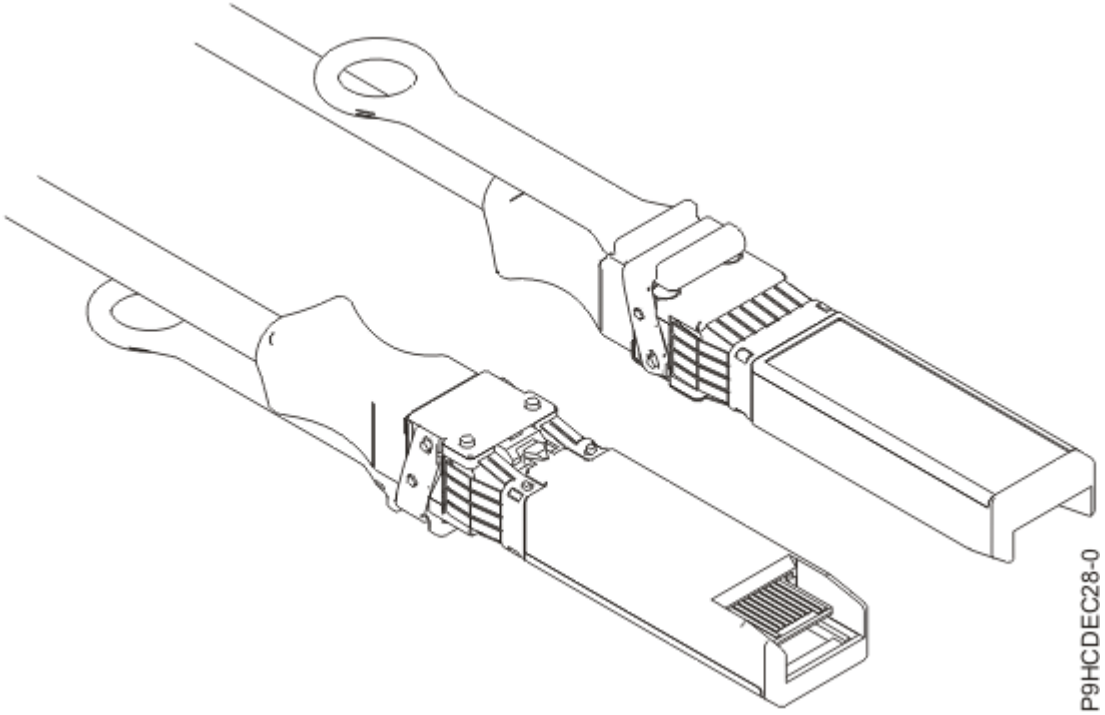


Figure 89. Top and bottom view of the cable

Table 45. Feature code, CCIN, and part number for varying lengths of the cable

Cable length	Feature code	CCIN	Part number
1 m (3.28 ft)	EN01	EF01	46K6182
3 m (9.84 ft)	EN02	EF02	46K6183
5 m (16.4 ft)	EN03	EF03	46K6184

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

NVMe 400 GB mainstream solid-state drive (FC ES14)

Learn about the specifications and operating system requirements for the feature code (FC) ES14 adapter.

Overview

The NVMe 400 GB mainstream solid-state drive (FC ES14) is formatted in 4096 byte sectors (4k). The drive is mounted in the PCIe NVMe carrier card with two M.2 sockets (FC EC59). Driver Write per day (DWPD) rating is 1 calculated over a 5 year period. Approximately 1,095 TB of data can be written over the life of the drive, but depending on the nature of the workload might be larger. It is used for boot support and non-intensive workloads.

Note: Usage beyond boot support and non-intensive workload could result in throttled performance and, or high temperatures that lead to time-outs and critical thermal warnings. For more information about mainstream drives, see Mainstream solid-state drives.

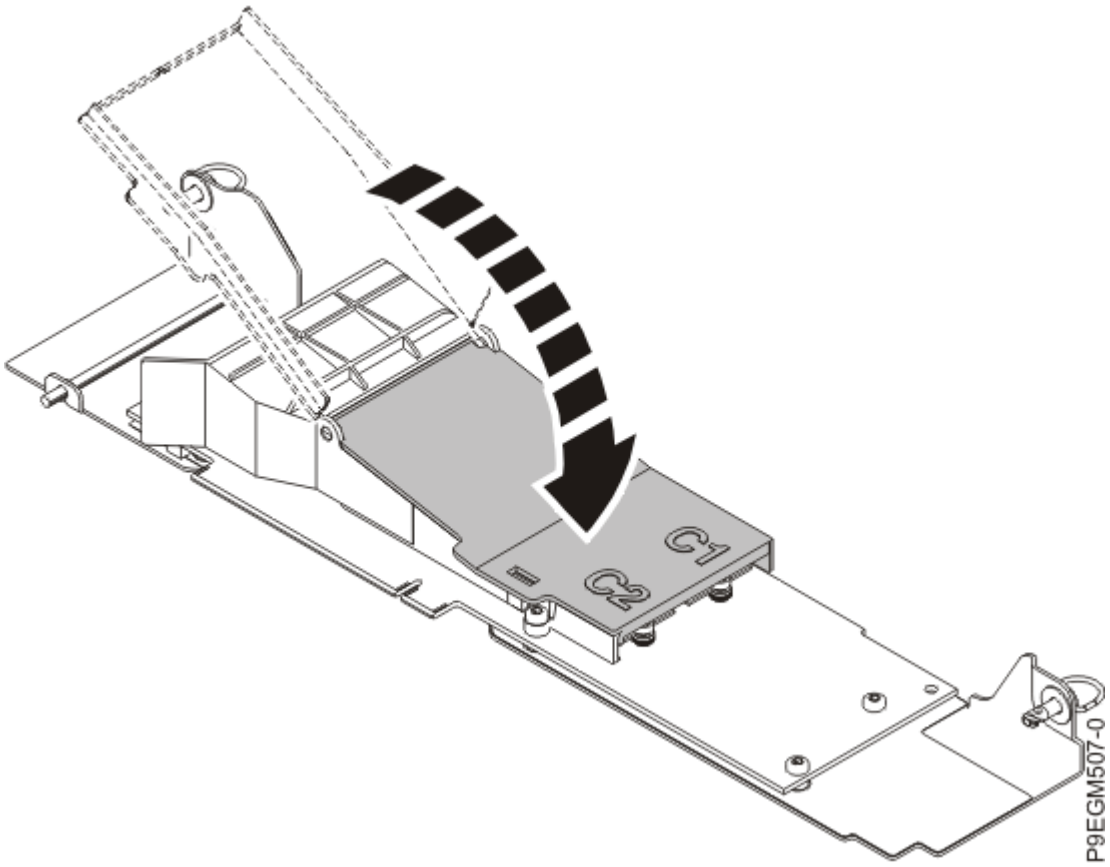


Figure 90. NVMe 400 GB mainstream solid-state drive (FC ES14)

Specifications

Item
Description

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the nvme-cli tool to manage NVMe devices can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

This adapter requires the following drivers:

- AIX: `devices.pciex.e4148a1614109304` for SFP+ optical ports and `devices.pciex.e4148a1614109404` for RJ45 ports
- Linux: bnx2x driver

PCIe3 x8 2-port Fibre Channel (32 Gb/s); (FC EN1A, EN1B, EL5U, and EL5V; CCIN 578F)

Learn about the specifications and operating system requirements for feature code (FC) EN1A, EN1B, EL5U, and EL5V adapters.

Overview

FC EN1A, EN1B, EL5V, and EL5U are electronically identical. FCs EN1A and EL5U are full-height adapters, and FCs EN1B and EL5V are low-profile adapters.

The PCIe3 x8 2-port Fibre Channel (32 Gb/s) Adapter is a PCI Express (PCIe) generation 3 (Gen3) x16 adapter. The adapter can be used in either a x8 or x16 PCIe slot in the system. This adapter is a high performance adapter that is based on the Emulex LPe32000-series PCIe host bus adapter (HBA). The adapter provides two ports of 32 Gb Fibre Channel capability that uses SR optics. Each port can provide up to 32 Gb Fibre Channel functions simultaneously. Each port provides single initiator capability over a fiber link or with NPIV, multiple initiator capabilities is provided. The ports are SFP+ and include an optical SR transceiver. The ports have LC type connectors and use shortwave laser optics. The adapter operates at link speeds of 4, 8, 16, and 32 Gbps and automatically negotiates to the highest speed possible. Each port has two LED indicators that are on the bracket next to each connector. These LEDs communicate boot status and give a visual indication of the operating state. The LEDs have five defined state; solid on, solid off, slow flash, fast flash, and steady flashing. The slow flash rate is 1 Hz. The fast blink is 4 Hz, and the flashing refers to an irregular on/off transition that reflects test progress. The operator must observe the LED sequence for several seconds to ensure that the operating state is correctly identified.

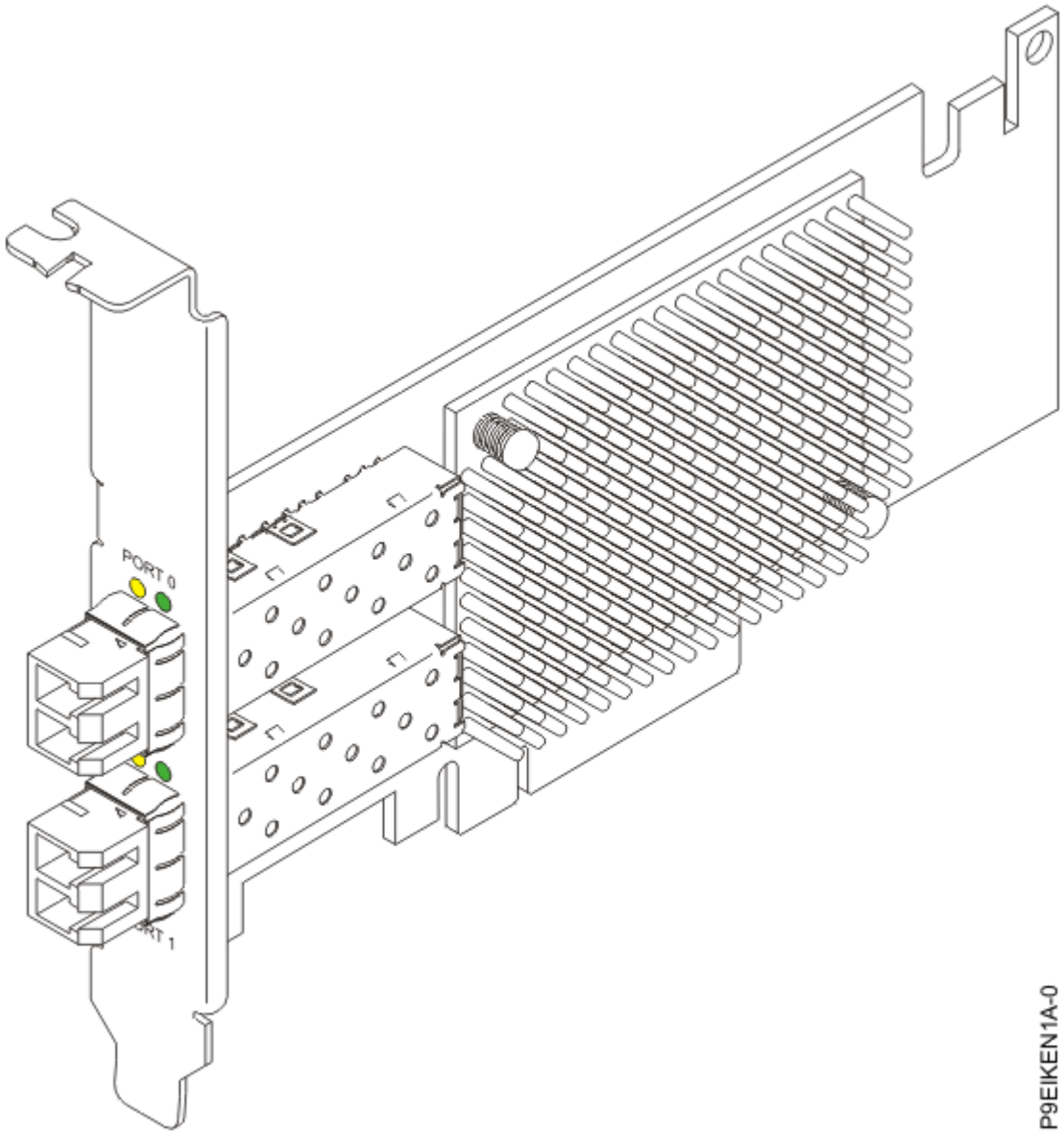


Figure 91. PCIe3 x8 2-port Fibre Channel (32 Gb/s)

Specifications

Item
Description

Adapter FRU number
01FT704

I/O bus architecture
PCIe3 x16.

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
3.3 V, 12 V.

Form factor
Short, low-profile.

Maximum number

For details about the maximum number of adapters that are supported, see Adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Attributes provided

32 Gb/s of throughput.

Enhanced diagnostics and manageability.

Unparalleled performance and more efficient port usage.

Single initiator capability over a fiber link or with NPIV.

Multiple initiator capabilities.

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe3 x8 4-port Fibre Channel (16 Gb/s); (FC EL5W, EL5X, EN1C, and EN1D; CCIN 578E)

Learn about the specifications and operating system requirements for feature code (FCs) EL5W, EL5X, EN1C, and EN1D (EL5X) adapters.

Overview

The FC EN1C (EL5W) and EN1D (EL5X) are electronically identical. FC EN1C (EL5W) is a full-height adapter and FC EN1D (EL5X) is a low-profile adapter.

The PCIe3 x8 4-port fibre Channel (16 Gb/s) Adapter is a PCI Express (PCIe) generation 3 (Gen3) x8 adapter. The adapter can be used in either a x8 or x16 PCIe slot in the system. This adapter is a high-performance adapter that is based on the Emulex LPe31004-series PCIe host bus adapter (HBA). The adapter provides four ports of 16 Gb Fibre Channel capability that uses SR optics. Each port can provide up to 16 Gb Fibre Channel functions simultaneously. Each port provides single initiator capability over a fibre link or with NPIV, multiple initiator capability is provided. The ports are SFP+ and include an optical SR transceiver. The ports have LC type connectors and use shortwave laser optics. The adapter operates at link speeds of 4, 8, and 16 Gbps and automatically negotiates to the highest speed possible. Each port has two LED indicators that are located on the bracket next to each connector. These LEDs communicate boot status and give a visual indication of the operating state. The LEDs have five defined state; solid on, solid off, slow blink, fast blink, and flashing. The slow blink rate is 1 Hz, the fast blink is 4 Hz, and the flashing refers to an irregular on/off transition that reflects test progress. The operator should observe the LED sequence for several seconds to ensure that the operating state is correctly identified.

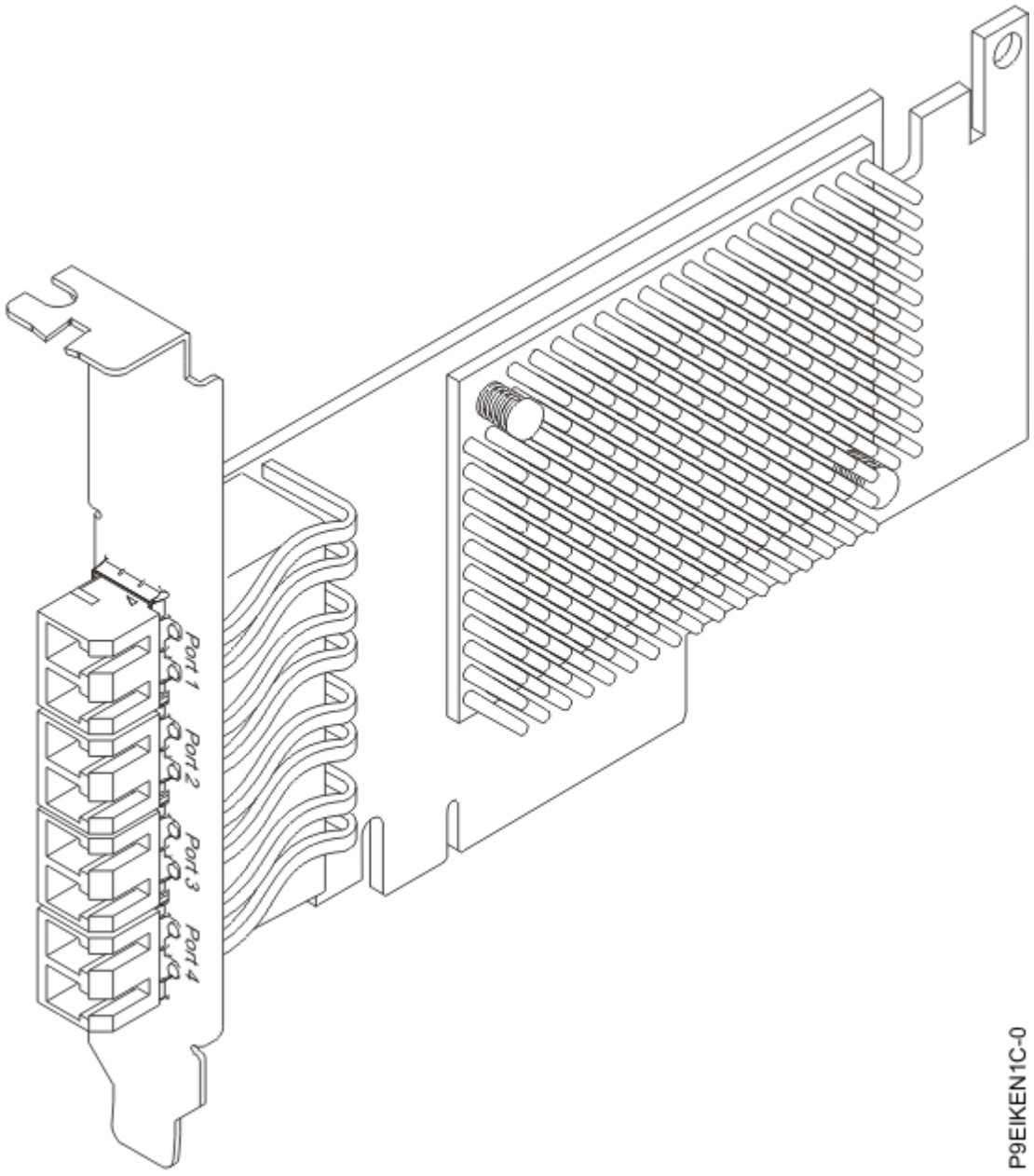


Figure 92. PCIe3 x8 4-port fibre Channel (16 Gb/s)

Specifications

Item
Description

Adapter FRU number
01FT699

12R9314

I/O bus architecture
PCIe3 x8

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
3.3 V, 12 V

Form factor
Short, low-profile

Maximum number
For details about the maximum number of adapters that are supported, see Adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Attributes provided
Enhanced diagnostics and manageability

Unparalleled performance and more efficient port utilization

Single initiator capability over a fibre link or with NPIV

16 Gb/s of throughput per port

Multiple initiator capability

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe3 x8 4-port Fibre Channel (16 Gb/s); (FC EN1E and EN1F; CCIN 579A)

Learn about the specifications and operating system requirements for feature code (FCs) EN1E and EN1F adapters.

Overview

The FC EN1E and EN1F are electronically identical. FC EN1E is a full-height adapter and FC EN1F is a low-profile adapter. The physical difference is that EN1E has a tail stock for full height PCIe slots and EN1F has a short tail stock for low profile PCIe slots. Both feature codes have the same CCIN 579A.

The PCIe Gen3 16 Gigabit quad-port optical Fibre Channel (FC) adapter is a high-performance x8 short form adapter. The adapter provides four ports of 16 Gb Fibre Channel capability by using SR optics. Each port can provide up to 3,200 MBps bandwidth per port. Each port provides single initiator capability over a fibre link or with NPIV, multiple initiator capabilities is provided. The adapter includes Soldered Small Form Factor (SFF) optical transceivers that are installed. The ports have LC type connectors and use shortwave laser optics. The adapter operates at link speeds of 4, 8, and 16 Gbps and automatically negotiates to the highest speed possible. The adapter can be started on IBM Power Systems with **FCode**.

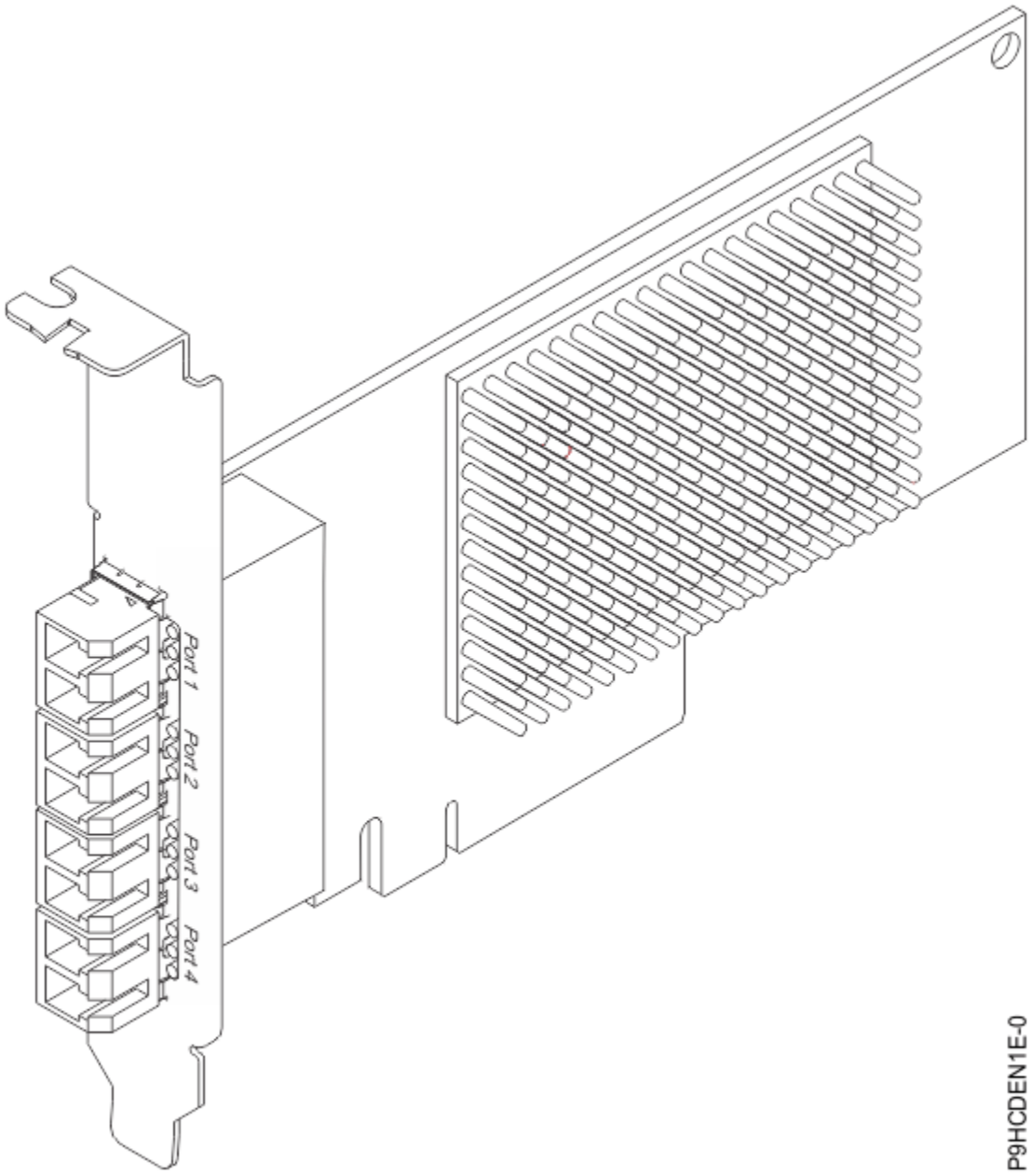


Figure 93. PCIe3 x8 4-port fibre Channel (16 Gb/s)

Specifications

Item
Description

Adapter FRU number
02JD586

I/O bus architecture
PCIe3 x8

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
3.3 V, 12 V

Form factor
Short, low-profile

Maximum number
For details about the maximum number of adapters that are supported, see Adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Attributes provided
Enhanced diagnostics and manageability

Unparalleled performance and more efficient port utilization

Single initiator capability over a fibre link or with NPIV

16 Gb/s of throughput per port

Multiple initiator capability

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe3 x8 2-port Fibre Channel Adapter (16 Gb/s); (FC EN1G and EN1H; CCIN 579B)

Learn about the specifications and operating system requirements for the feature code (FC) EN1G and EN1H adapters.

Overview

The FC EN1G and EN1H are electronically identical. FC EN1G is a full-height adapter and FC EN1H is a low-profile adapter.

The PCIe3 x8 dual-port Fibre Channel (16 Gb/s) adapter is a PCI Express (PCIe) generation 3 (Gen3) x8 adapter. This PCIe adapter is based on the Marvell QLE2692 PCIe host bus adapter 15.2 cm x 7 cm (6.6 inches x 2.7 inches). The adapter provides two ports of 16 Gb Fibre Channel capability by using SR optics. Each port can provide up to 16 Gb fibre channel functions simultaneously. Each port provides single initiator capability over a fiber optic link or with N_Port ID Virtualization (NPIV) it provides multiple initiator capabilities. The ports are small form-factor pluggable (SFP+) and include an optical SR transceiver. The ports have LC-type connectors and use shortwave laser optics. The adapter operates at link speeds of 4, 8, and 16 Gbps and it automatically negotiates to the highest speed possible. The adapter can be started on IBM Power Systems with FCode.

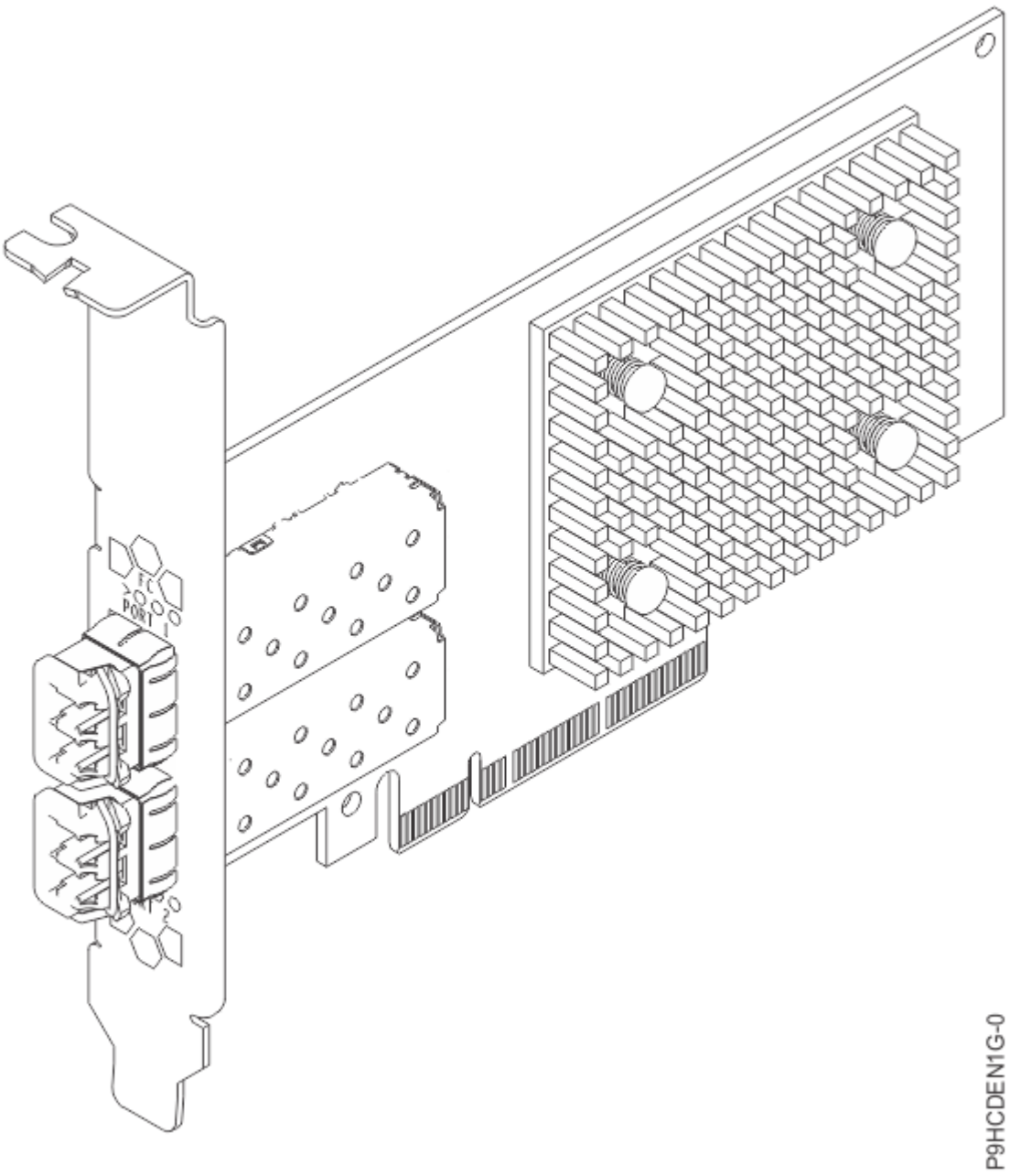


Figure 94. FC EN1G PCIe3 x8 2-port Fibre Channel Adapter (16 Gb/s)

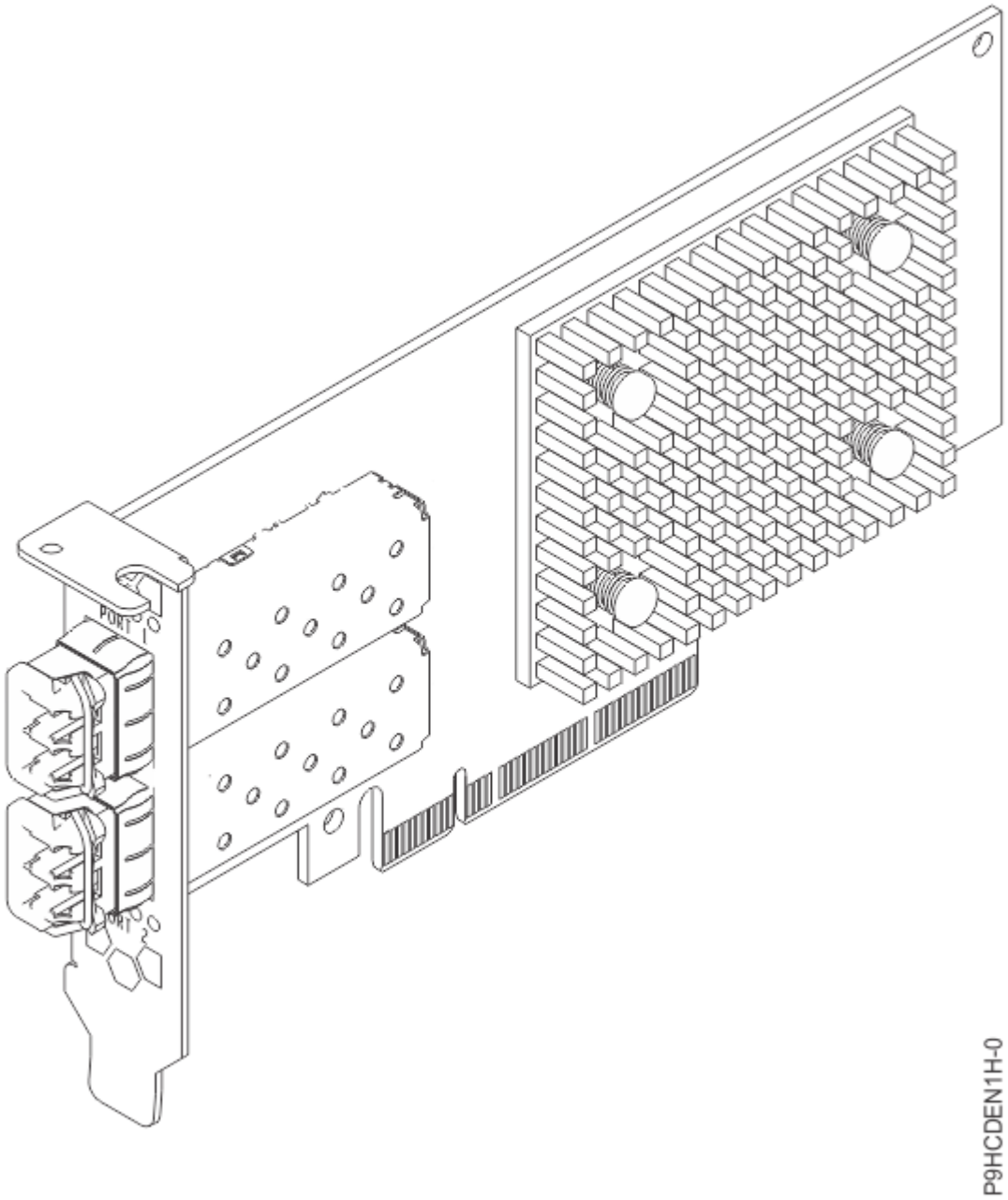


Figure 95. EN1H PCIe3 x8 2-port Fibre Channel Adapter (16 Gb/s)

Specifications

Item
Description

Adapter FRU number
02CM904

I/O bus architecture
PCIe3 x8

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Cables
See “Cables” on page 258 for details.

Voltage
3.3 V, 12 V

Form factor
Short, low-profile

Maximum number
For details about the maximum number of adapters that are supported, see Adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Attributes provided
Enhanced diagnostics and manageability

Unparalleled performance and more efficient port utilization

Single initiator capability over a fiber optic link or with NPIV

16 Gb/s of throughput per port

Multiple initiator capabilities

Cables

Use multimode fiber optic cables with shortwave lasers that adhere to the following specifications:

- OM4: Multimode 50/125 micron fiber, 4700 MHz x km bandwidth
- OM3: Multimode 50/125 micron fiber, 2000 MHz x km bandwidth
- OM2: Multimode 50/125 micron fiber, 500 MHz x km bandwidth
- OM1: Multimode 62.5/125 micron fiber, 200 MHz x km bandwidth

Because core sizes are different, OM1 cables can be connected only to other OM1 cables. For best results, OM2 cables must not be connected to OM3 or OM4 cables. However, if an OM2 cable is connected to an OM3 or OM4 cable, the characteristics of the OM2 cable apply to the entire length of the cables. The following table shows the supported distances for the different fiber optic cable types at different link speeds.

Table 46. Supported distances for multimode fiber optic cables

Header	**Cable Type and Distance**			
Rate	OM1	OM2	OM3	OM4
4 Gbps	0.5 meters to 70 meters (1.64 feet to 229.69 feet)	0.5 meters to 150 meters (1.64 feet to 492.12 feet)	0.5 meters to 380 meters (1.64 feet to 1246.72 feet)	0.5 meters to 400 meters (1.64 feet to 1312.34 feet)
8 Gbps	0.5 meters to 21 meters (1.64 feet to 68.89 feet)	0.5 meters to 50 meters (1.64 feet to 164.04 feet)	0.5 meters to 150 meters (1.64 feet to 492.12 feet)	0.5 meters to 190 meters (1.64 feet to 623.26 feet)
16 Gbps		0.5 meters to 35 meters (1.64 feet to 114.82 feet)	0.5 meters to 100 meters (1.64 feet to 328.08 feet)	0.5 meters to 125 meters (1.64 feet to 410.10 feet)

Note: The hardware cannot detect the type and length of cable that is installed. The link auto-negotiates to the speed that is reported during negotiation by the system. You must manually set the maximum value for speed that can be set during negotiation. If you set a value for speed that is higher than the supported cable value, errors can occur.

Adapter LED

Green LEDs can be seen through openings in the mounting bracket of the adapter. Table 47 on page 259 summarizes the LED states for this adapter.

Table 47. LED states			
State	**Green LED (16 Gbps)**	**Green LED (8 Gbps)**	**Green LED (4 Gbps)**
Power Off	Off	Off	Off
Power On (Before Firmware Initialization)	On	On	On
Power On (After Firmware Initialization)	Flash	Flash	Flash
Firmware Fault	Flash in sequence	Flash in sequence	Flash in sequence
4 Gbps Link Up/ACT	Off	Off	On / Flash
8 Gbps Link Up/ACT	Off	On / Flash	Off
16 Gbps Link Up/ACT	On / Flash	Off	Off
Beaconing	Flash	Off	Flash

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe4 x8 2-port Fibre Channel (32 Gb/s); (FC EN1J and EN1K; CCIN 579C)

Learn about the specifications and operating system requirements for feature code (FC) EN1J and EN1K adapters.

Overview

FC EN1J and EN1K are electronically identical. FC EN1J is a full-height adapter and FC EN1K is a low-profile adapter. The physical difference is that EN1J has a tail stock for full height PCIe slots and EN1K has a short tail stock for low profile PCIe slots. Both feature codes have the same CCIN 579C.

The PCIe Gen4 32 Gigabit two port optical Fibre Channel (FC) adapter is a high-performance x8 short form adapter. The adapter provides two ports of 32 Gb Fibre Channel capability by using SR optics. Each port can provide up to 6,400 MBps bandwidth per port. Each port provides single initiator capability over a fibre link or with NPIV, multiple initiator capabilities is provided. The adapter includes 32 Gb SR optical transceivers that are installed. The ports have LC type connectors and use shortwave laser optics. The adapter operates at link speeds of 8, 16, and 32 Gbps and automatically negotiates to the highest speed possible. The adapter can be started on IBM Power Systems with **FCode**.

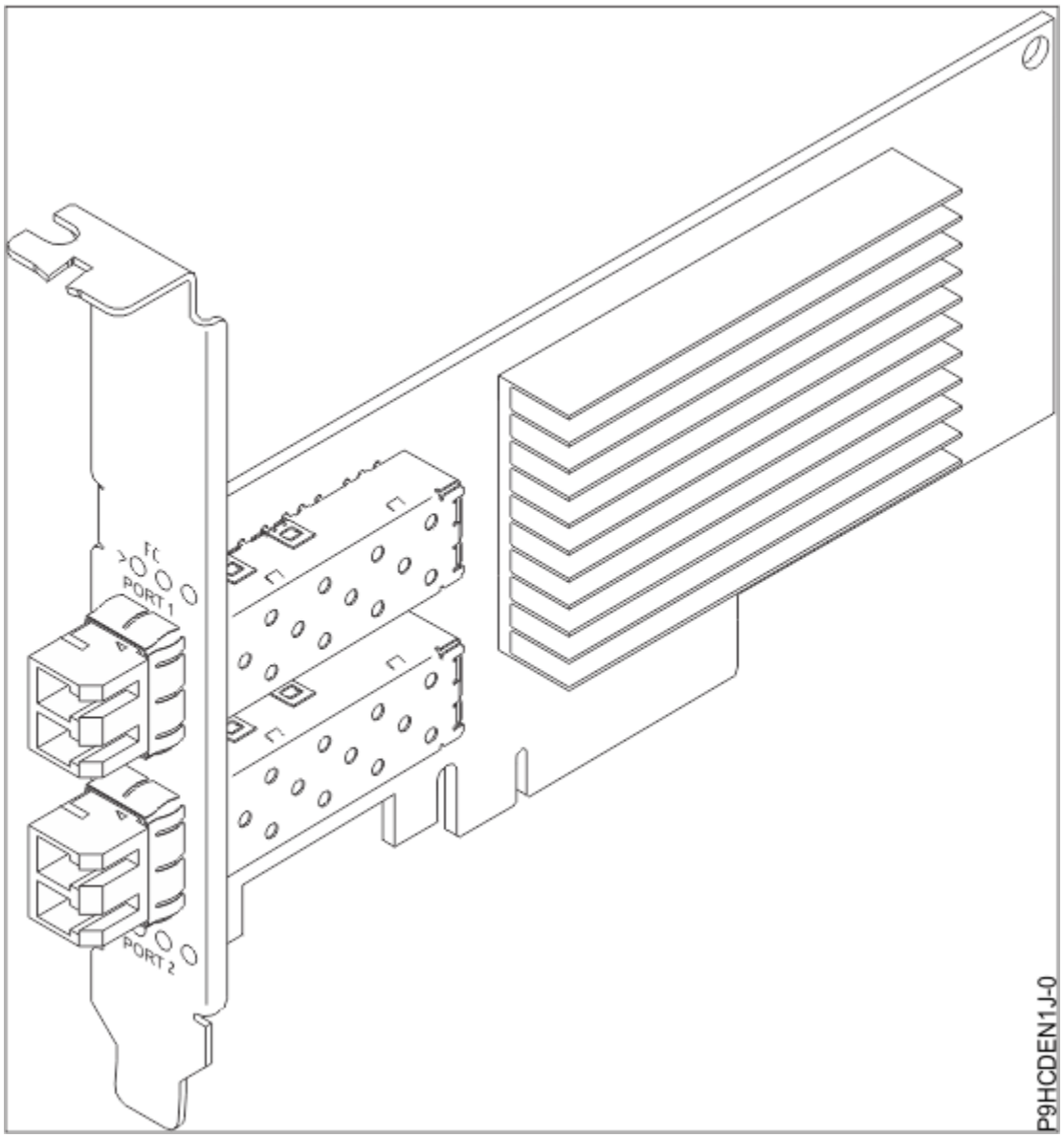


Figure 96. PCIe4 x8 2-port Fibre Channel (32 Gb/s)

Specifications

Item
Description

Adapter FRU number
02CM909

I/O bus architecture
PCIe4 x8.

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
3.3 V, 12 V.

Form factor
Short, low-profile.

Maximum number

For details about the maximum number of adapters that are supported, see Adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Attributes provided

32 Gb/s of throughput.

Enhanced diagnostics and manageability.

Unparalleled performance and more efficient port usage.

Single initiator capability over a fiber link or with NPIV.

Multiple initiator capabilities.

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

PCIe3 16 Gb 2-port Fibre Channel adapter (FC EN2A and FC EN2B; CCIN 579D)

Learn about the specifications and operating system requirements for the feature code (FC) FC EN2A and FC EN2B adapter.

Overview

The PCIe3 16 Gb 2-port Fibre Channel adapter is an x8, generation 3 (gen3), PCIe adapter. This adapter is a high-performance x8 short form adapter also referred to as a PCIe Host Bus Adapter (HBA). The adapter provides two ports of 16 Gb Fibre Channel capability using SR optics. Each port can provide up to 16 Gb Fibre Channel functions simultaneously.

The FC EN2A is a short, regular height adapter and the FC EN2B adapter is a short, low-profile adapter.

Each port provides single initiator capability over a fibre link. If you are using N_Port ID Virtualization (NPIV), multiple initiator capability is provided. The ports are SFP+ and include an optical SR transceiver. The ports have little connector-type (LC) and utilize shortwave laser optics. The adapter operates at link speeds of 4, 8, and 16 Gbps and it will automatically negotiate to the highest speed possible. LEDs on each port provide information on the status and link speed of the port.

The adapter connects to a Fibre Channel switch at 4 Gb, 8 Gb, or 16 Gb. It can directly attach to a device without a switch at 16 Gb. The adapter without a Fibre Channel switch attached is not supported at 4 Gb or 8 Gb.

NPIV capability is supported through Virtual I/O Server (VIOS).

The adapter has the following features:

- The adapter is compliant with the PCIe base and Card Electromechanical (CEM) 2.0 specifications with the following characteristics:
  - Provides an x8 lane link interface at 14.025 Gbps, 8.5 Gbps, or 4.25 Gbps (automatic negotiation with system)
  - Provides support for one Virtual Channel (VC0) and one Traffic Class (TC0)
  - Provides configuration and I/O memory read and write, completion, and messaging capabilities
  - Provides support for 64-bit addressing
  - Provides error correction code (ECC) and error protection functions
  - Provides link cyclic redundancy check (CRC) on all PCIe packets and message information
  - Provides a large payload size of 2048 bytes for read and write functions
  - Provides a large read request size of 4096 bytes
- The adapter is compatible with 4, 8, and 16 Gb Fibre Channel interface with the following characteristics:
  - Provides for automatic negotiation between 4 Gb, 8 Gb, or 16 Gb link attachments
  - Provides support for the following Fibre Channel topologies: point-to-point (16 Gb only) and fabric
  - Provides support for Fibre Channel class 3
  - Provides a maximum Fibre Channel throughput that is achieved by using full duplex hardware support
- The adapter provides an end-to-end data path parity and CRC protection, including internal data path random-access memory (RAM)
- Provides architectural support for multiple upper layer protocols
- Provides comprehensive virtualization capabilities with support for N_Port ID Virtualization (NPIV) and virtual fabric (VF)
- Provides support for message signaled interrupts extended (MSI-X)
- Provides support for 255 VFs and 1024 MSi-X
- Provides an internal, high-speed static random-access memory (SRAM) memory
- Provides ECC protection of local memory that includes single-bit correction and double-bit protection
- Provides an embedded shortwave optical connection with diagnostics capability
- Provides support for an on-board context management by firmware:
  - Up to 8192 FC port logins
  - I/O multiplexing down to the Fibre Channel frame level
- Provides data buffers capable of supporting 64+ buffer-to-buffer (BB) credits per port for shortwave applications
- Provides link management and recovery that is handled by firmware
- Provides on-board diagnostic capability accessible by an optional connection
- Provides a performance up to 16 Gbps full duplex

The following figures show the adapter.

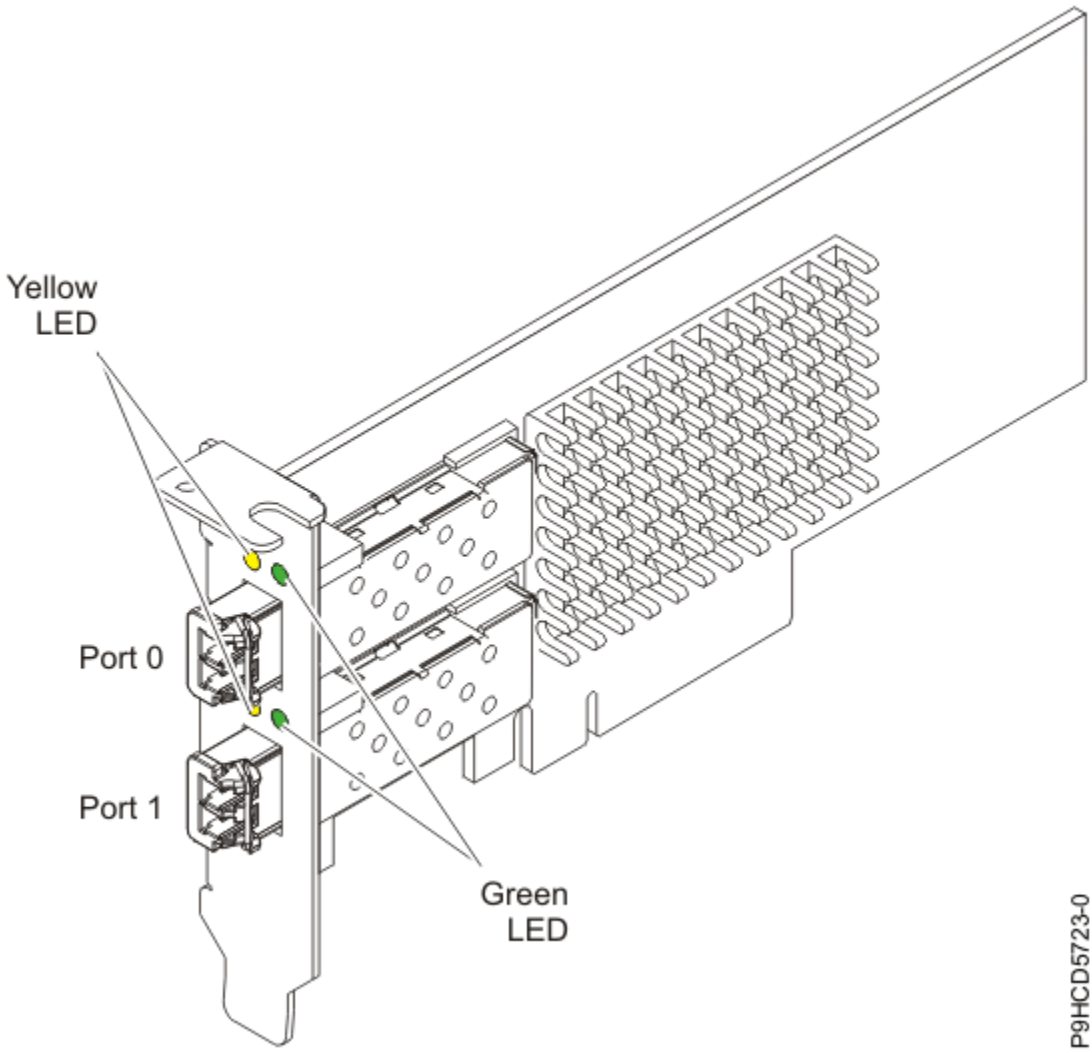


Figure 97. PCIe3 16 Gb 2-port Fibre Channel adapter (FC EN2B)

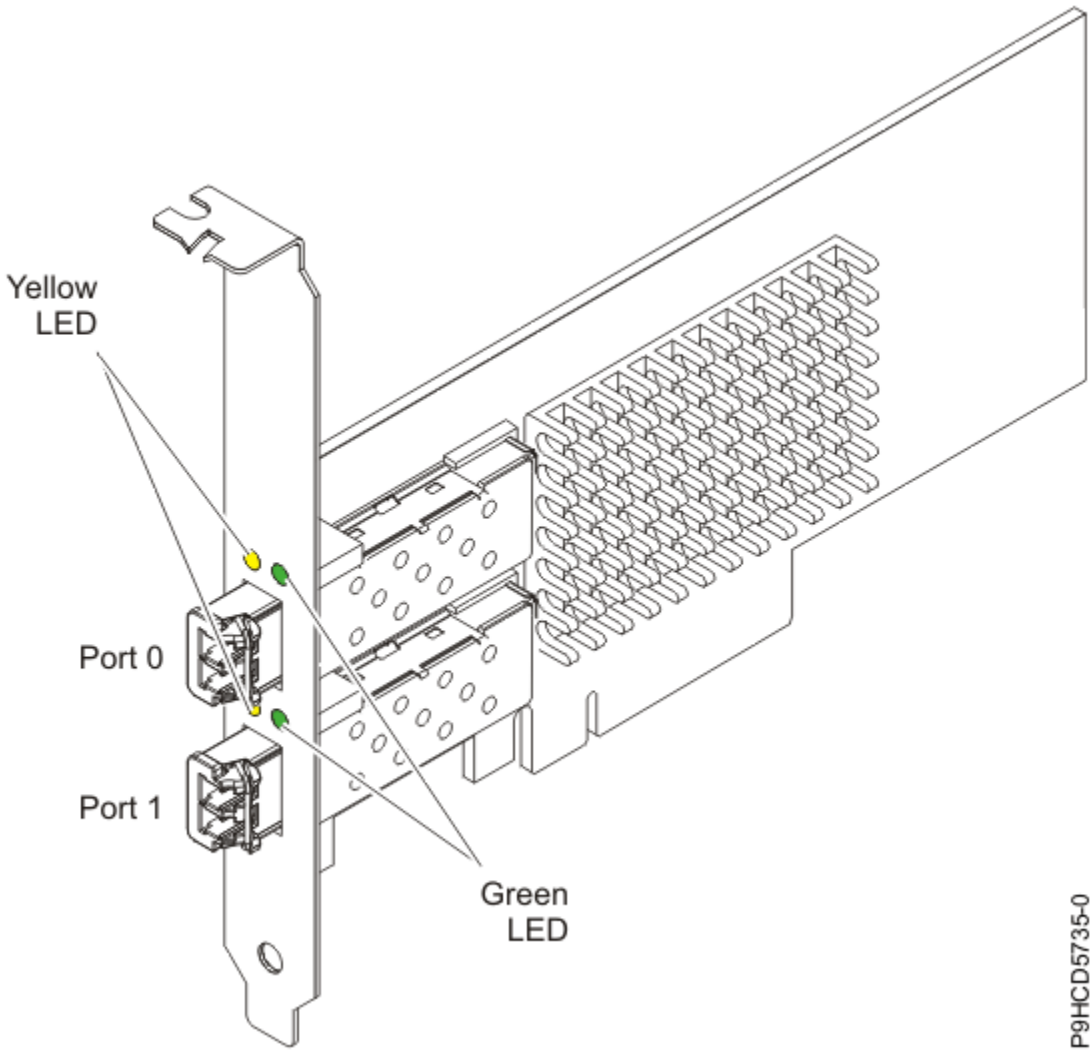


Figure 98. PCIe3 16 Gb 2-port Fibre Channel adapter (FC EN2A)

Specifications

Item
Description

Adapter FRU number
02JD564

Wrap plug FRU number
12R9314

Note: The wrap plug is included with the card, and can also be purchased from IBM.

I/O bus architecture
PCIe base and CEM 3.0, x8 PCIe bus interface

Slot requirement
For details about slot priorities, maximums, and placement rules, see PCIe adapter placement rules and slot priorities (http://www.ibm.com/support/knowledgecenter/POWER9/p9eab/p9eab_mtm_pciplacement.htm) and select the system you are working on.

Voltage
3.3 V, 12 V

Form factor
Short, MD2

FC compatibility
4, 8, 16 Gb

Cables
Cables are the responsibility of the customer. Use multimode fiber optic cables with shortwave lasers that adhere to the following specifications:

- OM4: Multimode 50/125 micron fiber, 4700 MHz x km bandwidth
- OM3: Multimode 50/125 micron fiber, 2000 MHz x km bandwidth
- OM2: Multimode 50/125 micron fiber, 500 MHz x km bandwidth
- OM1: Multimode 62.5/125 micron fiber, 200 MHz x km bandwidth

Because core sizes are different, OM1 cables can only be connected to other OM1 cables. For best results, OM2 cables must not be connected to OM3 cables. However, if an OM2 cable is connected to an OM3 cable, the characteristics of the OM2 cable apply to the entire length of the cables.

The following table shows the supported distances for the different cable types at the different link speeds.

Table 48. Supported distances for cables

Header	**Cable type and distance**			
Rate	OM1	OM2	OM3	OM4
4 Gbps	0.5 - 70 m (1.64 - 229.65 ft)	0.5 - 150 m (1.64 - 492.12 ft)	0.5 - 380 m (1.64 - 1246.71 ft)	0.5 - 400 m (1.64 - 1312.34 ft)
8 Gbps	0.5 - 21 m (1.64 - 68.89 ft)	0.5 - 50 m (1.64 - 164.04 ft)	0.5 - 150 m (1.64 - 492.12 ft)	0.5 - 190 m (1.64 - 623.36 ft)
16 Gbps	0.5 - 15 m (1.64 - 49.21 ft)	0.5 - 35 m (1.64 - 114.82 ft)	0.5 - 100 m (1.64 - 328.08 ft)	0.5 - 125 m (1.64 - 410.10 ft)

Adapter LED states

Green and yellow LEDs can be seen through openings in the mounting bracket of the adapter. Green indicates firmware operation, and yellow signifies port activity. Table 49 on page 265 summarizes normal LED states. A 1 Hz pause occurs when the LED is off between each group of fast flashes (2, 3 or 4). Observe the LED sequence for several seconds to ensure that you correctly identify the state.

Table 49. Normal LED states

Green LED	**Yellow LED**	**State**
On	2 fast flashes	4 Gbps link rate: normal, link active
On	3 fast flashes	8 Gbps link rate: normal, link active
On	4 fast flashes	16 Gbps link rate: normal, link active

Power-on-self-test (POST) conditions and results are summarized in Table 50 on page 265. These states can be used to identify abnormal states or problems.

Table 50. POST conditions and results

Green LED	**Yellow LED**	**State**
Off	Off	Wake-up failure of the adapter board

Table 50. POST conditions and results (continued)		
Green LED	**Yellow LED**	**State**
Off	On	POST failure of the adapter board
Off	Slow flash	Wake-up failure monitor
Off	Fast flash	Failure in post
Off	Flashing	Postprocessing in progress
On	Off	Failure while functioning
On	On	Failure while functioning
Slow flash	Off	Normal, link down
Slow flash	On	Not defined
Slow flash	Slow flash	Offline for download
Slow flash	Fast flash	Restricted offline mode, waiting for restart
Slow flash	Flashing	Restricted offline mode, test active
Fast flash	Off	Debug monitor in restricted mode
Fast flash	On	Not defined
Fast flash	Slow flash	Debug monitor in test fixture mode
Fast flash	Fast flash	Debug monitor in remote debug mode
Fast flash	Flashing	Not defined

Operating system or partition requirements

If you are installing a new feature, ensure that you have the software that is required to support the new feature and you must determine any prerequisites that must be met for this feature and the attached devices. For information about operating system and partition requirements, see one of the following topics:

- The latest version of enabling libraries and utilities can be downloaded from the Fix Central website (http://www.ibm.com/support/fixcentral/).
- Power Systems Prerequisites website (http://www14.software.ibm.com/support/customercare/iprt/home).
- IBM System Storage Interoperation Center (SSIC) website (http://www-03.ibm.com/systems/support/storage/ssic/interoperability.wss).
- The latest version of the device driver or IBM Power RAID adapter utilities (iprutils) can be downloaded from the IBM Service and Productivity Tools website (http://www14.software.ibm.com/webapp/set2/sas/f/lopdiags/home.html).
- For information about important notices for Linux on IBM Power Systems, see the Linux on IBM website (www14.software.ibm.com/webapp/set2/sas/f/lopdiags/info/LinuxAlerts.html).

Notices

This information was developed for products and services offered in the US.

IBM may not offer the products, services, or features discussed in this document in other countries. Consult your local IBM representative for information on the products and services currently available in your area. Any reference to an IBM product, program, or service is not intended to state or imply that only that IBM product, program, or service may be used. Any functionally equivalent product, program, or service that does not infringe any IBM intellectual property right may be used instead. However, it is the user's responsibility to evaluate and verify the operation of any non-IBM product, program, or service.

IBM may have patents or pending patent applications covering subject matter described in this document. The furnishing of this document does not grant you any license to these patents. You can send license inquiries, in writing, to:

IBM Director of Licensing
IBM Corporation
North Castle Drive, MD-NC119
Armonk, NY 10504-1785
US

INTERNATIONAL BUSINESS MACHINES CORPORATION PROVIDES THIS PUBLICATION "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Some jurisdictions do not allow disclaimer of express or implied warranties in certain transactions, therefore, this statement may not apply to you.

This information could include technical inaccuracies or typographical errors. Changes are periodically made to the information herein; these changes will be incorporated in new editions of the publication. IBM may make improvements and/or changes in the product(s) and/or the program(s) described in this publication at any time without notice.

Any references in this information to non-IBM websites are provided for convenience only and do not in any manner serve as an endorsement of those websites. The materials at those websites are not part of the materials for this IBM product and use of those websites is at your own risk.

IBM may use or distribute any of the information you provide in any way it believes appropriate without incurring any obligation to you.

The performance data and client examples cited are presented for illustrative purposes only. Actual performance results may vary depending on specific configurations and operating conditions.

Information concerning non-IBM products was obtained from the suppliers of those products, their published announcements or other publicly available sources. IBM has not tested those products and cannot confirm the accuracy of performance, compatibility or any other claims related to non-IBM products. Questions on the capabilities of non-IBM products should be addressed to the suppliers of those products.

Statements regarding IBM's future direction or intent are subject to change or withdrawal without notice, and represent goals and objectives only.

All IBM prices shown are IBM's suggested retail prices, are current and are subject to change without notice. Dealer prices may vary.

This information is for planning purposes only. The information herein is subject to change before the products described become available.

This information contains examples of data and reports used in daily business operations. To illustrate them as completely as possible, the examples include the names of individuals, companies, brands, and products. All of these names are fictitious and any similarity to actual people or business enterprises is entirely coincidental.

If you are viewing this information in softcopy, the photographs and color illustrations may not appear.

The drawings and specifications contained herein shall not be reproduced in whole or in part without the written permission of IBM.

IBM has prepared this information for use with the specific machines indicated. IBM makes no representations that it is suitable for any other purpose.

IBM's computer systems contain mechanisms designed to reduce the possibility of undetected data corruption or loss. This risk, however, cannot be eliminated. Users who experience unplanned outages, system failures, power fluctuations or outages, or component failures must verify the accuracy of operations performed and data saved or transmitted by the system at or near the time of the outage or failure. In addition, users must establish procedures to ensure that there is independent data verification before relying on such data in sensitive or critical operations. Users should periodically check IBM's support websites for updated information and fixes applicable to the system and related software.

Homologation statement

This product may not be certified in your country for connection by any means whatsoever to interfaces of public telecommunications networks. Further certification may be required by law prior to making any such connection. Contact an IBM representative or reseller for any questions.

Accessibility features for IBM Power Systems servers

Accessibility features assist users who have a disability, such as restricted mobility or limited vision, to use information technology content successfully.

Overview

The IBM Power Systems servers include the following major accessibility features:

- Keyboard-only operation
- Operations that use a screen reader

The IBM Power Systems servers use the latest W3C Standard, WAI-ARIA 1.0 (www.w3.org/TR/wai-aria/), to ensure compliance with US Section 508 (www.access-board.gov/guidelines-and-standards/communications-and-it/about-the-section-508-standards/section-508-standards) and Web Content Accessibility Guidelines (WCAG) 2.0 (www.w3.org/TR/WCAG20/). To take advantage of accessibility features, use the latest release of your screen reader and the latest web browser that is supported by the IBM Power Systems servers.

The IBM Power Systems servers online product documentation in IBM Knowledge Center is enabled for accessibility. The accessibility features of IBM Knowledge Center are described in the Accessibility section of the IBM Knowledge Center help (www.ibm.com/support/knowledgecenter/doc/kc_help.html#accessibility).

Keyboard navigation

This product uses standard navigation keys.

Interface information

The IBM Power Systems servers user interfaces do not have content that flashes 2 - 55 times per second.

The IBM Power Systems servers web user interface relies on cascading style sheets to render content properly and to provide a usable experience. The application provides an equivalent way for low-vision users to use system display settings, including high-contrast mode. You can control font size by using the device or web browser settings.

The IBM Power Systems servers web user interface includes WAI-ARIA navigational landmarks that you can use to quickly navigate to functional areas in the application.

Vendor software

The IBM Power Systems servers include certain vendor software that is not covered under the IBM license agreement. IBM makes no representation about the accessibility features of these products. Contact the vendor for accessibility information about its products.

Related accessibility information

In addition to standard IBM help desk and support websites, IBM has a TTY telephone service for use by deaf or hard of hearing customers to access sales and support services:

TTY service
800-IBM-3383 (800-426-3383)
(within North America)

For more information about the commitment that IBM has to accessibility, see IBM Accessibility (www.ibm.com/able).

Privacy policy considerations

IBM Software products, including software as a service solutions, (“Software Offerings”) may use cookies or other technologies to collect product usage information, to help improve the end user experience, to tailor interactions with the end user, or for other purposes. In many cases no personally identifiable information is collected by the Software Offerings. Some of our Software Offerings can help enable you to collect personally identifiable information. If this Software Offering uses cookies to collect personally identifiable information, specific information about this offering’s use of cookies is set forth below.

This Software Offering does not use cookies or other technologies to collect personally identifiable information.

If the configurations deployed for this Software Offering provide you as the customer the ability to collect personally identifiable information from end users via cookies and other technologies, you should seek your own legal advice about any laws applicable to such data collection, including any requirements for notice and consent.

For more information about the use of various technologies, including cookies, for these purposes, see IBM’s Privacy Policy at http://www.ibm.com/privacy and IBM’s Online Privacy Statement at http://www.ibm.com/privacy/details/us/en/ in the section entitled “Cookies, Web Beacons and Other Technologies”.

Trademarks

IBM, the IBM logo, and ibm.com® are trademarks or registered trademarks of International Business Machines Corp., registered in many jurisdictions worldwide. Other product and service names might be trademarks of IBM or other companies. A current list of IBM trademarks is available on the web at Copyright and trademark information.

INFINIBAND, InfiniBand Trade Association, and the INFINIBAND design marks are trademarks and/or service marks of the INFINIBAND Trade Association.

Intel, Intel logo, Intel Inside, Intel Inside logo, Intel Centrino, Intel Centrino logo, Celeron, Intel Xeon, Intel SpeedStep, Itanium, and Pentium are trademarks or registered trademarks of Intel Corporation or its subsidiaries in the United States and other countries.

The registered trademark Linux is used pursuant to a sublicense from the Linux Foundation, the exclusive licensee of Linus Torvalds, owner of the mark on a worldwide basis.

Electronic emission notices

Class A Notices

The following Class A statements apply to the IBM servers that contain the POWER9 processor and its features unless designated as electromagnetic compatibility (EMC) Class B in the feature information.

When attaching a monitor to the equipment, you must use the designated monitor cable and any interference suppression devices supplied with the monitor.

Canada Notice

CAN ICES-3 (A)/NMB-3(A)

European Community and Morocco Notice

This product is in conformity with the protection requirements of Directive 2014/30/EU of the European Parliament and of the Council on the harmonization of the laws of the Member States relating to electromagnetic compatibility. IBM cannot accept responsibility for any failure to satisfy the protection requirements resulting from a non-recommended modification of the product, including the fitting of non-IBM option cards.

This product may cause interference if used in residential areas. Such use must be avoided unless the user takes special measures to reduce electromagnetic emissions to prevent interference to the reception of radio and television broadcasts.

Warning: This equipment is compliant with Class A of CISPR 32. In a residential environment this equipment may cause radio interference.

Germany Notice

Deutschsprachiger EU Hinweis: Hinweis für Geräte der Klasse A EU-Richtlinie zur Elektromagnetischen Verträglichkeit

Dieses Produkt entspricht den Schutzanforderungen der EU-Richtlinie 2014/30/EU zur Angleichung der Rechtsvorschriften über die elektromagnetische Verträglichkeit in den EU-Mitgliedsstaatenund hält die Grenzwerte der EN 55022 / EN 55032 Klasse A ein.

Um dieses sicherzustellen, sind die Geräte wie in den Handbüchern beschrieben zu installieren und zu betreiben. Des Weiteren dürfen auch nur von der IBM empfohlene Kabel angeschlossen werden. IBM übernimmt keine Verantwortung für die Einhaltung der Schutzanforderungen, wenn das Produkt ohne Zustimmung von IBM verändert bzw. wenn Erweiterungskomponenten von Fremdherstellern ohne Empfehlung von IBM gesteckt/eingebaut werden.

EN 55032 Klasse A Geräte müssen mit folgendem Warnhinweis versehen werden:

"Warnung: Dieses ist eine Einrichtung der Klasse A. Diese Einrichtung kann im Wohnbereich Funk-Störungen verursachen; in diesem Fall kann vom Betreiber verlangt werden, angemessene Maßnahmen zu ergreifen und dafür aufzukommen."

Deutschland: Einhaltung des Gesetzes über die elektromagnetische Verträglichkeit von Geräten

Dieses Produkt entspricht dem “Gesetz über die elektromagnetische Verträglichkeit von Geräten (EMVG)“. Dies ist die Umsetzung der EU-Richtlinie 2014/30/EU in der Bundesrepublik Deutschland.

Zulassungsbescheinigung laut dem Deutschen Gesetz über die elektromagnetische Verträglichkeit von Geräten (EMVG) (bzw. der EMC Richtlinie 2014/30/EU) für Geräte der Klasse A

Dieses Gerät ist berechtigt, in Übereinstimmung mit dem Deutschen EMVG das EG-Konformitätszeichen - CE - zu führen.

Verantwortlich für die Einhaltung der EMV Vorschriften ist der Hersteller:
International Business Machines Corp.

New Orchard Road
Armonk, New York 10504
Tel: 914-499-1900

Der verantwortliche Ansprechpartner des Herstellers in der EU ist:
IBM Deutschland GmbH
Technical Relations Europe, Abteilung M456
IBM-Allee 1, 71139 Ehningen, Germany
Tel: +49 (0) 800 225 5426
email: HalloIBM@de.ibm.com

Generelle Informationen:

Das Gerät erfüllt die Schutzanforderungen nach EN 55024 und EN 55022 / EN 55032 Klasse A.

Japan Electronics and Information Technology Industries Association (JEITA) Notice

（一社）電子情報技術産業協会　高調波電流抑制対策実施
要領に基づく定格入力電力値： Knowledge Centerの各製品の
仕様ページ参照

This statement applies to products less than or equal to 20 A per phase.

高調波電流規格 JIS C 61000-3-2 適合品

This statement applies to products greater than 20 A, single phase.

高調波電流規格 JIS C 61000-3-2 準用品

本装置は、「高圧又は特別高圧で受電する需要家の高調波抑制対策ガイドライン」対象機器（高調波発生機器）です。
• 回路分類 ：6（単相、ＰＦＣ回路付）
• 換算係数 ：0

This statement applies to products greater than 20 A per phase, three-phase.

高調波電流規格 JIS C 61000-3-2 準用品

本装置は、「高圧又は特別高圧で受電する需要家の高調波抑制対策ガイドライン」対象機器（高調波発生機器）です。
• 回路分類 ：5（3相、ＰＦＣ回路付）
• 換算係数 ：0

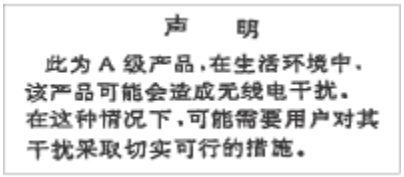
Japan Voluntary Control Council for Interference (VCCI) Notice

この装置は、クラスA 情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。 VCCI－A

Korea Notice

이 기기는 업무용 환경에서 사용할 목적으로 적합성평가를 받은 기기로서 가정용 환경에서 사용하는 경우 전파간섭의 우려가 있습니다.

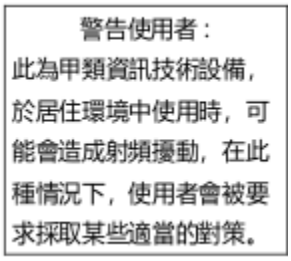
People's Republic of China Notice



Russia Notice

ВНИМАНИЕ! Настоящее изделие относится к классу А.
В жилых помещениях оно может создавать
радиопомехи, для снижения которых необходимы
дополнительные меры

Taiwan Notice



IBM Taiwan Contact Information:

台灣IBM 產品服務聯絡方式：
台灣國際商業機器股份有限公司
台北市松仁路7號3樓
電話：0800-016-888

United States Federal Communications Commission (FCC) Notice

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

Properly shielded and grounded cables and connectors must be used in order to meet FCC emission limits. Proper cables and connectors are available from IBM-authorized dealers. IBM is not responsible for any radio or television interference caused by using other than recommended cables and connectors

or by unauthorized changes or modifications to this equipment. Unauthorized changes or modifications could void the user's authority to operate the equipment.

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Responsible Party:
International Business Machines Corporation
New Orchard Road
Armonk, NY 10504
Contact for FCC compliance information only: fccinfo@us.ibm.com

Class B Notices

The following Class B statements apply to features designated as electromagnetic compatibility (EMC) Class B in the feature installation information.

When attaching a monitor to the equipment, you must use the designated monitor cable and any interference suppression devices supplied with the monitor.

Canada Notice

CAN ICES-3 (B)/NMB-3(B)

European Community and Morocco Notice

This product is in conformity with the protection requirements of Directive 2014/30/EU of the European Parliament and of the Council on the harmonization of the laws of the Member States relating to electromagnetic compatibility. IBM cannot accept responsibility for any failure to satisfy the protection requirements resulting from a non-recommended modification of the product, including the fitting of non-IBM option cards.

German Notice

Deutschsprachiger EU Hinweis: Hinweis für Geräte der Klasse B EU-Richtlinie zur Elektromagnetischen Verträglichkeit

Dieses Produkt entspricht den Schutzanforderungen der EU-Richtlinie 2014/30/EU zur Angleichung der Rechtsvorschriften über die elektromagnetische Verträglichkeit in den EU-Mitgliedsstaatenund hält die Grenzwerte der EN 55022/ EN 55032 Klasse B ein.

Um dieses sicherzustellen, sind die Geräte wie in den Handbüchern beschrieben zu installieren und zu betreiben. Des Weiteren dürfen auch nur von der IBM empfohlene Kabel angeschlossen werden. IBM übernimmt keine Verantwortung für die Einhaltung der Schutzanforderungen, wenn das Produkt ohne Zustimmung von IBM verändert bzw. wenn Erweiterungskomponenten von Fremdherstellern ohne Empfehlung von IBM gesteckt/eingebaut werden.

Deutschland: Einhaltung des Gesetzes über die elektromagnetische Verträglichkeit von Geräten

Dieses Produkt entspricht dem “Gesetz über die elektromagnetische Verträglichkeit von Geräten (EMVG)“. Dies ist die Umsetzung der EU-Richtlinie 2014/30/EU in der Bundesrepublik Deutschland.

Zulassungsbescheinigung laut dem Deutschen Gesetz über die elektromagnetische Verträglichkeit von Geräten (EMVG) (bzw. der EMC Richtlinie 2014/30/EU) für Geräte der Klasse B

Dieses Gerät ist berechtigt, in Übereinstimmung mit dem Deutschen EMVG das EG-Konformitätszeichen - CE - zu führen.

Verantwortlich für die Einhaltung der EMV Vorschriften ist der Hersteller:
International Business Machines Corp.
New Orchard Road

Armonk, New York 10504
Tel: 914-499-1900

Der verantwortliche Ansprechpartner des Herstellers in der EU ist:
IBM Deutschland GmbH
Technical Relations Europe, Abteilung M456
IBM-Allee 1, 71139 Ehningen, Germany
Tel: +49 (0) 800 225 5426
email: HalloIBM@de.ibm.com

Generelle Informationen:

Das Gerät erfüllt die Schutzanforderungen nach EN 55024 und EN 55032 Klasse B

Japan Electronics and Information Technology Industries Association (JEITA) Notice

（一社）電子情報技術産業協会　高調波電流抑制対策実施
要領に基づく定格入力電力値：Knowledge Centerの各製品の
仕様ページ参照

This statement applies to products less than or equal to 20 A per phase.

高調波電流規格 JIS C 61000-3-2 適合品

This statement applies to products greater than 20 A, single phase.

高調波電流規格 JIS C 61000-3-2 準用品

本装置は、「高圧又は特別高圧で受電する需要家の高調波抑制対策ガイドライン」対象機器（高調波発生機器）です。
• 回路分類 ：6（単相、ＰＦＣ回路付）
• 換算係数 ：0

This statement applies to products greater than 20 A per phase, three-phase.

高調波電流規格 JIS C 61000-3-2 準用品

本装置は、「高圧又は特別高圧で受電する需要家の高調波抑制対策ガイドライン」対象機器（高調波発生機器）です。
• 回路分類 ：5（3相、ＰＦＣ回路付）
• 換算係数 ：0

Japan Voluntary Control Council for Interference (VCCI) Notice

この装置は，クラスB情報技術装置です。この装置は，家庭環境で使用することを目的としていますが，この装置がラジオやテレビジョン受信機に近接して使用されると，受信障害を引き起こすことがあります。
取扱説明書に従って正しい取り扱いをして下さい。 VCCI－B

Taiwan Notice

台灣IBM 產品服務聯絡方式：
台灣國際商業機器股份有限公司
台北市松仁路7號3樓
電話：0800-016-888

United States Federal Communications Commission (FCC) Notice

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult an IBM-authorized dealer or service representative for help.

Properly shielded and grounded cables and connectors must be used in order to meet FCC emission limits. Proper cables and connectors are available from IBM-authorized dealers. IBM is not responsible for any radio or television interference caused by using other than recommended cables and connectors or by unauthorized changes or modifications to this equipment. Unauthorized changes or modifications could void the user's authority to operate the equipment.

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions:

(1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Responsible Party:

International Business Machines Corporation
New Orchard Road
Armonk, New York 10504
Contact for FCC compliance information only: fccinfo@us.ibm.com

Terms and conditions

Permissions for the use of these publications are granted subject to the following terms and conditions.

Applicability: These terms and conditions are in addition to any terms of use for the IBM website.