IBM zSystems and LinuxONE

3932 Single Frame
Installation Manual for Physical Planning
(Models A02/LA2)

IBM

Note:

Before you use this information and the product it supports, read the information in "Safety" on page vii, Appendix E, "Notices," on page 159, and *IBM Systems Environmental Notices and User Guide*, Z125–5823.

Contents

Safety

Safety notices

Safety notices may be printed throughout this guide. **DANGER** notices warn you of conditions or procedures that can result in death or severe personal injury. **CAUTION** notices warn you of conditions or procedures that can cause personal injury that is neither lethal nor extremely hazardous. **Attention** notices warn you of conditions or procedures that can cause damage to machines, equipment, or programs.

⚠ **CAUTION:** This equipment is not suitable for use in locations where children are likely to be present. (C052)

World trade safety information

Several countries require the safety information contained in product publications to be provided in their local language(s). If this requirement applies to your country, a safety information booklet is included in the publications package shipped with the product. The booklet contains the translated safety information with references to the US English source. Before using a US English publication to install, operate, or service this product, you must first become familiar with the related safety information in the *Systems Safety Notices*, G229-9054. You should also refer to the booklet any time you do not clearly understand any safety information in the US English publications.

Laser safety information

All IBM Z and IBM LinuxONE (LinuxONE) models can use I/O cards such as FICON®, Open Systems Adapter (OSA), RoCE Express, Integrated Coupling Adapter (ICA SR, ICA SR1.1), zHyperLink Express, or other I/O features which are fiber optic based and utilize lasers (short wavelength or long wavelength lasers).

Laser compliance

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

Laser Notice: U.S. FDA CDRH NOTICE if low power lasers are utilized, integrated, or offered with end product systems as applicable. Complies with 21 CFR 1040.10 and 1040.11 except for conformance with IEC 60825-1 Ed. 3., as described in Laser Notice No. 56, dated May 8, 2019.

CAUTION: This product might contain one or more of the following devices: CD-ROM drive, DVDROM 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. (C027)

About this publication

This publication contains information necessary for the planning of the physical installation of the 3932 system.

Unless otherwise stated, throughout this document "3932" refers to IBM z16™ Single Frame (Models A02/LA2).

Figures included in this document illustrate concepts and are not necessarily accurate in content, appearance, or specific behavior.

Important: This publication provides support for IBM z16 Single Frame offering. IBM z16 Rack Mount Bundle adds a new opportunity to build rack mount configurations and ***replaces*** the former 16U and/or 8U Reserved Space feature(s). For more information, refer to the *IBM z16 and LinuxONE Rockhopper 4 Rack Mount Bundle Installation Manual for Physical Planning*, GC28-7035.

What is included in this publication

This publication contains the following chapters and appendices:

- Chapter 1, "Introduction," on page 1 provides an introduction to planning for your system and a planning checklist.
- Chapter 2, "Environmental specifications," on page 15 contains important computer room environmental information.
- Chapter 3, "Models and physical specifications," on page 29 gives plan views, service clearances, weight distribution, and cooling information for the system.
- Chapter 4, "Guide for raised floor preparation," on page 71 contains information on preparation of the raised floor.
- Chapter 5, "Power requirements," on page 77 provides power and line cord information.
- Chapter 6, "Hardware Management Console and Support Element communications," on page 97 includes information on Hardware Management Console and Support Element communications.
- Chapter 7, "Remote Support Facility (RSF) installation planning," on page 107 contains Remote Support Facility installation planning.
- Chapter 8, "I/O cabling and connectivity ," on page 111 discusses cable connectivity information.
- Chapter 9, "Parallel sysplex planning," on page 139 provides information about operating in a Parallel Sysplex® environment.
- The appendices provide standard symbols, HMC specifications, cabling specification, and power cabling schematic.

    - Appendix A, "IBM standard symbols," on page 143
    - Appendix B, "Hardware Management Console physical specifications," on page 145
    - Appendix C, "Top Exit cabling and Bottom Exit cabling specifications," on page 151
    - Appendix D, "Dual power installation," on page 157

Related publications

Publications that you will find helpful and that you should use along with this publication are in the following list. The following publications are available on **IBM Documentation**. Go to https://www.ibm.com/docs/en/systems-hardware, select **IBM Z** or **IBM LinuxONE**, then select your configuration, and click **Library Overview** on the navigation bar.

- *3932 Single Frame External Cabling Best Practices* (https://www.ibm.com/support/pages/node/7001737)

- *Systems Safety Notices*, G229-9054
- *Systems Environmental Notices and User Guide*, Z125-5823
- *Planning for Fiber Optic Links (FICON/FCP, Coupling Links, Open Systems Adapters, zHyperLink Express, and RoCE Express)* , GA23-1408
- *FICON Channel-to-Channel Reference*, SB10-7174
- *Open System Adapter-Express Integrated Console Controller Dual Port User's Guide* , SA23-2266
- *Open Systems Adapter-Express Customer's Guide and Reference*, SA22-7935

Related HMC and SE console information

Hardware Management Console (HMC) and Support Element (SE) information can be found on the console help system.

Licensed Machine Code

Licensed Machine Code is provided in accordance with the terms and conditions of the applicable IBM® Customer Agreement or other applicable written agreement between the Customer and IBM.

Licensed Machine Code (LMC) is a fundamental component of the 3932 and is copyrighted and licensed by IBM. Each 3932 is delivered with Licensed Machine Code that is customized to the specific machine ordered. The Licensed Machine Code enables the 3932 to operate in accordance with its Official Published Specifications.

Model upgrades, feature additions, and system engineering changes may require updated Licensed Machine Code for the system. Updated Licensed Machine Code replaces the existing Licensed Machine Code.

Relocation of a 3932 requires that the Licensed Machine Code be reinstalled in the server at the new location. See the "Discontinuing the System" section in the *8562 Installation Manual* for the procedure about relocating a 3932.

Accessibility features

Accessibility features help users who have physical disabilities such as restricted mobility or limited vision use software products successfully. The accessibility features can help users do the following tasks:

- Run assistive technology such as screen readers and screen magnifier software.
- Operate specific or equivalent features by using the keyboard.
- Customize display attributes such as color, contrast, and font size.

Consult assistive technologies

Assistive technology products, such as screen readers, function with the user interfaces found in this product. Consult the product information for the specific assistive technology product that is used to access our product information.

Keyboard navigation

This product uses standard Microsoft Windows navigation keys.

IBM and accessibility

See http://www.ibm.com/able for more information about the commitment that IBM has to accessibility.

How to provide feedback to IBM

We welcome any feedback that you have, including comments on the clarity, accuracy, or completeness of the information.

For additional information use the following link that corresponds to your configuration:

Configuration	Link
IBM z16 Model A02	How to send feedback to IBM
IBM z16 Rack Mount Bundle	How to send feedback to IBM
IBM LinuxONE Rockhopper 4 Model LA2	How to send feedback to IBM
IBM LinuxONE Rockhopper 4 Rack Mount Bundle	How to send feedback to IBM

Revisions

A technical change from the previous edition of this document is indicated by a thick vertical line to the left of the change.

Summary of changes

Summary of changes for the *3932 Single Frame Installation Manual for Physical Planning (Models A02/LA2)*, GC28-7040.

Table 1. Summary of changes

Release date	Changes in level

March 2024	This revision contains editorial changes and the following technical changes:
	
	• New topic added, "Sales considerations" on page 2.
	• Corrected information and new line cord feature information added in "Power installation considerations" on page 80 and "Supported power cords (PDU)" on page 83.
	• New IPv4 and IPv6 addresses added to "Server address lists and host names" on page 110.
	  – "IPv4 addresses" on page 110
	  – "IPv6 addresses" on page 110
	• Corrected feature code information in "I/O cabling" on page 111.

August 2023	This revision contains editorial changes and the following technical changes: • Clarification for former 16U and 8U Reserved Space features added to "About this publication" on page ix. • References updated for the 3932 Single Frame External Cabling Best Practices document. • Note regarding nominal dimensions added to "System planning" on page 3, Chapter 3, "Models and physical specifications," on page 29, and Appendix B, "Hardware Management Console physical specifications," on page 145. • Corrected the maximum number of PCIe+ I/O drawers supported in Chapter 5, "Power requirements," on page 77. • Corrected information in "Supported power cords (PDU)" on page 83 and "Line cord wire specifications (PDU)" on page 91. • Important note added to "Grounding specifications" on page 94. • Power cord requirements for "Trusted Key Entry (TKE)" on page 103 features added to "Power requirements" on page 105. • Corrected information in "Integrated Coupling Adapter (ICA) SR feature" on page 123 and "Coupling Express2 LR feature (FC 0434)" on page 125. • Dual power installation diagrams for PDU power updated Appendix D, "Dual power installation," on page 157.

Chapter 1. Introduction

This chapter is intended to help you prepare your physical site for the installation of an 3932. Marketing and Installation Planning Representatives are also available to help you with installation planning. Proper planning for your new system will facilitate a smooth installation and fast system start up.

The use of the terms, "server", "processor", "system" and "all models" in this publication refer to the 3932.

Sales considerations

As part of your system sales and planning activity, you **must** take the following requirements into careful consideration *prior* to the sale of your rack mount offering.

- IBM z16, machine type 3932, provides a scalable, sustainable, highly available platform that delivers differentiated value to help enable business growth, reduce cost, and improve performance efficiency. It provides:

  - 19-inch form factor available in either a single frame (IBM rack) or rack mount (components can be inserted into an existing client rack).

  - Up to 68 cores. The new IBM Telum processor using 7nm technology runs at 4.6GHz processor frequency. The new processor is supported by a Dual Chip Module driving an integrated Nest and Cache architecture, and new integrated AI Accelerators for high speed inferencing in addition to the cryptography, compression, and sort accelerators.

  - Up to 8TB RAIM memory per CPC drawer for up to 16TB per machine all supported by physical memory encryption, NVMe 1.1, enhanced computing for TKE, Coupling Express Long Reach (Coupling Express2 LR), and Crypto Express8S allowing for Quantum-Safe system and HSM encryption.

- Utilization of z16 single frame requires planning and prior provisioning of storage devices, networks, power, operating systems, programs, floor space, air conditioning, programmers, and support staff. Before the sale, confirm that the following required conditions are present. Failure to meet these conditions will result in the sale of equipment that cannot be installed.

  The client **must** confirm the following *before a sale* can be considered, as there is no possible recovery:

  - Single phase AC voltage at the Power Distribution Unit (PDU) outlet must be between 200 and 250VAC. This prohibits 3 Phase 480VAC at the PDU power cord. The maximum 3 phase voltage as PDU input is limited to 415VAC.

  - Each PDU outlet is measured to ensure that voltage of 200-250VAC is present. Mis-wired 3 phase WYE would put 415VAC to certain outlets and will cause a hazardous situation by over voltaging the power supplies.

  - PDUs are wired to redundant power sources.

- The rack mount offering has some additional requirements. The rack mount drawers are designed to fit IBM racks with IBM PDUs. Before the sale, confirm that the following required conditions are present. Failure to meet these conditions will result in the sale of equipment that cannot be installed.

  With the environment being outside IBM's control, the client **must** confirm the following *before a sale* can be considered, as there is no possible recovery:

  - The PDUs and the cords plugged into them must not block the removal or adapter cards or power supplies, which are at the extreme edges of the 19" drawer.

  - There must be 8" of space between the rear EIA rail and the rear door.

  - The rack cannot be against a wall or structure which would prohibit standing on both sides of the 19" rack.

  - The data center must allow the use of the Genie Lift Tool GL-8 to install server rack mount bundle components.

  - The client must submit to IBM, for the SSR, a detailed list of exactly which PDU outlet each "ordered" power jumper will plug into.

    Note: To determine which PDU outlets are for which ordered power jumpers, the client must follow the education in the Installation Manual for Physical Planning (IMPP). This education covers taking a sample configuration through the IBM Power Estimator tool to determine the amps required for the actual AC voltage, and the connector type and quantity of power jumpers. It also helps clients understand electrical de-ratings and PDU internal wiring. If not properly planned, circuit breakers might trip and cause an unexpected outage during normal operation or during a power failure.

System planning

As part of your system planning activity, you must make decisions about where to locate your equipment, who will operate the system, and so on. A good plan ensures that the equipment and materials are ready to use when the 3932 arrives.

The type of software (operating system and application programs) that you intend to use must support the features and devices on the system. You should already be familiar with your software requirements, but may want to contact your IBM marketing representative for information on planning for the software.

⚠️ **Attention:** The physical preparation requirements for the 3932 server are similar to the 3907 (z14 Model ZR1 or Rockhopper II Model LR1) system, but *significantly* different from prior legacy systems. You must ensure that you and your IBM marketing representative or Business Partner are thorough when planning for the physical installation of this system.

The review and completion of the following assessments is recommended:

- "Site planning checklist" on page 4
- **Technical and Delivery Assessment (TDA)**

    Complete with your IBM marketing representative or Business Partner and the IBM service representatives that will be installing your system.

- For cable management best practices and guidelines, see *3932 Single Frame External Cabling Best Practices* (https://www.ibm.com/support/pages/node/7001737).

    To assist in site planning, 2-D drawing files to be used with Microsoft Visio® and AutoCAD® available on Resource Link at http://www.ibm.com/servers/resourcelink under **Planning > Physical Planning**. Navigate to the section for your specific IBM zSystem system, then click **Visio® files**.

Note: All dimensions are considered nominal.

Site planning checklist

The following checklist identifies installation tasks and responsibilities sequentially, and is designed for new installations. If you have to renovate your site, you may need a longer planning cycle.

Checkpoint 1

__ 1. Designate a person in your organization with the responsibility for all phases of site preparation for this system installation.

__ 2. Review all site planning information with the designated person.

__ 3. Determine who will actually perform each site preparation task and who will control the marking of this checklist.

__ 4. Identify the following communication needs:

    __ • Remote Support Facility

    __ • Cables

    __ • Switches

    __ • Telephones

    __ • Connection panels

__ 5. Review the following materials for the planning of I/O cabling and connectivity:

    • Chapter 8, "I/O cabling and connectivity ," on page 111

    • "IBM Site and Facilities" on page 112

__ 6. Identify the following channel needs:

    __ • Cables

    __ • Directors

    __ • Switches

    __ • Patch Panels

__ 7. Identify additional system requirements, including any changes needed to existing equipment.

__ 8. Determine the schedule with your IBM marketing representative and make a note of the target dates for each checkpoint.

Checkpoint 2

__ 1. Lay out the floor plan. Include the following:

    __ • Stationary obstacles

    __ • Walls

    __ • All computer equipment

    __ • Locations for all of the following:

        – Power

        – Lighting

        – Cooling

        – Fire detection and extinguishing equipment

    __ • Floor tiles and floor tile cutout(s), if using the bottom exit cabling feature.

__ 2. If the level of acoustical noise is a concern, consider arranging the floor layout to avoid areas of excessive noise exposure. If needed, utilize noise control screens or other treatments to reduce noise levels.

__ 3. To assist in site planning, a 3-D graphic file to be used with CAD software is available on Resource Link at http://www.ibm.com/servers/resourcelink under **Planning > Physical Planning**. Navigate to the section for your specific IBM zSystem system, then click **STP 3-D graphic files**.

__ 4. To assist in site planning, 3-D computational fluid dynamics files to be used with 6SigmaDCX CFD software, are available on Resource Link at http://www.ibm.com/servers/resourcelink under **Planning > Physical Planning**. Navigate to the section for your specific IBM zSystem system, then click **CFD 3-D graphic files**.

__ 5. To assist in site planning, 2-D drawing files to be used with Microsoft Visio® and AutoCAD® available on Resource Link at http://www.ibm.com/servers/resourcelink under **Planning > Physical Planning**. Navigate to the section for your specific IBM zSystem system, then click **Visio® files**.

__ 6. Order the following communication equipment:

    __ • Cables

    __ • Modems

    __ • Switches

    __ • Telephones

    __ • Connection Panels

__ 7. Order the following channel equipment:

    __ • Cables

    __ • Directors

    __ • Switches

    __ • Patch Panels

Note: For information about cabling requirements and responsibilities, see Chapter 8, "I/O cabling and connectivity ," on page 111 and "IBM Site and Facilities" on page 112. Your IBM marketing representative can assist you with this task.

__ 8. If you are planning for a system that will use FICON channels, Coupling Links, Open System Adapters (OSA), zHyperLink Express, or RoCE Express, contact your IBM marketing representative to obtain *Planning for Fiber Optic Links (FICON/FCP, Coupling Links, Open Systems Adapters, zHyperLink Express, and RoCE Express)* , GA23-1408.

__ 9. Order the *Earthquake Kit (FC 8014 or FC 8015)* feature if you require frame ruggedizing hardware to secure the frame and its contents from damages related to vibration and shock experienced in a seismic event.

FC 8014 is for raised floor environments. **FC 8015** is for non-raised floor environments.

__ 10. Ensure that there is sufficient height clearance to transport the system into the environment. If height reduction is required, you must order the Height Reduction feature (**FC 9975**).

Checkpoint 3

__ 1. Prepare your computer room for the following:

    __ • Machine service clearance and floor loading

    __ • Physical placement of system based on logical priority

    __ • Cabling restrictions

    __ • Vibration and shock considerations

    __ • Electromagnetic compatibility or interference

    __ • Power requirements

If the *Earthquake Kit (FC 8014 or FC 8015)* feature was ordered, install the following at this time:

    Raised floor (FC 8014): 4 eye bolts in concrete floor
    Non-raised floor (FC 8015): 8 anchors and 2 lock down plates in concrete floor

__ 2. As part of your business continuity management (BCM), complete emergency and backup operations planning for the following:

    __ • Fire detection, prevention, and extinguishing

    __ • Control equipment

    __ • Storm protection and damage recovery procedures

__ 3. Ensure that there is sufficient physical space around equipment, including:

    __ • Passageways for movement of people and machines

    __ • Considerations for lighting and potential areas of high acoustic noise levels

    __ • Required service clearances, as described in "Machine and service clearance areas" on page 65.

__ 4. Ensure that the following office equipment and areas have adequate lighting, heating/cooling, and acoustics:

    __ • Furniture

    __ • Vending

    __ • Meeting/Conference areas

    __ • Entrance/Exit areas

__ 5. Verify that material and data storage provisions are satisfied.

__ 6. Schedule and make changes to existing programs, as required.

__ 7. Schedule and make changes to existing machines/devices, as required.

__ 8. Arrange the installation of cables between work stations, controllers, modems, switches, etc.

__ 9. Arrange the installation of new power receptacles and wiring.

__ 10. Define a training program for employees.

Checkpoint 4

__ 1. Verify that the following power requirements have been met:

   __ • Electrically clean, dedicated circuits for all computer equipment

   __ • Sufficient power provided to avoid outages caused by power transients

   __ • Protection from lightning damage

__ 2. Arrange backup power, batteries, or generators, if required.

__ 3. Verify that the following power features adhere to local electrical code and equipment guidelines:

   __ • Branch circuits

   __ • Grounding

   __ • Conduits

   __ • Phase rotation

   __ • Emergency controls

__ 4. Verify that there are an adequate number of power connections provided in the necessary locations, for computer equipment and convenience usage.

__ 5. Verify that all computer room personnel have completed their training and are prepared to perform the all power procedures, including the following:

   __ • Switching of circuit breakers

   __ • Connecting system line cords to customer receptacles

   __ • Those to be followed in emergency situations

__ 6. Review the progress of the communications, channel, and adapter cabling. Identify and resolve problems, and schedule conflicts.

__ 7. Review the system configuration to ensure that the configuration meets all of your needs, and that there are no physical problems present.

Checkpoint 5

__ 1. Ensure that the air conditioning installation is complete and all of the following requirements are met:

   __ • Capacity and controls provided for automatic temperature and humidity levels

   __ • Filtration system is adequate and maintenance plan is established

   __ • Regular monitoring and testing plan is established

__ 2. Verify that all computer room personnel have completed their training.

__ 3. If you have elected to complete I/O cabling procedures yourself, keep the following in mind:

   __ • For cable management best practices and guidelines, review *3932 Single Frame External Cabling Best Practices* (https://www.ibm.com/support/pages/node/7001737).

   __ • As the cables arrive, start installing and labeling them appropriately

   __ • Label power receptacles as they are installed

   Note: Customer cabling preparation does not include plugging cables into the 3932.

   CAUTION: **Servicing of this product or unit is to be performed by trained service personnel only. (C032)**

__ 4. Complete the **Technical and Delivery Assessment** with your IBM marketing representative or Business Partner and the IBM service representatives that will be installing your system.

__ 5. Carefully measure the delivery path from shipper drop-off point, to the installation location.

   Note: Obtaining the accurate measurements now will prevent installation delays later on.

Checkpoint 6

__ 1. Complete the installation of the following communication equipment:

    __ • Cables

    __ • Modems

    __ • Switches

    __ • Telephones

    __ • Connection Panels

__ 2. Complete the installation of the Remote Support Facility, including:

    __ • LAN and communication cables

    __ • Switches

    __ • Patch Panels

__ 3. Prepare IOCP input statements or HCD definitions.

__ 4. If you are planning to use dynamic I/O for a standalone coupling facility, configure your HCD definition accordingly.

__ 5. Use the CPHID Mapping Tool on Resource Link to assign PCHIDs to CHPIDs.

__ 6. If you have elected to complete I/O cabling procedures yourself, verify the following:

Note: Customer cabling preparation does not include plugging cables into the 3932.

CAUTION: Servicing of this product or unit is to be performed by trained service personnel only. (C032)

    __ • Checkout of system cables is completed as frequently as possible.

    __ • Cable safety procedures are followed

    __ • Cables are properly routed

    __ • Protective end caps are in place

    __ • Processor-end cables are safely out of the way for system installation

__ 7. Complete the checkout of all power cables by testing for the following:

    __ • Continuity and polarity

    __ • Proper grounding

    __ • Correct phase wiring

    __ • General power safety considerations

    DANGER: 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. (D004)

__ 8. Complete the required changes to the existing programs and data processing units.

__ 9. Install communication facilities, such as telephone lines.

Checkpoint 7

1. Are there any applications that must be installed or tested before the arrival of your new system?
2. Do you need to conduct training for your computer room personnel? In areas such as:

   __ • Safety
   __ • Security
   __ • Operations
3. Are there outstanding hardware changes required to any of your existing systems or facilities? Such as:

   __ • Computer equipment
   __ • Communications equipment
   __ • Site facilities
4. Are the following system configurations ready for installation?

   __ • IOCP input
   __ • CHPIDs
5. Do you have a comprehensive channel cabling plan in place?

   __ • Are all cables either readily available or ordered?
   __ • Do you have a reliable installer assigned?
   __ • Are plans in place for cable connection to remote devices?
   __ • Is there a system test plan?
   __ • Are you prepared to provide cable labels or labeling information?
   __ • Are protective end cap devices installed on all cable connectors?
   __ • Are all cables routed and coiled appropriately, as to not interfere with the installation?

   For cable management best practices and guidelines, see *3932 Single Frame External Cabling Best Practices* (https://www.ibm.com/support/pages/node/7001737).
6. Does the path for moving new equipment meet the following criteria?

   __ • Wide enough
   __ • High enough
   __ • Free of obstructions
   __ • Ramps readily available, if required
7. Are the floor panels ready?

   If the *Earthquake Kit (FC 8014 or FC 8015)* feature was ordered, verify that the following has been installed:

   Raised floor (FC 8014): 4 eye bolts in concrete floor
   Non-raised floor (FC 8015): 8 anchors and 2 lock down plates in concrete floor
8. Is all furniture and miscellaneous equipment moved or removed, as to not interfere with the installation?
9. Is your setup team adequately trained and prepared for the arrival of new equipment?
10. Complete the site preparation.

Arrival of new equipment

__ 1. Review the information provided in "System acclimation" on page 21 to verify that the system acclimation time is met.

__ 2. Move unit(s) to installation location.

__ 3. Place the unit(s) according to the machine clearance dimensions provided in "Machine and service clearance areas" on page 65.

__ 4. Unpack unit(s) according to the provided instructions.

__ 5. Call your service provider to install the unit(s).

Customized planning aid

A customized planning aid will be available for your system one day after receipt of your order in manufacturing *and* the order has been assigned a serial number.

You may obtain access to this aid by registering on Resource Link® at *http://www.ibm.com/servers/ resourcelink*. This planning aid will include unique physical planning requirements based on your system's specific configuration.

It is important to note here that the planning aid is not intended to replace this manual. You should be familiar with the contents of this document before you attempt to use the planning aid.

Estimated installation time

The IBM z16 and LinuxONE Rockhopper 4 Single Frame (Models A02/LA2) is a traditional, factory racked system and is installed by IBM. The average installation time is approximately 22 hours, including planning hours. There is a Pre-sale and Pre-install Technical and Delivery Assessment (TDA) Checklist that will need to be completed in the IMPACT tool.

ASHRAE declaration

ASHRAE Declarations (Metric) for 3932

ASHRAE Class A3 Description	Typical Heat Release (1)	Airflow Nominal (1)	Airflow Maximum (1)	Weight (2, 5, 6, 7)	Overall System Maximum Dimensions (8)	Maximum Elevation (5, 6)	Maximum Dry Bulb Temperature (4, 5)	Maximum Dew Point (9)
	kW	m3/hr	m3/hr	kg	W x D x H (cm)	m	C°	C°
Minimum Configuration MT 3932 1 CPC drawer 0 PCIe+ I/O drawers	2.7	425	850	403	62.4 x 120.8 x 202	3048 (dry bulb <28°C)	40 (altitude <914 m) (RH <40%)	24
Maximum Configuration MT 3932 2 CPC drawers 3 PCIe+ I/O drawers	8.1	1710	3940	767	249.6 x 120.8 x 202	3048 (dry bulb <28°C)	40 (altitude <914 m) (RH <40%)	24

ASHRAE Declarations (English) for 3932

ASHRAE Class A3 Description	Typical Heat Release (1)	Airflow Nominal (1)	Airflow Maximum (1)	Weight (2, 5, 6, 7)	Overall System Maximum Dimensions (8)	Maximum Elevation (5, 6)	Maximum Dry Bulb Temperature (4, 5)	Maximum Dew Point (9)
	kBTU/hr	cfm	cfm	lbs	W x D x H (in)	ft	F°	F°
Minimum Configuration MT 3932 1 CPC drawer 0 PCIe+ I/O drawers	9.2	250	500	889	24.6 x 47.6 x 79.5	10,000 (dry bulb <82o F)	104 (altitude <3000 ft) (RH <40%)	75.2
Maximum Configuration MT 3932 2 CPC drawers 3 PCIe+ I/O drawers	27.6	1005	2320	1692	98.4 x 47.6 x 79.5	10,000 (dry bulb <82o F)	104 (altitude <3000 ft) (RH <40%)	75.2

Airflow Diagram Cooling Scheme
front to rear

Front of the server
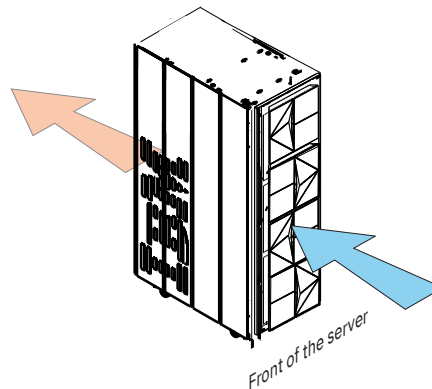
Notes:

1. Airflow is designed to increase as the local ambient room temperature, altitude, or component temperature increases. Minimum airflow assumes an ambient temperature below 16º C (60.8º F) and altitude below 110 m (360 ft) and no component-based fan-speed increase. Nominal airflow assumes an ambient temperature of 25º C (77º F), sea-level and nominal workloads. Maximum airflow is based on an operating condition that results in the fan speeds operating at their maximum speed (for example, operating at 40º C (104º F) or at very high workloads).

2. Weights provided assume that the optional Earthquake Kit (FC 8014 or 8015) is **not** installed.

3. Dimensions do not include top exit cabling feature (FC 7802)

4. For ambient temperatures exceeding 25º C (77º F), the acoustical noise levels of the system may increase significantly as the speeds of the air moving devices increase. See "Acoustics" on page 26 for the declared acoustical noise emission levels for the system under nominal temperature conditions of 23º C plus or minus 2º C (73.4º F plus or minus 3.6º F).

5. Maximum ambient reduces 1º C (1.8º F) for every 175 m (574 ft) over 900 m (2953 ft). At 3048 m (10,000 ft), maximum allowable ambient temperature is 28º C (82º F).

6. See the elevation label ( ) or tropical climate label ( ) in the *Systems Safety Notices* document to determine **if** there are any elevation limitations or tropical climate limitations for your country.

Chapter 2. Environmental specifications

The 3932 is among the most powerful group of mainframe processors ever built. Technology improvements have placed the 3932 in the top levels of Reliability, Availability, and Serviceability. But it takes more than premium computer equipment to achieve these goals. The data center environment must be able to support the demands that the 3932 capability requires. On the following pages, environmental specifications are presented in tabular and graphic forms to emphasize how important it is that you provide the conditions necessary to utilize all of the power the 3932 offers.

The 3932 is designed to operate in an ASHRAE Class A3 (4th Edition) environment.

Environmental specifications are presented in two categories: Recommended and Allowable. Obviously, meeting the required specifications is prerequisite to using the 3932. It is strongly suggested that you strive for a long-term operating environment within the recommended specification range. The powerful computing the 3932 provides generates heat that must be removed from the machine. Operating your data center most of the time within the recommended range instead of the allowable range will enhance its overall resiliency, energy efficiency, and reliability.

Unless otherwise noted on individual specification pages, the following environmental specifications, based on an altitude from sea level to 900 meters (2953 feet), apply:

Table 2. Environmental specifications - table format

Environment, Operating: [9]		
	Recommended [1,6]	**Allowable [2,3,4,5,6]**
Temperature	18°C - 27°C (64.4°F - 80.6°F)	5°C - 40°C (41°F - 104°F)
Low end moisture	-9.0°C (15.8°F) dew point	-12°C (10.4°F) dew point and 8% relative humidity
High end moisture	60% relative humidity and 15°C (59°F) dew point	85% relative humidity and 24°C (72.5°F) dew point
Gaseous contamination	Severity level G1 according to ANSI/ISA S71.04-1985 [7,8]	
Particulate contamination	Cleanliness level of ISO 14644-1 Class 8 [8]	
Allowable environment, Non-operating: [10]		
Temperature	5°C (45°F) to 45°C (113°F)	
Relative humidity	8% to 85%	
Maximum dew point	27°C (80.6°F)	
Gaseous contamination	Severity level G1 as per ANSI/ISA 71.04-1985 [7,8]	
Environment, shipping: [9]		
Temperature	-40°C (-40°F) to 60°C (140°F)	
Relative humidity	5% to 100% (no condensation)	
Maximum wet bulb temperature	29°C (84.2°F)	
Shipping package	IBM-approved crate with vapor barrier bag with desiccant	
Environment, storage: [10]		
Temperature	1°C (33.8°F) to 60°C (140°F)	
Relative humidity	5% to 80% (no condensation)	
Wet bulb	29°C (84.2°F)	
Shipping package	IBM-approved crate with vapor barrier bag with desiccant	

Notes:

1. The recommended operating environment specifies a long-term operating environment that can result in the greatest resiliency, energy efficiency, and reliability.

2. The allowable operating environment represents where the equipment has been tested to verify functionality. Due to the stresses that operating in the allowable envelope can place on the equipment, these envelopes should be used for short-term operation, not continuous operation (for example, in the case of a cooling failure).

3. Must derate the maximum allowable temperature 1°C (1.8°F)/175 m (574 ft) above 900 m (2953 ft) up to a maximum allowable elevation of 3050 m (~10,000 ft).

4. The minimum humidity level is the larger absolute humidity of the -12°C (10.4°F) dew point and the 8% relative humidity. These intersect at approximately 25°C (77°F). Below this intersection the dew point (-12°C) represents the minimum moisture level, while above it, the relative humidity (8%) is the minimum. See for a graphical explanation of the envelope.

5. For temperatures in the allowable envelope, the acoustical noise levels of the system may increase significantly as the speeds of the air moving devices increase. See "Acoustics" on page 26 for the declared acoustical noise emission levels for the system.

6. Based in research funded by ASHRAE and performed at low relative humidity, the following are the minimum requirements:

   a. Data centers that have non-ESD floors, where people are permitted to wear non-ESD shoes, might want to consider increasing humidity; given that the risk of generating 8 kV increases from 0.27% (at 25% relative humidity) to 0.43% (at 8% relative humidity).

   b. All mobile furnishings/equipment is to be made of conductive or static dissipative materials and bonded to the ground.

   c. During maintenance on any hardware, a properly functioning and grounded wrist strap must be used by any personnel who contacts IT equipment.

7. ANSI/ISA-S71.04. 1985. "Environmental conditions for process measurement and control systems: Airborne contaminants." Instrument Society of America, Research Triangle Park, NC, 1985.

8. See "Conductive contamination" on page 24 for details of the requirements for gaseous and particulate contamination.

9. See "System acclimation" on page 21 for guidance on how long the system must be acclimated before being attached to the power source.

10. For equipment that has been removed from original shipping container and installed but powered down. The allowable non-operating environment is provided to define the environmental range that a non-powered system should be able to experience short-term without being damaged. It assumes that the system has not been contaminated with low deliquescent relative humidity dust, which could damage the equipment and require the system to dry out before powering on. (See "Conductive contamination" on page 24 for details.) Under all conditions, the environment must remain non-condensing. The allowable non-operating environment is meant for abnormal conditions (for example, power or cooling failure). It is expected that the data center will return conditions to the recommended operating conditions within a short period of time. The allowable non-operating environment is not meant to be used for periodic, planned changes from an operating to non-operating condition.

Figure 1 on page 18 shows the environmental specifications in **line graph** format.
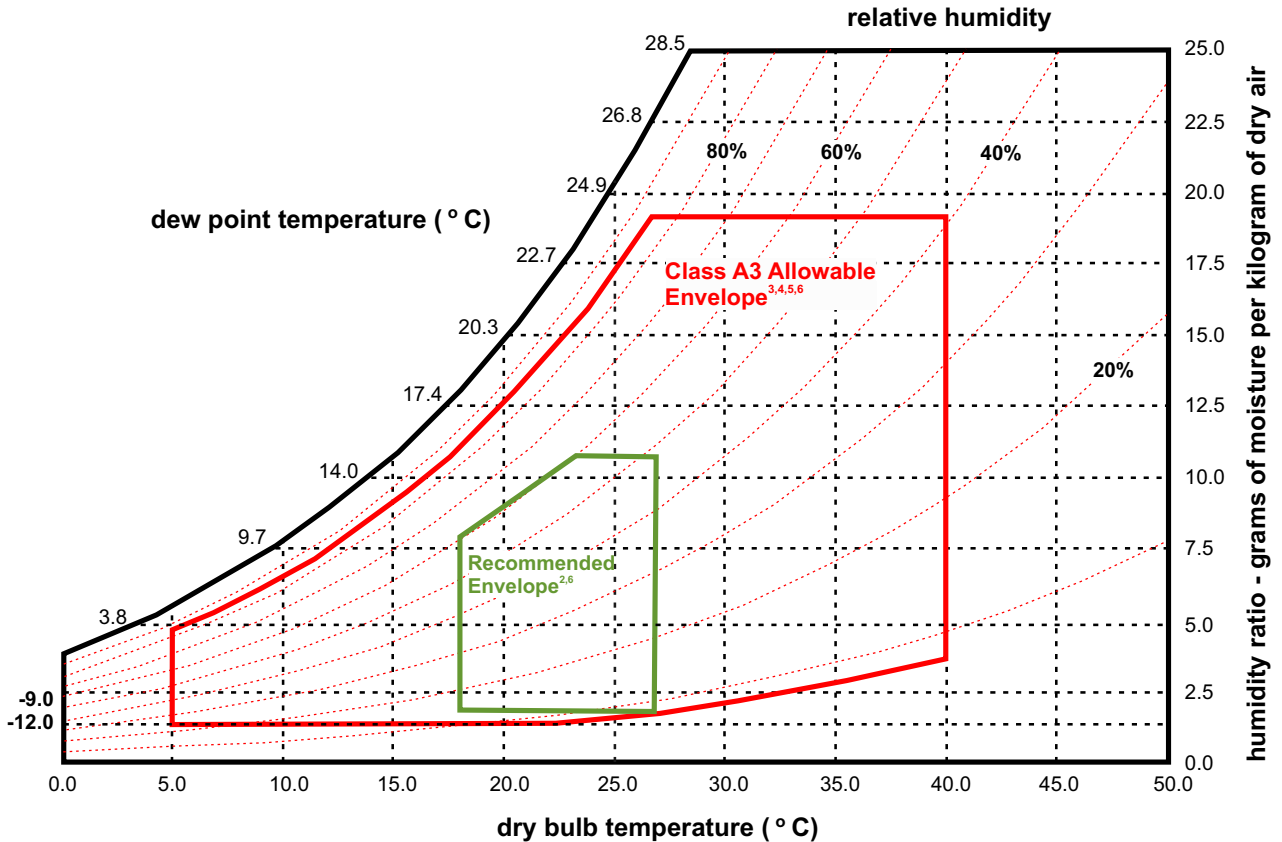
Figure 1. Environmental operating specifications - line graph format

Notes:

1. Psychrometric chart is shown in SI (metric) units and a barometric pressure 101.325 kPa (sea level).

2. The recommended operating environment specifies a long-term operating environment that can result in the greatest reliability and energy efficiency.

3. The allowable operating environment represents where the equipment has been tested to verify functionality. Due to the stresses that operating in the allowable envelope can place on the equipment, these envelopes should be used for short-term operation, not continuous operation, for example in the case of a cooling failure.

4. Must derate the maximum allowable temperature 1°C (1.8°F)/175 m (574 ft) above 900 m (2953 ft) up to a maximum allowable elevation of 3050 m (~10,000 ft).

5. For temperatures in the allowable envelope, the acoustical noise levels of the system may increase significantly as the speeds of the air moving devices increase. See "Acoustics" on page 26 for the declared acoustical noise emission levels for the system.

6. Based in research funded by ASHRAE and performed at low relative humidity, the following are the minimum requirements:

   a. Data centers that have non-ESD floors, where people are permitted to wear non-ESD shoes, might want to consider increasing humidity; given that the risk of generating 8 kV increases from 0.27% (at 25% relative humidity) to 0.43% (at 8% relative humidity).

   b. All mobile furnishings/equipment is to be made of conductive or static dissipative materials and bonded to the ground.

   c. During maintenance on any hardware, a properly functioning wrist strap must be used by any personnel who contacts the system.

Figure 2 on page 19 shows the environmental specifications in **bar graph** format.
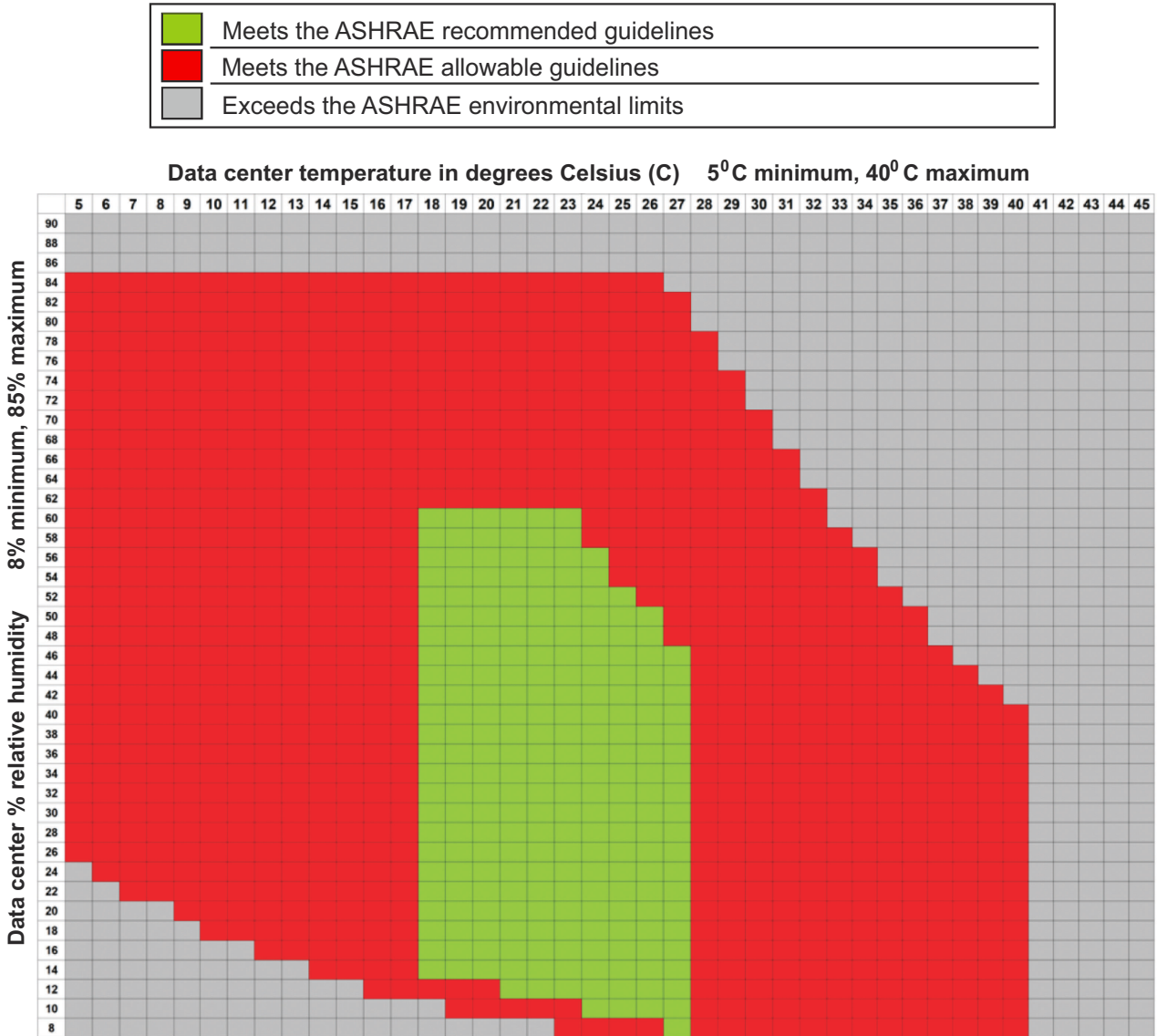
Figure 2. Environmental operating specifications - bar graph format

Notes:

1. Graph is shown in SI (metric) units and a barometric pressure 101.325 kPa (sea level).

2. The recommended operating environment specifies a long-term operating environment that can result in the greatest reliability and energy efficiency.

3. The allowable operating environment represents where the equipment has been tested to verify functionality. Due to the stresses that operating in the allowable envelope can place on the equipment, these envelopes should be used for short-term operation, not continuous operation, for example in the case of a cooling failure.

4. Must derate the maximum allowable temperature 1°C (1.8°F)/175 m (574 ft) above 900 m (2953 ft) up to a maximum allowable elevation of 3050 m (~10,000 ft).

5. For temperatures in the allowable envelope, the acoustical noise levels of the system may increase significantly as the speeds of the air moving devices increase. See "Acoustics" on page 26 for the declared acoustical noise emission levels for the system.

6. Based in research funded by ASHRAE and performed at low relative humidity, the following are the minimum requirements:

   a. Data centers that have non-ESD floors, where people are permitted to wear non-ESD shoes, might want to consider increasing humidity; given that the risk of generating 8 kV increases from 0.27% (at 25% relative humidity) to 0.43% (at 8% relative humidity).

   b. All mobile furnishings/equipment is to be made of conductive or static dissipative materials and bonded to the ground.

   c. During maintenance on any hardware, a properly functioning wrist strap must be used by any personnel who contacts the system.

It is very important the environmental specifications be met immediately in front of the frame of the 3932. Ideally, it would be best if the temperature and humidity controls are good enough to surround the service area in front of the 3932.

System acclimation

Server and storage equipment (frames) should be gradually acclimated to the surrounding environment before being powered on.

When server and storage equipment is shipped in a climate where the outside temperature is below the dew point of the destination indoor location, condensation and frost will naturally form on the cooler inside and outside surfaces of the equipment when brought indoors. All IBM products are tested and verified to withstand these phenomena produced under these circumstances. As long as sufficient time is provided to allow the hardware to gradually acclimate to the indoor environment before attaching it to electrical power, there should be no issues with long term reliability of the product.

General recommendations

- DO NOT attach power to the product before the recommended acclimation time. Attaching power may cause some features to enter into a stand-by mode even before the product has been formally switched on.

- Product must be acclimated before attaching to power to avoid shorts and other damage due to wet or moist components. Use of vapor barrier bags and/or desiccant does not negate the need for acclimation.

- If the install/staging area environment allows it, DO leave the product in the full package, or at least the inner plastic bag, for the recommended time as shown in the following tables. This helps minimize condensation directly on or within the product.

- Acclimate the product _away_ from perforated tiles or other direct sources of forced air convection to minimize excessive condensation on or within the equipment. DO NOT blow room air at the product to acclimate it faster as this can _increase_ moisture accumulation within the product and may also cause dust from the room to adhere to moist surfaces.

- If possible, try to acclimate the system in environments where the temperature is greater than 15°C (59°F), the relative humidity is less than 60%, and the dewpoint is less than 27°C (80°F) to minimize the acclimation time. Cold, humid environments will lead to greater acclimation times.

- There are certain situations where some or all coolant water shipped in blue containers can freeze. Freezing of the coolant does not affect the container integrity or the anti-corrosive chemical-water solution. However, the blue container must be completely thawed, back to liquid state, and allowed to come to room temperature, before beginning the Fill Drain tool process.

Determining system acclimation time

Note: Use the following information to determine the system acclimation time, unless otherwise stated by product specific install instructions.

1. Determine the shipping condition and lowest temperature the product was exposed to in the 48 hours prior to it being moved to the staging area or final installation area. Work with your representative if you don't have this information.

   - Use Table 3 on page 22 if the minimum temperature was between -40°C (-40°F) and -20°C (-4°F). Shipments conducted in cold weather or in cold climates and which were not conveyed in climate-controlled trucking will need to use this table.

   - Use Table 4 on page 22 if the minimum temperature was between -20°C (-4°F) and 0°C (32°F). Shipments conducted in cold weather or in cold climates and which were not conveyed in climate-controlled trucking will need to use this table.

   - Use Table 5 on page 23 if the minimum temperature was between 0°C (32°F) and 15°C (59°F). Shipments conducted in chilly to mild weather and which were not conveyed in climate-controlled trucking may use this table. Air shipments followed by transport in warmer conditions may also use this table. If air shipment was followed by non-climate controlled transport in very cold or cold conditions, then use Table 3 on page 22 and Table 4 on page 22, respectively.

- Use Table 6 on page 23 if the minimum temperature was greater than 15ºC (59ºF). Shipments conducted in warm/hot weather or in climate controlled conditions may use this table. If shipments were transported by air less than 48 hours prior to delivery, this table may not be used. Refer to Table 3 on page 22, Table 4 on page 22, or Table 5 on page 23 instead.

2. Once the appropriate acclimation table has been identified, determine the acclimation zone (AA-D) for your environment. Determine the *minimum* temperature and *maximum* relative humidity of the room where the product will be acclimated. If the temperature falls between two tabulated values, use the *lower* tabulated temperature. If the relative humidity falls between two tabulated values, use the *higher* tabulated relative humidity.

3. Once the acclimation zone has been determined, use Table 7 on page 23 to determine the acclimation requirements for the system. For example, if the acclimation zone was determined to be C, then you will need to acclimate the system in its packaging (or bag) for 24 hours, then remove the packaging, and then acclimate for an additional 24 hours for a total of 48 hours.

4. Once the system has been acclimated as recommended, verify that <u>both</u> the outer surface of the frame and components of the system are free of moisture. A system may appear dry on the outside but may still be wet inside. If moisture is present, continue to acclimate the system without the packaging for an additional 12 hours before reverifying that it is dry. Continue acclimating and reverifying in 12 hour intervals while moisture persists. If moisture is still found to be present after a week, please contact an IBM representative for assistance and to troubleshoot the environment in which the system is acclimating.

Table 3. Acclimation zone table for shipments conducted in non-climate controlled and extreme cold weather conditions (-40ºC / -40ºF to -20ºC / -4ºF)

extreme cold: -40° C (-40° F) to -20° C (-4° F)		room temperature -- deg C (deg F)								
		5 (41)	10 (50)	15 (59)	20 (68)	25 (77)	30 (86)	35 (95)	40 (104)	45 (113)
room relative humidity %	8	D	C	C	C	C	B	B	B	B
	20	D	C	C	C	C	C	B	B	B
	40	D	D	C	C	C	C	C	C	X
	60	D	D	D	C	C	C	C	X	X
	80	X	D	D	D	D	C	X	X	X
	85	X	X	D	D	D	D	X	X	X

Table 4. Acclimation zone table for shipments conducted in non-climate controlled and very cold weather conditions (-20ºC / -4ºF to 0ºC / 32ºF)

very cold: -20° C (-4° F) to 0° C (32° F)		room temperature -- deg C (deg F)								
		5 (41)	10 (50)	15 (59)	20 (68)	25 (77)	30 (86)	35 (95)	40 (104)	45 (113)
room relative humidity %	8	C	C	B	B	B	B	B	B	B
	20	C	C	C	B	B	B	B	B	B
	40	D	C	C	C	C	C	B	B	X
	60	D	D	C	C	C	C	C	X	X
	80	X	D	D	C	C	C	X	X	X
	85	X	X	D	D	C	C	X	X	X

Table 5. Acclimation zone table for shipments conducted in non-climate controlled and cool weather conditions (0ºC / 32ºF to 15ºC / 59ºF). Shipments via air may use this table if subsequent transport and storage was in warmer conditions.

cool: 0° C (32° F) to 15° C (59° F)		room temperature -- deg C (deg F)								
		5 (41)	10 (50)	15 (59)	20 (68)	25 (77)	30 (86)	35 (95)	40 (104)	45 (113)
room relative humidity %	8	C	C	B	B	B	B	B	B	B
	20	C	C	B	B	B	B	B	B	B
	40	D	C	C	B	B	B	B	B	X
	60	D	C	C	C	C	C	B	X	X
	80	X	D	D	C	C	C	X	X	X
	85	X	X	D	D	C	C	X	X	X

Table 6. Acclimation zone table for shipments conducted in non-climate controlled but warm weather conditions or for shipments conducted in climate controlled trucking (15ºC / 59ºF and above). Shipments conducted via air may not use this table.

warm: 15° C (59° F) and above		room temperature -- deg C (deg F)								
		5 (41)	10 (50)	15 (59)	20 (68)	25 (77)	30 (86)	35 (95)	40 (104)	45 (113)
room relative humidity %	8	AA	AA	AA	AA	AA	AA	AA	AA	AA
	20	AA	AA	AA	AA	AA	AA	AA	AA	AA
	40	AA	AA	AA	AA	AA	AA	AA	A	X
	60	AA	AA	AA	A	A	A	A	X	X
	80	AA	A	A	C	B	B	X	X	X
	85	AA	A	A	C	C	C	X	X	X

Table 7. Acclimation recommendation

Zone	In bag + Out of bag	Total
AA	0 hours + 6 hours	6 hours
A	0 hours + 24 hours	24 hours
B	12 hours + 12 hours	24 hours
C	1 day + 1 day	2 days
D	2 days + 2 days	4 days
X	Acclimation not recommended in this zone. Contact an IBM representative for assistance.	

Conductive contamination

Semiconductors and sensitive electronics used in current Information Technology equipment have allowed for the manufacture of very high density electronic circuitry. While new technology allows for significant increases or capacity in a smaller physical space, it is susceptible to contamination, especially contamination particles that will conduct electricity. Since the early 1990s, it has been determined that data center environments may contain sources of conductive contamination. Contaminants include; carbon fibers, metallic debris such as aluminum, copper and steel filings from construction, and zinc whiskers from zinc-electroplated materials used in raised floor structures.

Although very small, and at times not easily seen without the visual aide of magnifying lenses, this type of contamination can have disastrous impacts on equipment availability and reliability. Errors, component damage and equipment outages caused by conductive contamination can be difficult to diagnose. Failures may be at first attributed to other more common factors such as lightning events or electrical power quality or even just presumed to be defective parts.

The most common conductive contamination in raised-floor data centers is what is known as zinc whiskers. It is the most common because it is frequently found on the underside of certain types of access floor tiles. Typically, the wood core style floor tile has a flat steel bottom. The steel may be coated with zinc either by a hot dip galvanize process or by zinc electroplate. The zinc electroplate steel exhibits a phenomena which appears as whisker-like growths on the surface. These small particles of approximately 1-2 mm (.04-.08 in.) in length, can break away from the surface and get pulled into the cooling air stream. Eventually they my be ingested by the equipment air, settle on a circuit board and create a problem. If you suspect that you may have this type of problem, contact your service representative.

Airborne particulates (including metal flakes or particles) and reactive gases acting alone or in combination with other environmental factors such as humidity or temperature might pose a risk to the 3932 that is described in this document. Risks that are posed by the presence of excessive particulate levels or concentrations of harmful gases include damage that might cause the 3932 to malfunction or cease functioning altogether. This specification sets forth limits for particulates and gases that are intended to avoid such damage. The limits must not be viewed or used as definitive limits because numerous other factors, such as temperature or moisture content of the air, can influence the impact of particulates or environmental corrosives and gaseous contaminant transfer. In the absence of specific limits that are set forth in this document, you must implement practices that maintain particulate or gas levels that are consistent with the protection of human health and safety. If it is determined that the levels of particulates or gases in your environment have caused damage to the 3932, there may be a provision of repair or replacement of 3932 or parts on implementation of appropriate remedial measures to mitigate such environmental contamination. Implementation of such remedial measures is a customer responsibility.

Table 8. Contaminant descriptions	
Contaminant	**Description**
Gaseous contamination	Severity level G1 as per ANSI/ISA 71.04-1985[1] which states that the reactivity rate of copper coupons shall be less than 300 Angstroms per month (Å/month, ~ 0.0039 µg/cm^2-hour weight gain).[2] In addition, the reactivity rate of silver coupons shall be less than 200 Å/month (~ 0.0035 µg/cm^2-hour weight gain).[3] As a best practice, the reactive monitoring of gaseous corrosivity should be conducted approximately 2 inches (5 cm) in front of the frame on the air inlet side at one-quarter and three-quarter frame height off the floor or where the air velocity is much higher.

Table 8. Contaminant descriptions (continued)	
Contaminant	**Description**
Particulate contamination	Datacenters must meet the cleanliness level of ISO 14644-1 class 8. For data centers without airside economizer, the ISO 14644-1 class 8 cleanliness may be met simply by the choice of the following filtration: • The room air may be continuously filtered with MERV 8 filters. Air entering a data center may be filtered with MERV 11 or preferably MERV 13 filters. • For datacenters with airside economizers, the choice of filters to achieve ISO class 8 cleanliness depends on the specific conditions present at that data center. The deliquescent relative humidity of the particulate contamination should be greater than 70% RH.[4] Datacenters must be free of zinc whiskers.[5]

Notes:

1. ANSI/ISA-71.04.1985. "Environmental conditions for process measurement and control systems: Airborne contaminants." Instrument Society of America, Research Triangle Park, NC, 1985.

2. The derivation of the equivalence between the rate of copper corrosion product thickness growth in Å/month and the rate of weight gain assumes that Cu_2S and Cu_2O grow in equal proportions.

3. The derivation of the equivalence between the rate of silver corrosion product thickness growth in Å/month and the rate of weight gain assumes that Ag_2S is the only corrosion product.

4. The deliquescent relative humidity of particulate contamination is the relative humidity at which the dust absorbs enough water to become wet and promote corrosion and/or ion migration.

5. As a best practice, one method that can be used to assess the presence of zinc whiskers is as follows. Surface debris is randomly collected from 10 areas of the data center on a 1.5-cm diameter disk of sticky electrically conductive tape on a metal stub. If examination of the sticky tape in a scanning electron microscope reveals no zinc whiskers, the data center is considered free of zinc whiskers.

6. If there is any question about potential corrosive gases or level of particulates, contact your representative for assistance in monitoring the environment.

Beyond the specific information provided in this document, it is recommended that the customer's facility meet the general guidelines published in the *American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) Handbook*.

Acoustics

This section provides information on acoustics for the 3932 at nominal environmental ambient temperatures of 23ºC plus or minus 2ºC (73.4ºF plus or minus 3.6ºF) except as otherwise noted.

Acoustical noise emission levels

Table 9. Acoustical noise emissions for the 3932						
Declared noise emission values in accordance with ISO 9296 [1-8]						
Product description M/T 3932 Model A02 and Model LA2	**Declared mean A-weighted sound power level $L_{WA,m}$ (B)**		**Declared mean A-weighted emission sound pressure level $L_{pA,m}$ (dB)** ---------------------- *bystander* ____ *front* ____ *rear*		**Statistical adder for verification K_v (B)**	
	Operating	**Idling**	**Operating**	**Idling**	**Operating**	**Idling**
Typical Configuration: • One frame with acoustical doors, one processor drawer, one PCIe+ I/O drawer, two Support Elements, and Power Distribution Units • Typical workload • 23 ºC, 500 m environment	7.1[9]	7.1[9]	56 ____ 73 ____ 64	56 ____ 73 ____ 64	0.3	0.3
Typical Configuration: • One frame with acoustical doors, one processor drawer, one PCIe+ I/O drawer, two Support Elements, and Power Distribution Units • Typical workload • 25 ºC, 500 m environment	7.3[10]	7.3[10]	59 ____ 74 ____ 65	59 ____ 74 ____ 65	0.3	0.3
Maximum Configuration: • One frame with acoustical doors, two processor drawers, three PCIe+ I/O drawers, two Support Elements, and Power Distribution Units • Typical workload • 25 ºC, 500 m environment	7.6[10]	7.6[10]	62 ____ 78 ____ 70	62 ____ 78 ____ 70	0.3	0.3

Table 9. Acoustical noise emissions for the 3932 (continued)

Product description M/T 3932 Model A02 and Model LA2	Declared mean A-weighted sound power level $L_{WA,m}$ (B)		Declared mean A-weighted emission sound pressure level $L_{pA,m}$ (dB) ---------------------- *bystander* ⎯⎯⎯⎯ *front* ⎯⎯⎯⎯ *rear*		Statistical adder for verification K_V (B)	
Declared noise emission values in accordance with ISO 9296 [1-8]						
	Operating	Idling	Operating	Idling	Operating	Idling
Maximum Configuration: • One frame with acoustical doors, two processor drawers, three PCIe+ I/O drawers, two Support Elements, and Power Distribution Units • Typical workload • 27 ºC, 500 m environment	7.8	7.8	63 ⎯⎯⎯⎯ 80 ⎯⎯⎯⎯ 70	63 ⎯⎯⎯⎯ 80 ⎯⎯⎯⎯ 70	0.3	0.3
Typical Configuration: • One frame with acoustical doors, one processor drawer, one PCIe+ I/O drawer, two Support Elements, and Power Distribution Units • Maximum workload • 45 ºC, 914 m environment	8.7	8.7	72 ⎯⎯⎯⎯ 89 ⎯⎯⎯⎯ 79	72 ⎯⎯⎯⎯ 89 ⎯⎯⎯⎯ 79	0.3	0.3
Maximum Configuration: • One frame with acoustical doors, two processor drawers, three PCIe+ I/O drawers, two Support Elements, and Power Distribution Units • Maximum workload • 45 ºC, 914 m environment	9.1	9.1	76 ⎯⎯⎯⎯ 95 ⎯⎯⎯⎯ 84	76 ⎯⎯⎯⎯ 95 ⎯⎯⎯⎯ 84	0.3	0.3

Notes:

1. Declared level $L_{WA,m}$ is the mean A-weighted sound power level.

2. Declared level $L_{pA,m}$ is the mean A-weighted sound pressure level computed as the arithmetic average of the measurements at the 1-meter bystander positions, or it is measured as the maximum 0.5-meter operator position at the front or rear face with the doors opened.

3. The statistical adder for verification, K_V, is a quantity to be added to the declared mean A-weighted sound power level $L_{WA,m}$, such that there will be a 95% probability of acceptance when using the

verification procedures of ISO 9296, if no more than 6.5% of the batch of new equipment has A-weighted sound power levels greater than the sum of ($L_{WA,m} + K_V$).

4. The quantity $L_{WA,c}$ (formerly called L_{WAd}), can be computed from the sum of $L_{WA,m}$ and K_V.

5. Measurements are made in conformance with ISO 7779 and declared in conformance with ISO 9296, except for the inclusion of some modeled results derived from ISO 7779 measurements.

6. **B** and **dB** are the abbreviations for **bels** and **decibels**, respectively. 1 B = 10 dB.

7. Under certain environments, configurations, system settings and/or workloads, fan speeds are increased which results in higher noise levels.

8. **Notice:** Government regulations (such as those prescribed by OSHA or European Community Directives) may govern noise level exposure in the workplace and may apply to you and your server installation. The actual sound pressure levels in your installation depend upon a variety of factors, including the number of frames in the installation; the size, materials, and configuration of the room where you designate the frames to be installed; the noise levels from other equipment; the room ambient temperature, and employees' location in relation to the equipment. Further, compliance with such government regulations also depends upon a variety of additional factors, including the duration of employees' exposure and whether employees wear hearing protection. IBM recommends that you consult with qualified experts in this field to determine whether you are in compliance with the applicable regulations.

9. Meets IT Product Noise Limits for "Generally Attended Data Center" per Statskontoret Technical Standard 26:6.

10. Meets IT Product Noise Limits for "Generally Unattended Data Center" per Statskontoret Technical Standard 26:6.

Relevant international standards:

- Measurements: ISO 7779
- Declaration: ISO 9296

Chapter 3. Models and physical specifications

This chapter provides the following detailed information for the 3932:

- Model and frame descriptions
- Shipping specifications
- Plan view and specifications
- Weight distribution data and service clearances information
- Cooling recommendations

Note: All dimensions are considered nominal.

Figure 3. IBM z16 Single Frame Model A02

Facts about the 3932:

- **System configuration**
  - The 3932 is a single frame configuration.
  - The 3932 is powered by 2 or 4 Power Distribution Units (PDUs). For more information, see Chapter 5, "Power requirements," on page 77.
  - The 3932 can be powered from an AC source only. HVDC power source is <u>not</u> supported.
  - The 3932 is air-cooled, and can be installed on a *raised floor* or *non-raised floor*.

- **Cable management**
  - For the 3932, bottom exit cabling and top exit cabling for power and I/O are supported.
    - For bottom exit cabling, you must order the bottom exit feature (**FC 7804**). See "Bottom Exit Cabling specifications" on page 155 for more information.
    - For top exit cabling, you can order one of the following features:
      - Top Exit cabling feature (**FC 7802**) - provides additional enclosure hardware for installation on the top of the frame(s).
      - Base Top Exit cabling feature (**FC 7803**) - provides no additional hardware; cables are routed directly through the top of the frame(s).

      See "Top Exit Cabling specifications" on page 152 for more information.
  - If cables are exposed in your system environment, refer to your local and national electric and safety codes for more information.

    If you are planning an installation on a raised floor in Canada, the installation must be in accordance with Section 12-020 of the Canadian Electrical Code. In any country, refer to your national electric code if you have questions about routing data processing cables in exposed areas.
  - If a system's frame contains more than two PCIe+ I/O drawers, more than one CPC drawer, the spine cable management hardware will be installed on your system. This hardware allows you to route the cables from the PCIe+ I/O drawers and the CPC processor drawer to the middle of the frame, which provides accessibility for servicing a machine. The cables can be routed to the bottom of the frame or to the top of the frame.
  - For cable management best practices and guidelines, see *3932 Single Frame External Cabling Best Practices* (https://www.ibm.com/support/pages/node/7001737).

- **Other considerations**
  - In areas that might be prone to seismic events, the Earthquake Kit feature (**FC 8014 or 8015**) is available. See "Earthquake Kit" on page 58 for more information.
    - **FC 8014** provides frame tie-down hardware to cover *raised floor* heights from 228.6 mm - 330.2 mm (9 in - 13 in), 304.8 mm - 558.8 mm (12 in - 22 in), and 304.8 mm - 914.4 mm (12 in - 36 in).
    - **FC 8015** provides frame tie-down hardware for *non-raised floor* environments.
  - There are separate shipping containers for the covers of the frame.

Important: When an incline or ramp needs to be traversed during system transport, the angle of inclination must be less than or equal to 10º. Angles that are greater than 10º pose a safety hazard as well as expose the potential for the system frame to bottom out while transitioning to or from the level surface.

Physical dimensions

This section lists the dimensions for the following:

- Frame dimensions
- Top Exit feature (FC 7802)
- Height Reduction feature (FC 9975)

Frame dimensions

Note: The installation of side covers is optional on the 3932.

Table 10. A frame dimensions			
A frame/cover combination	**Width mm (in)**	**Depth mm (in)**	**Height mm (in)**
Frame A w/o covers	600 mm (23.6 in)	1070 mm (42.1 in)	2016 mm (79.4 in)
Frame A w/ covers	624 mm (24.6 in)	1208 mm (47.6 in)	2023 mm (79.7 in)
Frame A w/ covers and top exit feature	624 mm (24.6 in)	1208 mm (47.6 in)	2139 mm (84.2 in)

Top Exit feature (FC 7802)

The top exit cabling enclosure is installed on the top of the machine in the rear. The following table provides the dimensions and weight for the top exit cabling enclosure:

Table 11. Top exit cabling enclosure (FC 7802) measurements			
Weight	**Width**	**Depth**	**Height**
5.4 kg (12 lbs)	599 mm (23.58 in)	336.5 mm (13.25 in)	123 mm (4.8 in)

Height Reduction feature (FC 9975)

3932 is composed of a 42 EIA A-frame. The base frame is 40 EIA with a 2U removable top hat.

If you have doorways that will not fit the 3932, you should order FC 9975. FC 9975 reduces the frame height to 1900 mm (74.8 in). With FC 9975, the 2U top hat, the primary Support Element, and the alternate Support Element are shipped in separate boxes.

Shipping and packaging specifications

Frame packaging

The 3932 is shipped in a fully enclosed wooden and palatalized crate.

- The frame is wrapped in a clear white poly bag and a green vapor barrier with desiccant packages in the bottom rear of the wooden crate; as shown in .
- The wooden crate has a tilt indicator label located on the external side of the crate.
  - If the indicator is red, the label instructs you on what you should do next.
- When you open the crate, there is a humidity card attached to the system.
  - The card identifies the humidity level of the environment within the crate, shows a scale to determine the valid humidity range, and instructs you on what you should do if the humidity level is not within the appropriate range.

The following table provides the physical dimensions and weight of the wooden crate. The weight provided indicates the weight of the wooden crate *without* the frame inside. The actual weight of the packaged frame may vary.

Table 12. Wooden crate specifications			
Width mm (in)	**Depth mm (in)**	**Height mm (in)**	**Weight kg (lb)**
939.8 mm (37 in)	1333.5 mm (52.5 in)	2286.0 mm (90 in)	254.0 kg (560 lb)

Figure 4. Frame packaged in clear white poly bag and green vapor barrier bag

Planning for system packaging and return packaging

⚠️ **Attention:** Depending on your specific system configuration, the 3932 might require additional packaging equipment to ensure safe system transport. This additional packaging may be large in size and <u>must</u> be planned for accordingly. Discuss the required storage space for your specific system configuration with your IBM marketing representative or Business Partner.

Box Contents	Width mm (in)	Depth mm (in)	Height mm (in)	Weight kg (lb)
Table 13. 3932 packaging for system delivery				
A frame	940 mm (37 in)	1346 mm (53 in)	2286 mm (90 in)	1021 kg (2252 lb)[1]
Cover kit	457 mm (18 in)	2134 mm (84 in)	1016 mm (40 in)	50 kg (110 lb)
Ship Group	610 mm (24 in)	1016 mm (40 in)	1016 mm (40 in)	32 kg (70 lb)
Lift Tool	559 mm (22 in)	1118 mm (44 in)	889 mm (35 in)	48 kg (105 lb)
1U HMC *or* 1U TKE (*per your configuration*)	610 mm (24 in)	1016 mm (40 in)	508 mm (20 in)	18 kg (40 lb)

Note:

1. The actual weight of the packaged frame may vary significantly, depending on the system configuration.

The following equipment <u>must</u> be remain on site:

- Ship Group and Tool Kit
- Lift Tool

Cover set packaging

	Width mm (in)	Depth mm (in)	Height mm (in)	Weight kg (lb)
Table 14. Cover set packaging specifications				
cover set	457.2 mm (18 in)	2133.6 mm (84 in)	1016.0 mm (40 in)	49.9 kg (110 lb)
side cover pack	1511.3 mm (59.5 in)	2184.4 mm (86 in)	330.2 mm (13 in)	-

Top Exit Feature - FC 7802

The Top Exit feature (FC 7802) is wrapped in a poly bag for packaging.

	Width mm (in)	Depth mm (in)	Height mm (in)	Weight kg (lb)
Table 15. Top exit feature packaging specifications				
top exit enclosure	599 mm (23.58 in)	336.5 mm (13.25 in)	123 mm (4.8 in)	5.4 mm (12 in)

Height Reduction Feature - FC 9975

If the Height Reduction feature (FC 9975) is ordered, the top hat, primary Support Element, and alternate Support Element are shipped in separate boxes.

Table 16. Height reduction feature packaging specifications				
	Width mm (in)	**Depth mm (in)**	**Height mm (in)**	**Weight kg (lb)**
top hat	660.4 mm (26 in)	1117.6 mm (44 in)	406.4 mm (16 in)	34.1 kg (75 lb)
primary Support Element	609.6 mm (24 in) [1]	1016.0 mm (40 in) [1]	355.6 mm (14 in) [1]	25.0 kg (55 lb)
alternate Support Element	609.6 mm (24 in) [1]	1016.0 mm (40 in) [1]	355.6 mm (14 in) [1]	25.0 kg (55 lb)
Note: 1. For two Support Element boxes stacked together on one pallet, the specifications are 609.6 mm x 1016.0 mm x 584.2 mm (24 in x 40 in x 23 in).				

3932 Single Frame feature codes

Table 17. 3932 Single Frame model descriptions	
Feature code	**Description**
0513	Model A02 IBM z16 Single Frame model Supports CP and all specialty engines
0514	Model LA2 IBM LinuxONE Rockhopper 4 Single Frame model Supports IFLs only
CP - Central Processor **IFL** - Integrated Facilities for Linux®	

The 3932 Single Frame contains four feature codes based on the maximum number of configurable PUs.

Table 18. Model A02/LA2 processor descriptions	
Feature code	**Description**
0672	Model A02/Model LA2 2 CP DCMs 2 CP chips Maximum 5 configurable PUs
0673	Model A02/Model LA2 2 CP DCMs 4 CP chips Maximum 16 configurable PUs
0674	Model A02/Model LA2 4 CP DCMs 8 CP chips Maximum 32 configurable PUs
0675	Model A02/Model LA2 8 CP DCMs 16 CP chips Maximum 68 configurable PUs

These models contain Dual Chip Modules (DCMs),user-definable Processor Units (PUs), System Assist Processors (SAPs), and spare PUs (used to provide uninterrupted computing if there should be a problem with a working PU). Model specifications are described in Table 19 on page 36 and Table 20 on page 38.

Table 19. Model A02 (FC 0513) configurable PUs and options	
Feature code	**Description**
FC 0672 (Max 5 configurable PUs)	• 1 CPC drawer • 0-5 CPs • 0-5 IFLs • 0-4 uIFLs • 0-4 zIIPs • 0-4 uzIIPs • 0-5 ICFs • 0-4 uICFs • 2 IFP • 2 standard SAPs • 2 spares • Max Memory: 4T
FC 0673 (Max 16 configurable PUs)	• 1 CPC drawer • 0-6 CPs • 0-16 IFLs • 0-15 uIFLs • 0-15 zIIPs • 0-15 uzIIPs • 0-16 ICFs • 0-15 uICFs • 2 IFP • 2 standard SAPs • 2 spares • Max Memory: 4T
FC 0674 (Max 32 configurable PUs)	• 1 CPC drawer • 0-6 CPs • 0-32 IFLs • 0-31 uIFLs • 0-31 zIIPs • 0-31 uzIIPs • 0-32 ICFs • 0-31 uICFs • 2 IFP • 4 standard SAPs • 2 spares • Max Memory: 8T

Table 19. Model A02 (FC 0513) configurable PUs and options (continued)	
Feature code	**Description**
FC 0675 (Max 68 configurable PUs)	• 2 CPC drawers • 0-6 CPs • 0-68 IFLs • 0-67 uIFLs • 0-67 zIIPs • 0-67 uzIIPs • 0-68 ICFs • 0-67 uICFs • 2 IFP • 8 standard SAPs • 2 spares • Max Memory: 16
CP - Central Processor **SAP** - System Assist Processor **IFL** - Integrated Facilities for Linux **ICF** - Integrated Coupling Facility **zIIP** - z Integrated Information Processor **IFP** - Integrated Firmware Processor	

Table 20. Model LA2 (FC 0514) configurable PUs and options	
Feature code	**Description**
FC 0672 (Max 5 configurable PUs)	• 1 CPC drawer • 0-1 CPs ** • 1-5 IFLs • 0-4 uIFLs • 0 zIIPs • 0 uzIIPs • 0 ICFs • 0 uICFs • 2 IFP • 2 standard SAPs • 2 spares • Max Memory: 4T
FC 0673 (Max 16 configurable PUs)	• 1 CPC drawer • 0-1 CPs ** • 1-16 IFLs • 0-15 uIFLs • 0 zIIPs • 0 uzIIPs • 0 ICFs • 0 uICFs • 2 IFP • 2 standard SAPs • 2 spares • Max Memory: 4T
FC 0674 (Max 32 configurable PUs)	• 1 CPC drawer • 0-1 CPs ** • 1-32 IFLs • 0-31 uIFLs • 0 zIIPs • 0 uzIIPs • 0 ICFs • 0 uICFs • 2 IFP • 4 standard SAPs • 2 spares • Max Memory: 8T

Table 20. Model LA2 (FC 0514) configurable PUs and options (continued)	
Feature code	**Description**
FC 0675 (Max 68 configurable PUs)	• 2 CPC drawers • 0-1 CPs ** • 1-68 IFLs • 0-67 uIFLs • 0 zIIPs • 0 uzIIPs • 0 ICFs • 0 uICFs • 2 IFP • 8 standard SAPs • 2 spares • Max Memory: 16T
CP - Central Processor **SAP** - System Assist Processor **IFL** - Integrated Facilities for Linux **ICF** - Integrated Coupling Facility **zIIP** - z Integrated Information Processor **IFP** - Integrated Firmware Processor ****** 1 CP for GDPS (Geographically Dispersed Parallel Sysplex) Virtual Appliance	

PCIe+ I/O drawers

The 3932 supports up to 3 PCIe+ I/O drawers. The number of drawers supported is dependent on the system configuration.

Each PCIe+ I/O drawer:

• Is 8 EIA units

• Provides 2 Power Supply Units (PSUs) located at the top of the drawer.

• Provides 16 adapters, with two ports per adapter, over two domains. They are plugged in the following locations:

Domain 0	Domain 1
LG02	LG12
LG03	LG13
LG04	LG14
LG05	LG15
LG07	LG17
LG08	LG18
LG09	LG19
LG10	LG20

• Requires 2 Baseboard Management Controller (BMC) cards plugged in locations **LG01** and **LG11**.

• Requires 2 PCIe Interconnect cards (FC 0421) plugged as both domains will initially be activated. They are plugged in locations **LG06** and **LG16**.
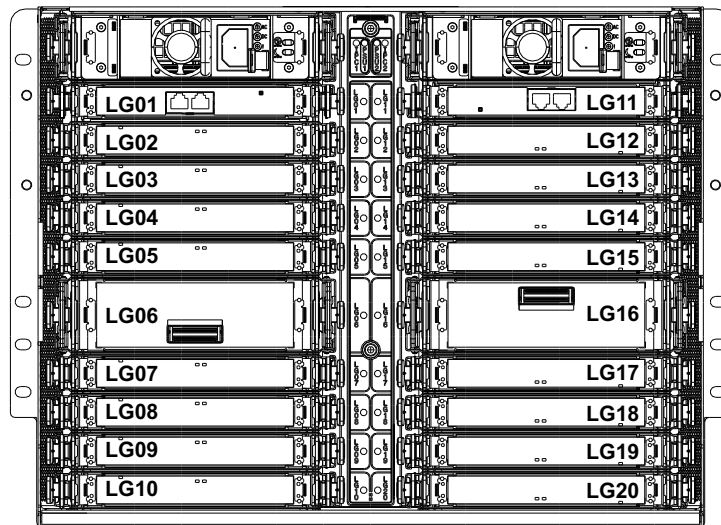
PCIe+ I/O drawer rear view

System upgrades

The following upgrades are supported:

- 8562 (IBM z15® Model T02) to 3932 (IBM z16 Model A02).

An upgrade includes all frames, support cards, and new I/O features.

CPC processor drawer

The 3932 supports up to 2 CPC processor drawers.

Each CPC processor drawer:

- Is 5 EIA units
- In the *rear* of the CPC drawer:
    - 12 PCIe+ Fanouts plugged in the following locations:

        LG01, **LG02**, **LG03**, **LG04**, **LG05**, **LG06**, **LG07**, **LG08**, **LG09**, **LG10**, **LG11**, **LG12**

    - 0-1 Symmetric Multiprocessing (SMP) ports
    - 4 Power Supply Units (PSUs)
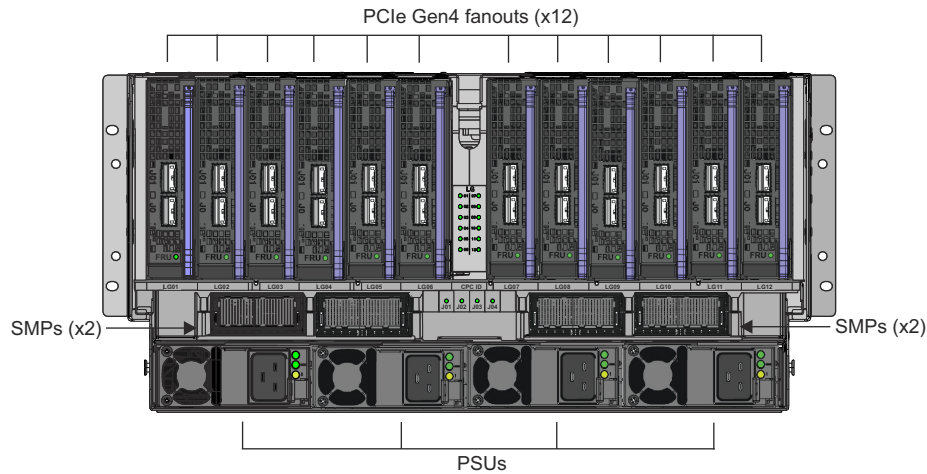
- In the *front* of the CPC drawer:
    - 5 Fans
    - 2 Flexible Service Processors (FSPs) and Oscillator cards (OSC)
    - 2 Processor Power Control (PPC) cards
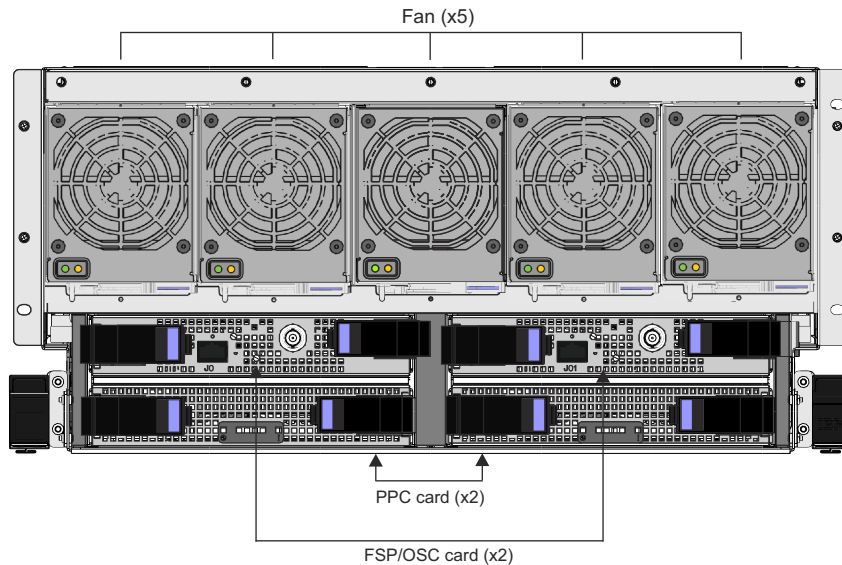
Differences between IBM servers

Comparison information is provided here for those who may be placing an 3932 on a raised floor with another IBM zSystem server.

Table 21. Differences between single-frame servers				
System family	**Depth (with covers)**	**Height (with covers)**	**Width (with covers)**	**Weight (Maximum)**
z13s *or* Rockhopper (2965)	1595 mm (62.8 in)	2015 mm (79.3 in)	785 mm (30.9 in)	1209 kg (2665 lb)
z13s *or* Rockhopper (2965 with I/O towers)	1595 mm (62.8 in)	2154 mm (84.8 in)	937 mm (36.9 in)	1245 kg (2743 lb)
z14 Model ZR1 *or* Rockhopper II Model LR1 (3907)	1204 mm (47.4 in)	2022 mm (79.5 in)	624 mm (24.6 in)	790 kg (1740 lb)
z14 Model ZR1 *or* Rockhopper II Model LR1 (3907 with top exit feature)	1204 mm (47.4 in)	2140 mm (84.3 in)	624 mm (24.6 in)	795 kg (1750 lb)
IBM z15 Model T02 *or* IBM LinuxONE III Model LT2 (3932)	1208 mm (47.6 in)	2023 mm (79.7 in)	624 mm (24.6 in)	767 kg (1692 lb)
IBM z15 Model T02 *or* IBM LinuxONE III Model LT2 (3932 with top exit feature)	1208 mm (47.6 in)	2139 mm (84.2 in)	624 mm (24.6 in)	772 kg (1702 lb)
IBM z16 Model A02 *or* IBM LinuxONE Rockhopper 4 Model LA2 (3932)	1208 mm (47.6 in)	2023 mm (79.7 in)	624 mm (24.6 in)	767 kg (1692 lb)
IBM z16 Model A02 *or* IBM LinuxONE Rockhopper 4 Model LA2 (3932 with top exit feature)	1208 mm (47.6 in)	2139 mm (84.2 in)	624 mm (24.6 in)	772 kg (1702 lb)

Notes:

1. The installation of side covers is optional on the 3932. For system dimensions *without* covers, see "Physical dimensions" on page 31.

2. This weight <u>does not</u> include the weight for the Earthquake Kit feature (**FC 8014** or **FC 8015**).

   The Earthquake Kit hardware weighs approximately 43 kg (95 lbs).

If you are replacing an existing machine, also refer to the *Installation Manual for Physical Planning* for your existing machine (available on **IBM Documentation**; go to https://www.ibm.com/docs/en/systems-hardware, select **IBM Z** or **IBM LinuxONE**, then select your configuration, and click **Library Overview**

on the navigation bar) to determine actual differences between your existing installed machine and the 3932. Plan views, physical dimensions, service clearances, aisle spacing, and power and cooling requirements may be substantially different.

Plan views

The following graphic provides a visual representation of the 3932 physical dimensions.

For installations planning to use top exit power cords, the frame openings for these cords are on the top of the left front and right rear corners of the frame.

Note: The dimensions provided <u>do not</u> include the optional side covers.

rear

600 mm
(23.6 in)

150 mm
(5.9 in)

A

1070 mm
(42.1 in)

1208 mm
(47.6 in)

front
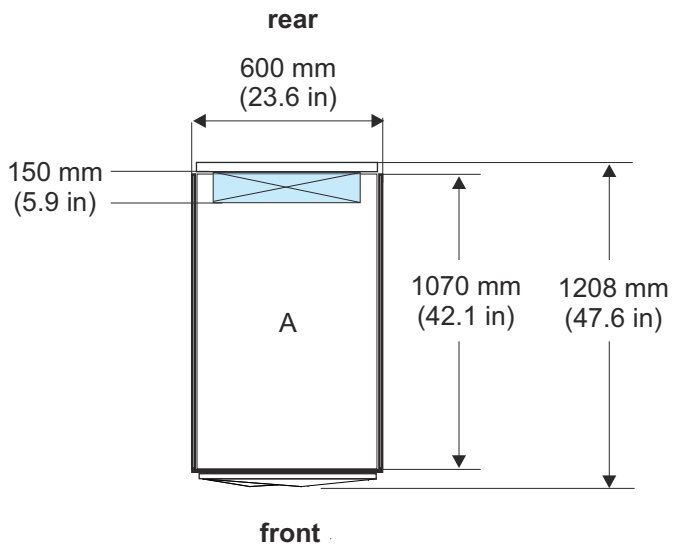
Weight distribution and floor loading

The following topics provide weight and physical dimensions information that are used to calculate weight distribution and floor loading for the 3932. All floor loading calculations are intended for a raised floor environment. If you are using a non-raised floor environment, these floor loading calculations do not apply.

- For system weight examples, see "System weight examples" on page 47.
- For floor loading examples, see "Floor loading examples" on page 48.

The following figure, and tables in "System weight examples" on page 47, show sample floor loading values for the 3932.
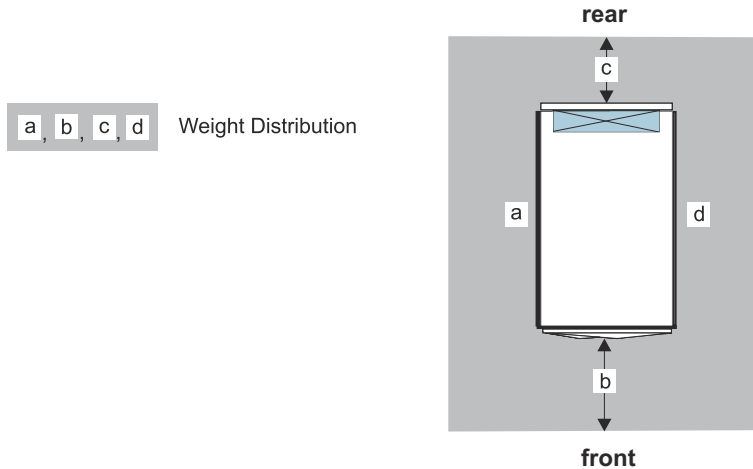
Figure 5. One frame

All measurements are taken from the outside edge of the machine frame, without covers, unless described otherwise.

- "a" = left side clearance dimension
- "b" = front clearance dimension
- "c" = rear clearance dimension
- "d" = right side clearance dimension

System weight examples

The following table provides weight estimates for the *minimum* and *maximum* system configurations of the 3932.

The **Power and Weight Estimation** tool includes weight data and provides a more accurate weight for your particular configuration. See "Power and environmental estimation tool" on page 79.

⚠️ **Attention:**
- Due to system weight and machine area variability, you **must** use a floor loading calculator or work with a structural engineer for specific floor loading requirements!
- All weights are approximate and <u>do not</u> include Earthquake Kit hardware.
  - The Earthquake Kit hardware weighs approximately 43 kg (95 lbs).
- The estimated weight provided reflects a *maximum* populated single-frame configuration.
- Actual weight varies and can only be determined by an exact specification of content.

CPCs	I/O drawers							
	0		**1**		**2**		**3**	
	lbs	kg	lbs	kg	lbs	kg	lbs	kg
1	889	403	1090	494	1291	565	1492	676
2	1091	495	1291	585	1388	676	1692	767

Figure 6. Weights for minimum and maximum machine configurations

Floor loading examples

The following table provides *estimated* floor loading values for the 3932.

Floor loading is a function of system weight, system area, clearance area around the system, and system installation environment (raised or non-raised floor).

⚠️ **Attention:** Due to system weight variability, the following table does not cover every system configurations. The following table provides the maximum limits of floor loading for a system that meets the requirements for operation and serviceability.

The provided floor loading values are for installed systems. Systems that are surrounded by other equipment, such as in storage, can exceed a floor loading of 976 kg/M^2 (200 lbs/ft^2).

- The *minimum* floor loading values are for a stand-alone installation with 5 ft of clearance space all the way around the system.
- The *maximum* floor loading values are for a system that is being installed in the middle of an existing row. This scenario assumes that there is no side clearance area, a 3 ft hot aisle (rear), and a 4 ft cold aisle (front).

The system weight that is used to calculate the following floor loading values (minimum and maximum) assumes that all of the drawers are maximum plugged. The weight in each instance is the **maximum**.

Note: The Earthquake Kit hardware weighs approximately 43 kg (95 lbs). If this feature is ordered, you must add the following:

2.3 kg/M^2 (5 lbs/ft^2) to the *maximum* floor loading values
1.5 kg/M^2 (3 lbs/ft^2) to the *minimum* floor loading values

The following formula is used to calculate the floor loading values and is provided for your reference. You can use this formula to obtain the floor loading (FL) values for your specific system configuration.

```
FL (lbs/ft²) = k + (w + 120) / ((2 + a + d)*(4 + b + c)
```

k = 10 (raised floor environment) *or* 0 (non-raised floor environment)
w = System weight (lbs)
a and *d* = side clearance dimensions (ft)
b and *c* = front and rear clearance dimensions (ft)

See for sample floor loading figures of the 3932.

I/O drawers

CPCs		0		1		2		3	
		lbs/sqft	kg/sqm	lbs/sqft	kg/sqm	lbs/sqft	kg/sqm	lbs/sqft	kg/sqm
1	min	26	127	29	143	32	158	36	174
1	max	77	376	91	443	104	508	117	573
2	min	29	143	32	158	34	166	39	189
2	max	91	443	104	508	111	540	131	639

Weight distribution and multiple systems

Under typical conditions, service clearances of adjacent products may be overlapped but weight distribution areas should not be overlapped. If weight distribution clearances are overlapped, the customer should obtain the services of a qualified consultant or structural engineer to determine floor loading. Regardless of floor loading, minimum service and aisle clearances must be observed:

- Rear dimension "f" is **914 mm (36.0 in)**.
- Front dimension "e" is **1168 mm (46 in)**.
- Both "f" and "e" are measured from the frame edge (without covers) to the nearest obstacle.
- Cover opening dimensions are also shown.

Note that aisle clearances are not the same between rows of front-facing and rear-facing covers. Front-facing rows require a **minimum** of **1168 mm (46 in)** of clearance while rear-facing rows need a **minimum** of **914 mm (36.0 in)**.

For physical planning purposes, you must verify system placement considering:

- Weight distribution
- Power availability
- Power access
- Machine and service clearance area
- Air conditioning delivery
- Thermal interaction
- Cable locations
- Floor tile cutouts.

rear

front

103.6 mm (4.1 in)

e

c

aisle width
1168 mm (46 in)

front

rear

b

f

aisle width
914 mm (36 in)

30 mm (1.18 in)

rear

front

aisle width
1168 mm (46 in)

Wall

= load shedding area   = service clearance area
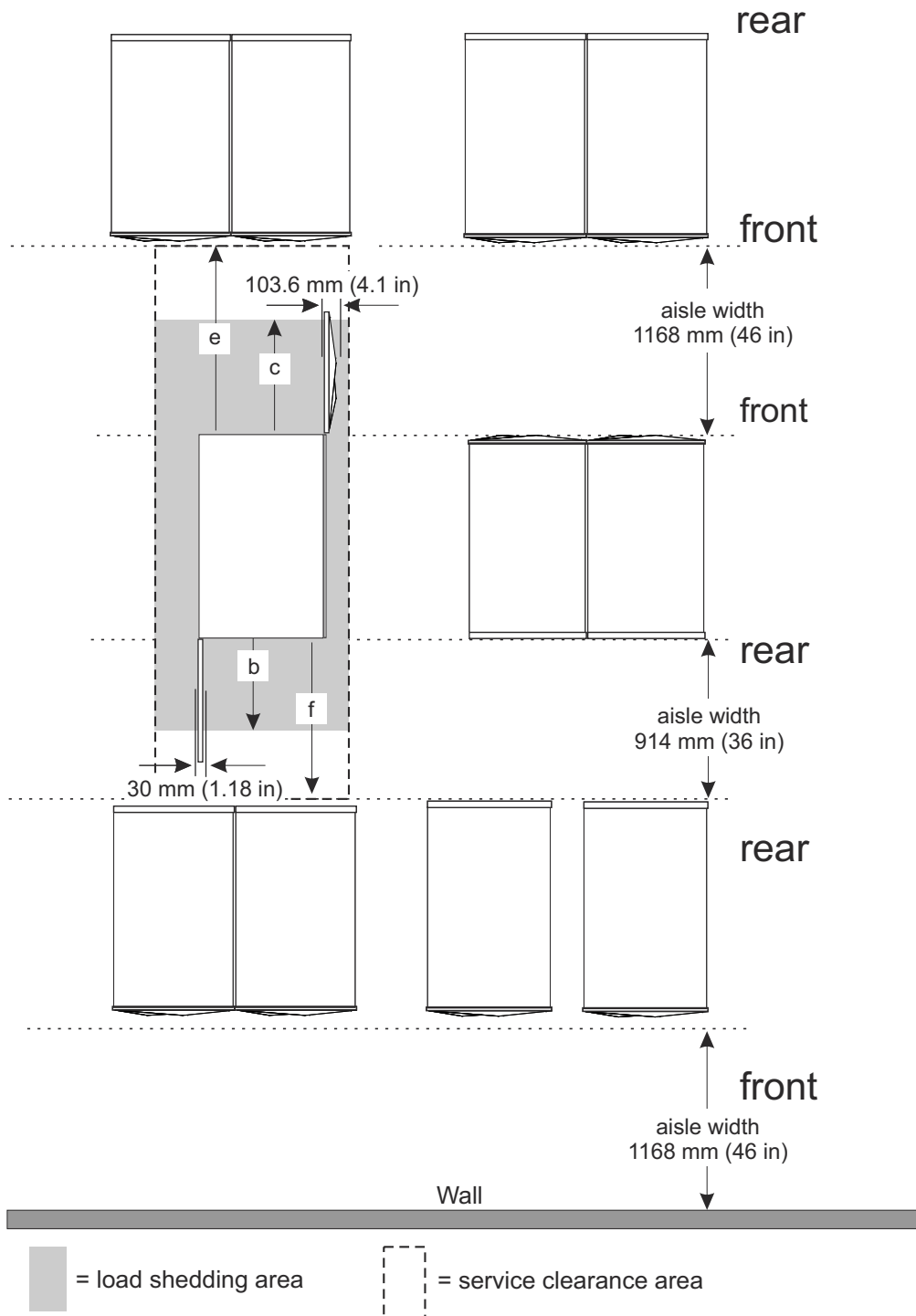
Figure 7. Aisle and service clearances

Structural integrity, seismic support, and system mobility

The 3932 is structurally designed to be transported, installed, relocated, and operated in customer environments without loss of functionality and without structural failure or cosmetic damage. Equipped with certain features, the 3932 is capable to withstand high magnitude earthquake events without functional degradation during and after earthquake events.

This section addresses environmental conditions or the level that the 3932 tested and verified.

Note: The vibration and shock levels given here are the levels that 3932 tested and verified and not the upper limit of what the system can withstand. If you have any environmental conditions higher than specified here, please contact your IBM representatives.

There are three shock and vibration levels:

- Ruggedness (Fragility)
- Operational shock and vibration
- Seismic resistance

Ruggedness (Fragility)

Ruggedness relates to a product's ability to withstand the shipping and relocation environments without structural damage. Product ruggedness is assured through shipping shock, vibration, and horizontal impact testing. Passing the test requirements include no short-term and long-term structural and functional degradation. Ruggedness is a key focus item during the new product design phase. Significant analysis and testing efforts are typically associated with new product and subassembly designs to ensure adequate ruggedness for frames, fragile components, and assemblies. To ensure broad protection against shock and vibration, the subassemblies and minimum and maximum system configurations are subjected to unpackaged and packaged testing to cover possible shipping configurations.

Focus on system level or the frame with its drawers installed include:

- Excessive deflection of chassis during drop test
- Yielding of drawer chassis, frame rails, cages, and subassemblies
- Excessive frame transmissibility

Focus on subassembly level or drawers not installed in a frame include:

- Heatsink retention
- Chip damage due to heatsink loading
- Card interconnect damage
- Card retention and latching
- Card connector fretting wear
- Card and cable connectors
- Power supply assembly fragility
- Cooling components air moving devices
- Hinges and doors

Test levels

There are two vibration test profiles:

- Sinusoidal at 0.5 g sweep 2 - 200 Hz for a total of 30 minutes
- Random vibration for 15 minutes with power spectral density as shown in .

For system level testing, the system is subjected to vertical direction vibration.

For subassembly testing, the test is conducted on all three perpendicular axes.

Table 22. Truck, air, rail, and ocean vibration spectrum *		
Frequency (Hz)	**G^2/Hz (PSD level)**	**graph representation**
2	0.0010	
4	0.0220	
8	0.0220	
40	0.0022	
55	0.0070	
70	0.0070	
75	0.0220	
200	0.0007	
Note: * A rms = 0.8044 G, V rms = 4.508 in/s, D rms = 0.1578 in zero to peak		

There are two shock test levels:

- System level or the frame with its drawers installed – vertical direction
  10 times free fall drops at 39.3 in/s velocity change
  2 times free fall drops at 55.6 in/s velocity change
- Subassembly or drawers level – in all 6 faces
  100 g, 3 ms half sine pulse 2x per face
  50 g, 11 ms half sine pulse 2x per face

Since 1980, the shock test levels that are previously specified and vibration test levels specified in have been utilized. No documented cases of field problems associated with normal shipping shock and vibration exist.

Operational shock and vibration

Operational shock and vibration relates to a product's ability to withstand normal shock and vibration from its installation environments without functional degradation. Although the shock and vibration sources are typically from the surrounding environment (nearby cooling operating equipment, people walking by or dropping materials, etc.), they also can be self-induced (vibration from fans, blowers, compressors, etc.).

Test levels

All the 3932 systems while running are verified to meet the vertical vibration level given in and without any functional degradation. The 3932 is verified to be able to withstand five vertical shock inputs 3.5 g with 3 ms half sine pulse width.

Table 23. Random vibration PSD profile breakpoint [1]									
Class	**5 Hz**	**17 Hz**	**45 Hz**	**48 Hz**	**62 Hz**	**65 Hz**	**150 Hz**	**200 Hz**	**500 Hz**
V1L/V2	2.0×10^{-7}	2.2×10^{-5}	2.2×10^{-5}	2.2×10^{-5}	2.2×10^{-5}	2.2×10^{-5}	2.2×10^{-5}	2.2×10^{-5}	2.2×10^{-5}
Notes:									
1. All values in this table are in g^2/Hz.									
2. For reference only. No test required.									
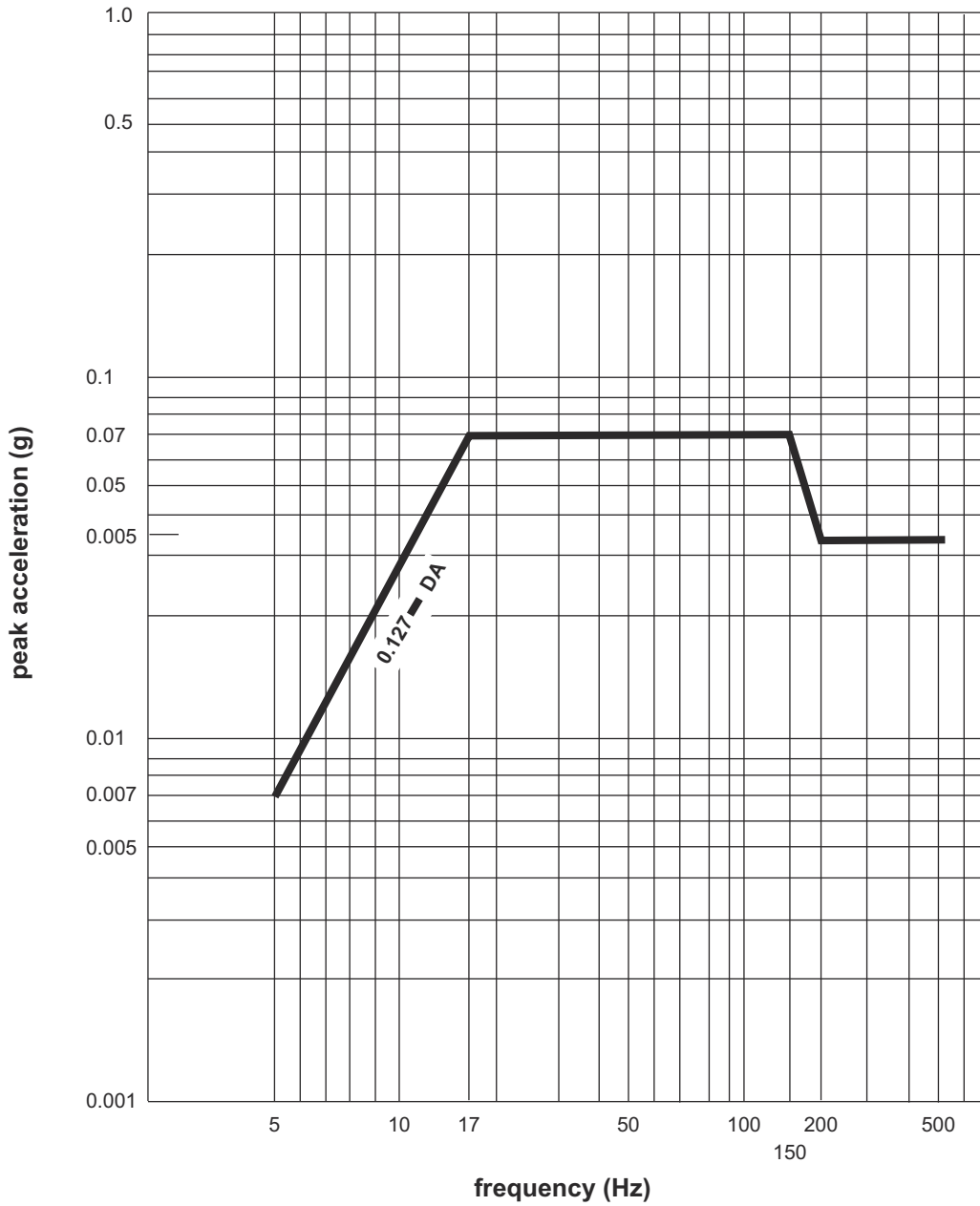
Figure 8. Continuous operational vibration

Documented cases of field problems associated with externally imposed shock and vibration during normal equipment operation are essentially nonexistent.

Seismic (Earthquake) resistance

In earthquake areas, the 3932 equipped with the appropriate earthquake kits are certified to meet requirements ICC IES AC156.

To achieve the most generally applicable results, the required 5% damped response spectrum (RRS) was based on the worst-case scenario parameters for ground level, as defined by IBC and summarized in Table 24 on page 55. Using these parameters, the maximum spectral acceleration values, **A_{FLX-H}** and **A_{RIG-H}** as defined in AC156, were calculated as shown in the following table.

$$A_{FLX-H} = S_{DS}\left(1 + 2\frac{z}{h}\right) \leq 1.6S_{DS} \; or \; 3.2 \quad \text{and} \quad A_{RIG-H} = 0.4S_{DS}\left(1 + 2\frac{z}{h}\right)$$

Table 24. Parameters used for Required Response Spectrum (RRS)						
Test criteria	**S_{DS} (g)**	**z/h**	**Horizontal**		**Vertical**	
			A_{FLX-H}	**A_{RIG-H}**	**A_{FLX-V}**	**A_{RIG-V}**
ICC-ES AC156	2.5	1.0	3.20	3.00	1.68	0.68

Notes:

- S_{DS} = Design spectral response acceleration at short period
- A_{FLX-H} = Horizontal spectral acceleration calculated for flexible components
- A_{RIG-H} = Horizontal spectral acceleration calculated for rigid components
- A_{FLX-V} = Vertical spectral acceleration calculated for flexible components
- A_{RIG-V} = Vertical spectral acceleration calculated for rigid components

For vertical response, z is assumed to be 0.00 for all attachment heights, which results in the follow:

$$A_{FLX-V} = 0.67S_{DS} \quad \text{and} \quad A_{RIG-H} = 0.27S_{DS}$$

A set of three, phase incoherent simulated ground motions were derived using a specialty software and based on the RRS parameters previously defined. The duration of the records were set to 30 seconds. In order to achieve the minimum acceleration required specified by ASCE 7, it was ensured that the nominal peak shake-table (ground) accelerations were equal to, or exceeding 0.90 A_{RIG-H} by introducing a spike in the input acceleration.

The above S_{DS} parameters 2.5 g represents the high magnitude covering most of densely populated area in California. As an example S_{DS} values for Los Angeles (1.29 g), San Francisco (2.00 g), Santa Barbara (2.00 g), and San Diego (1.60 g).

In addition, the 3932 was tested to Telcordia NEBS (National Equipment Building Specifications) zone 4 seismic test profile. During and after the test, no system functional interruption was observed with only the front and rear covers opening during testing.

A mainframe computer's structure consists of a frame or rack, drawers with central processor units, I/O equipment, memory, and other electronic equipment. The focus of this structural mechanical analysis and design is on the frame, earthquake stiffening brackets, and frame tie-down methods. The primary function of the frame is to protect critical electronic equipment in two modes. The first mode is during shipping shock and vibration, which provides excitation primarily in the vertical direction. The second mode of protection is protecting the equipment during seismic events where horizontal vibration can be significant. Frame stiffening brackets and tie-downs are features added to mainframe systems that must meet earthquake resistance requirements. Designing to withstand seismic events

requires significant analysis and test efforts because the functional performance of the system must be maintained during and after seismic events. The frame stiffening brackets and anchorage system must have adequate strength and stiffness to counteract earthquake-induced forces, thereby preventing human injury and potential system damage. The frame's stiffening bracket and tie-down combination must ensure continued system operation by limiting overall displacement of the structure to acceptable levels, while not inducing undue stress to the critical electronic components.

Quality screen (Manufacturing stress screening)

One application of shock and vibration technology that falls outside the design function is manufacturing stress screening and field failure analysis of intermittent subassemblies, such as the 3932 power supplies. By subjecting samples of production subassemblies to screening tests, it is possible to detect certain manufacturing, component, and design problems in these subassemblies. Typical tests include thermal cycling and random vibration, followed by burn-in and functional test at a vendor or subassembly manufacturer.

System mobility

DANGER: Heavy equipment — personal injury or equipment damage might result if mishandled. (D006)

As previously mentioned, all systems are shipped within a fully enclosed wooden and palatalized crate. In addition, the bottom of the system contains two pairs of casters; one pair of fixed casters and one pair of swivel casters. Due to the caster functionality, care must be taken when transporting the system within the wooden crate or when directly rolling the system on its casters.

To ensure safe transportation, a, minimum of 3 people should be available to transport the system. Prior to system relocation, the levers securing the casters must be rotated upward and a maximum of 10º incline is recommended for all ramped surfaces.
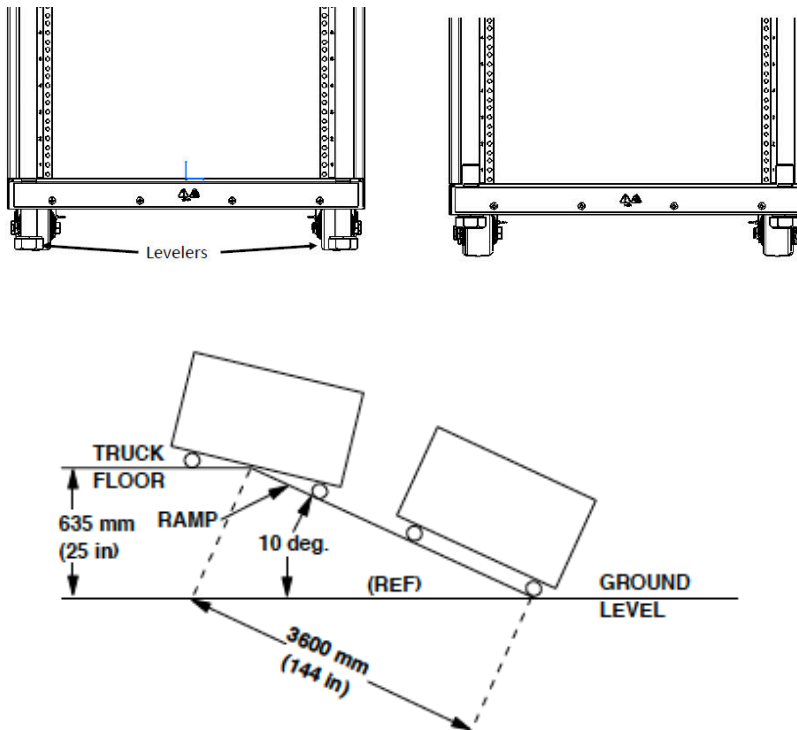
Earthquake Kit

The purpose of this section is to describe the parts used to install an Earthquake Kit that will provide frame ruggedizing and the floor tie-down hardware for securing a 3932. The kit is designed to help secure the frame and its contents from damage when exposed to vibrations and shocks, such as those in a seismic event.

- FC 8014 is used on a *raised* floor.
- FC 8015 is used on a *non-raised* floor.

Frame stiffener

Figure 9 on page 58 shows the parts for the inner frame stiffener component of the earthquake kit.

frame stiffener bracket, 02EA977
screw, 01KV711 (11)

latch, 01EL908
screw, 46K4337 (2)

hinge, 01KV358
screw, 46K4337 (2)

latch, 01KU054 (3)
screw, 46K4337 (6)

hinge, 01KV643
screw, 46K4337 (2)

hinge, 01KV358
screw, 46K4337 (2)

frame stiffener bracket, 02EA977
screw, 01KV744 (11)

hinge, 01KV643
screw, 46K4337 (2)

front

latch, 01KU054 (3)
screw, 46K4337 (6)

airflow plate (raised floor), 01KL479
screw, 01KL446 (2)

latch, 01EL908screw, 46K4337 (2)

airflow plate (non-raised floor), 01PP565
screw, 01KL446 (2)

Figure 9. Frame stiffening parts list

Raised floor Earthquake Kit

The Earthquake Kit for the 3932 on a raised floor is a system of adjustable turnbuckles intended to fasten each corner of the server frames to eyebolts installed in the concrete floor beneath your computer room raised floor. FC 8014 supplies parts to cover raised floor heights from 241.3 mm to 1320.8 mm (9.5 in - 52 in).

Measure the height from the concrete floor to the top of the raised floor as indicated in
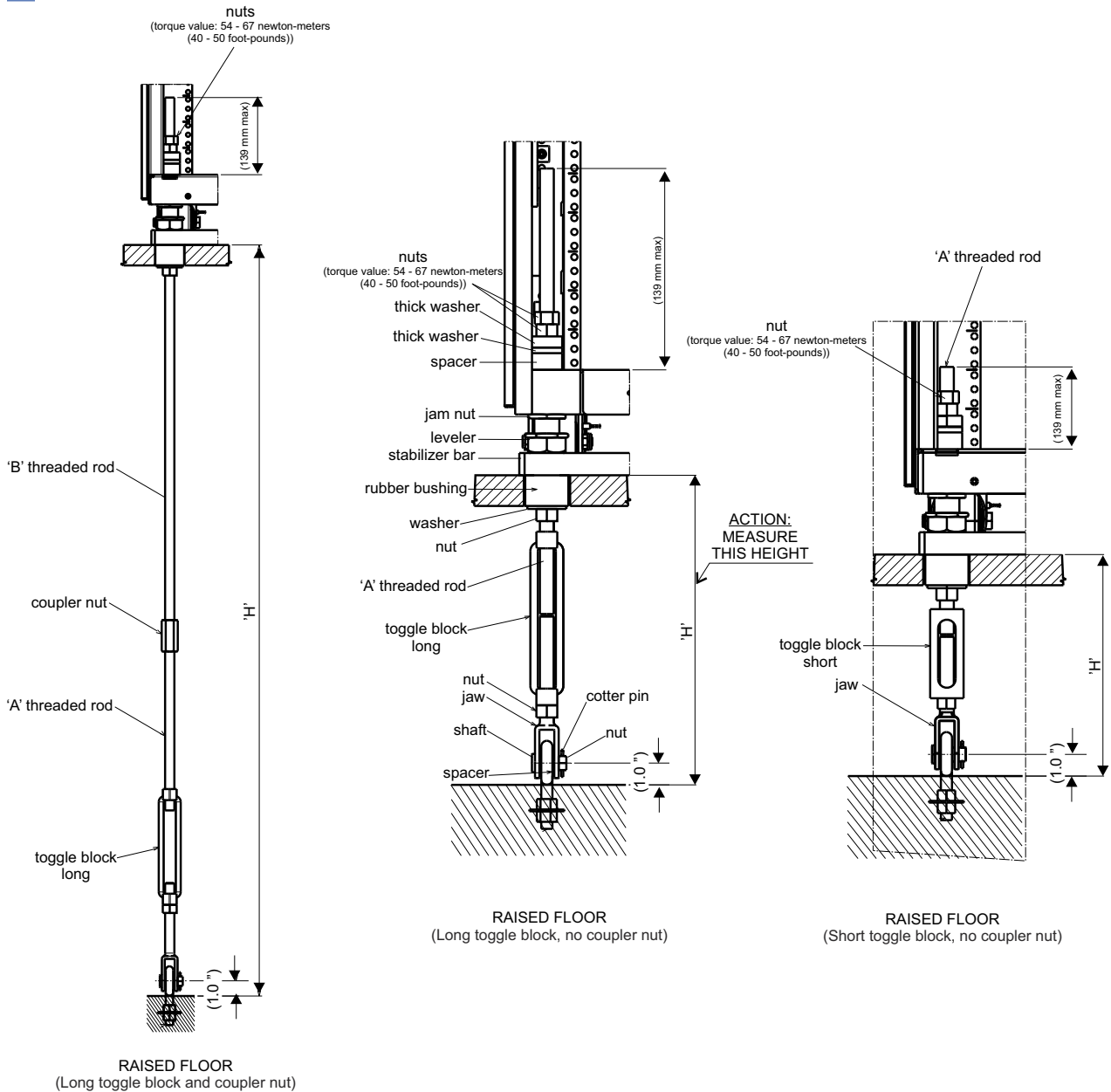
Figure 10. Turnbuckle assembly

Use the raised floor height (specified as **'H'**) and to determine the specific hardware that you need to select from the Earthquake Kit.

Table 25. Configuration table

Raised floor height 'H'	Toggle block	Coupler nut	Threaded rod length 'A'	Threaded rod length 'B'
9.5" to 13"	Short	No	12"	-
13" to 17.5"	Long	No	12"	-
17.5" to 25.5"	Long	No	20"	-
21.5" to 29.5"	Long	No	24"	-
29.5" to 37.5"	Long	Yes	12"	20"
33.5" to 41.5"	Long	No	36"	-
41.5" to 49.5"	Long	Yes	20"	24"
45.5" to 52"	Long	Yes	12"	36"

Important: Make a note of the measurement information and hardware selection, as it will be needed later in the server installation.

You are responsible for obtaining the services of a qualified consultant or structural engineer to determine what must be done at your particular location to install **four eyebolts**. These eyebolts should be capable of withstanding the appropriate seismic forces for a frame weighing up to 1308 kg (2885 lbs) with the center of gravity 1270 mm (50 inches) from the bottoms of the frame casters and at the center of the frame.

Installing the eyebolts

You are responsible for obtaining and installing the eyebolts that will anchor the frames of 3932. Following are the specifications for the eyebolts:

- The minimum pull out force is 4000 lbs (17.8 kN)
- Inside diameter of the eyebolt is not smaller than 34.9 mm (1 3/8 in)
- Installed so that the center of the eye is not less than 25.4 mm (1 in) nor more than 63.5 mm (2.5 in) from the surface of the concrete floor.

length of the eyebolts to be determined by the installation contractor

34.9 mm (1 3/8 in) diameter

**center of the eye
not < 25.4 mm (1 in)
not > 63.5 mm (2.5 in)
above the concrete surface**

12.7 mm (0.5 in) diameter
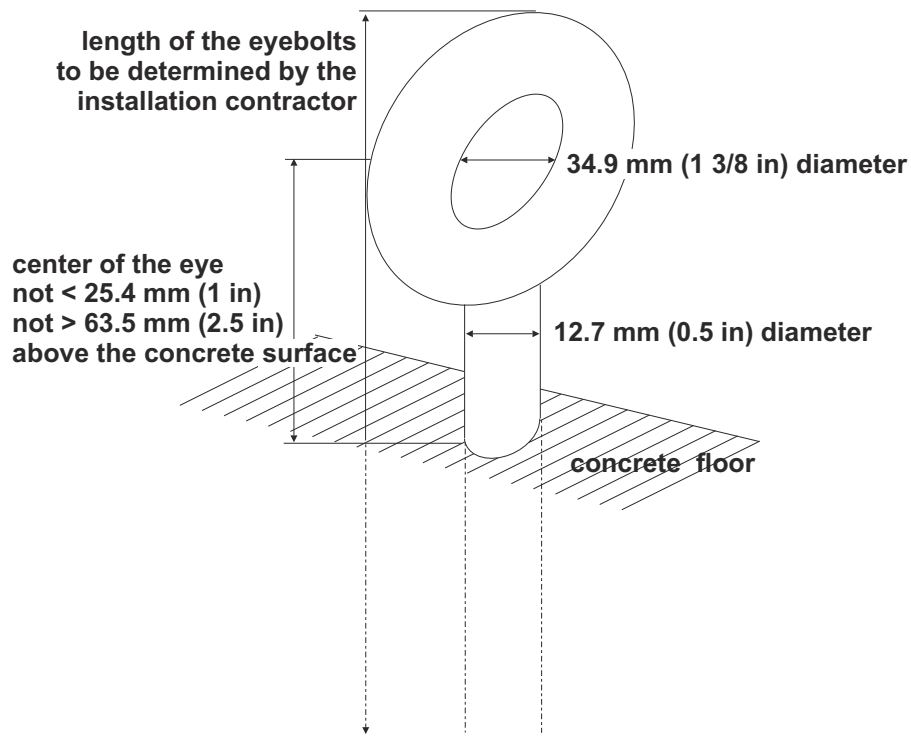
concrete floor

Regardless of length of the turnbuckles, the following illustration shows where to cut the floor panels for the turnbuckles to pass through to the eyebolts set in the concrete floor beneath.

rear

527.8 mm (20.8 in)

879.6 mm (34.6 in)
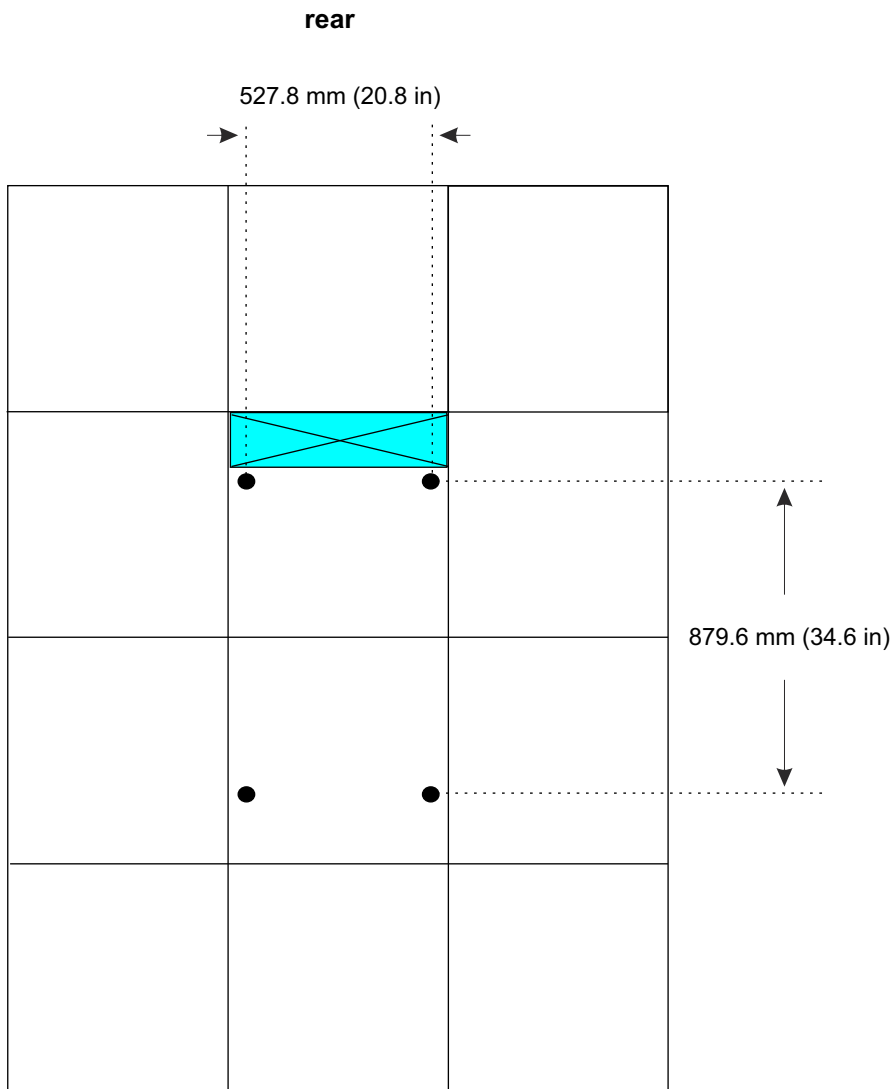
Additional floor panel pedestals may be necessary to restore structural integrity to the raised floor after making the circular cuts for the turnbuckles. Consult your flooring manufacturer for recommendations.

The installation instructions are included in the *8562 Installation Manual,* which is shipped with the server.

Non-raised floor Earthquake Kit

The purpose of this installation instruction is to install an Earthquake kit that will provide hardware for securing the frame to a concrete non-raised floor. This kit (FC 8015) is designed to help secure the frame and its contents from damage when exposed to vibrations and shocks such as those in a seismic event.

You are responsible for obtaining the services of a qualified consultant or structural engineer to determine what must be done at your particular location to install **4 anchors per plate (8 anchors per frame)** and for securing the front and rear lock down plate to the concrete floor according to the following illustration.

Contact your marketing representative well ahead of server delivery to obtain the lock down plate so that the site will be ready when the server arrives.

Use the following illustrations to plan carefully where the anchors that secure the stabilizers must be installed.

floor bolt hole pattern
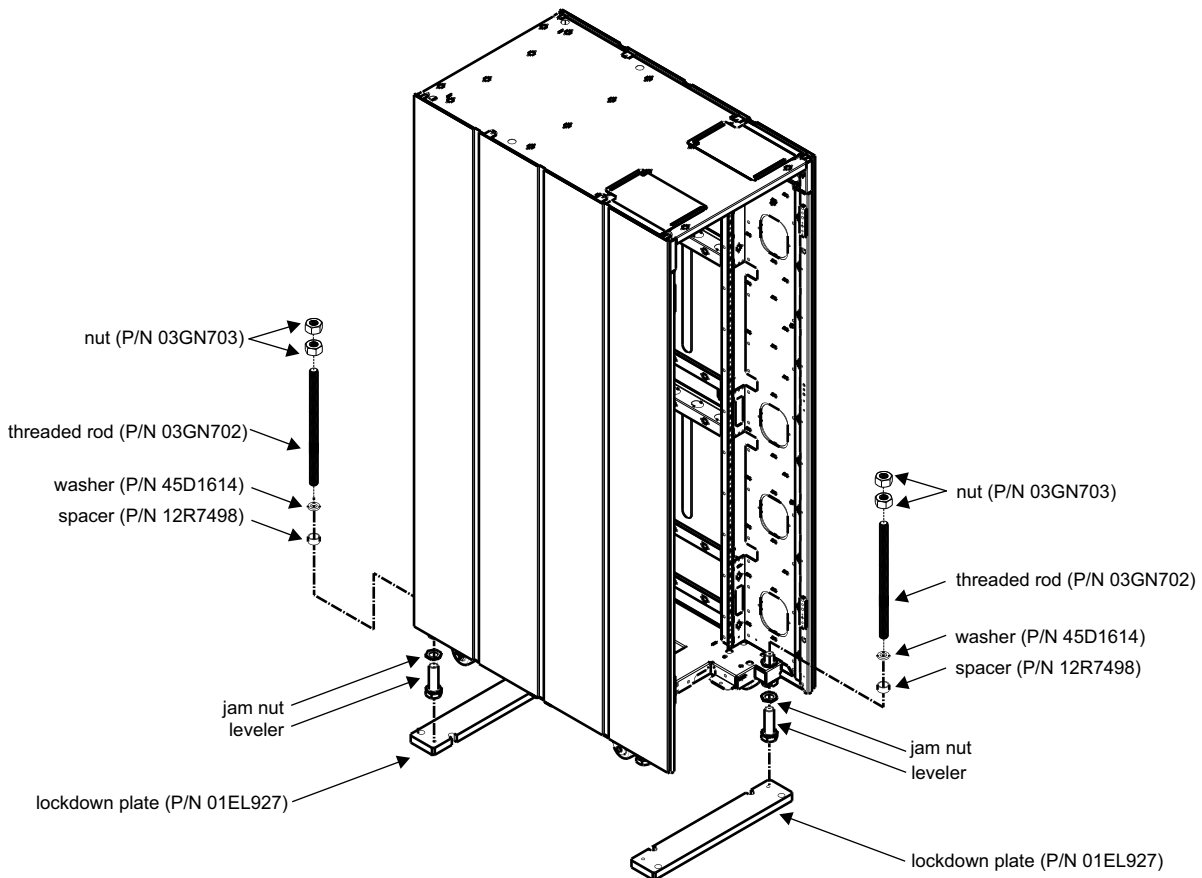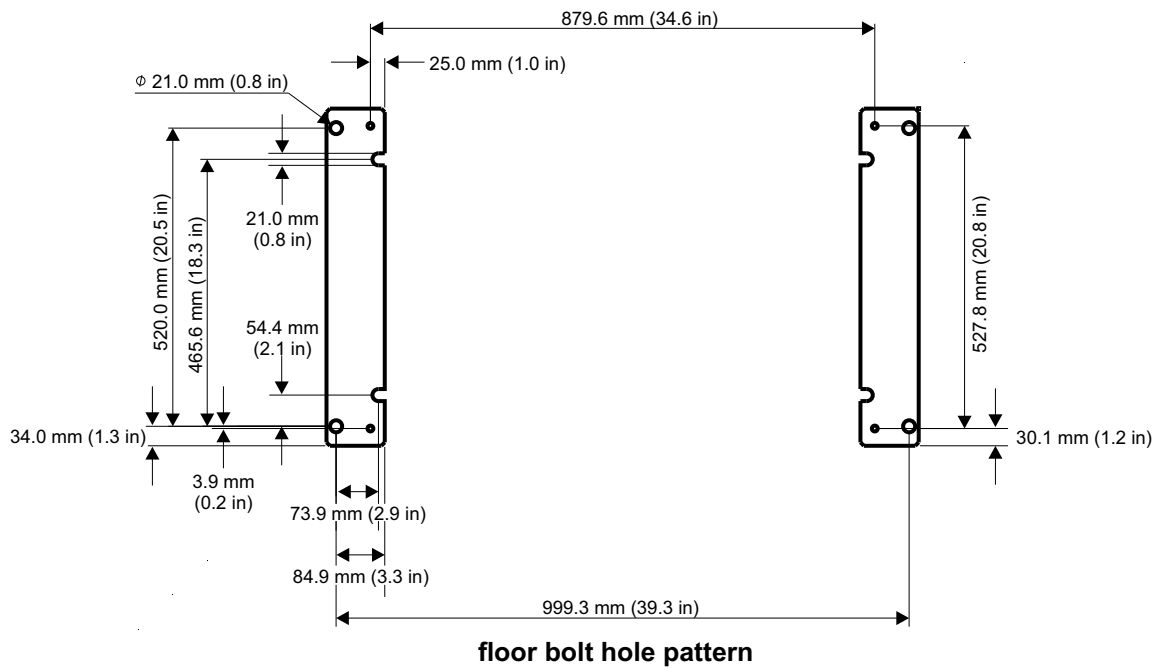
The lock down plate to concrete fasteners should be a **heavy duty expansion anchor**. The contractor you engage to install the stabilizers will determine the length of the anchors.

When the server arrives, remove the fasteners from either the front or rear lockdown plate. Remove the lockdown plate to position the server frame. Then reinstall the lockdown plate and the fasteners before the service provider begins the installation.

Machine and service clearance areas

Machine area is the actual floor space covered by the system. Service clearance area includes the machine area, plus additional space required to open the doors for service access to the system.

Table 26. Machine area and service clearance area			
Model	**Number of frames**	**Machine area M^2 (ft^2)**	**Service clearance area M^2 (ft^2)**
A02 / LA2	1 frame	0.751 (8.08)	front service clearance = 0.783 (8.43) machine area w/o doors and side covers = 0.642 (6.91) rear service clearance = 0.618 (6.65)
Notes:			
1. Machine area includes installed covers.			
2. Service clearance area must be free of all obstacles. Units must be placed in a way that all service areas are accessible. The weight distribution clearance area extending beyond the service clearance area, such as the area at the outside corners of the units, may contain support walls and columns.			

d = front depth = 1168 mm (46.0 in)

e = rear depth = 914.4 mm (36.0 in)

g = rear side to side = 624 mm (24.6 in) *w/ side covers*
600 mm (23.6 in) *w/o side covers*

h = front side to side = 688 mm (27.1 in)

service clearance area
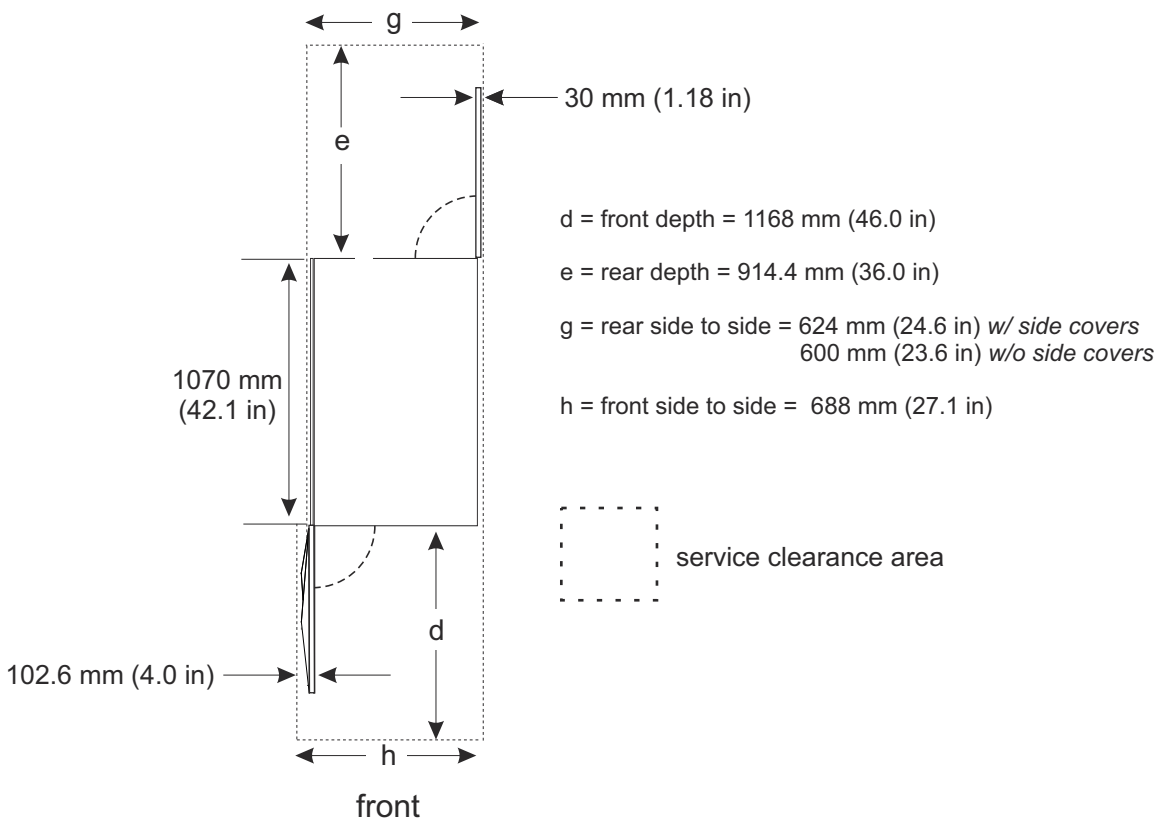
Figure 11. Minimum service clearance area (single frame)

The front and rear doors access all of the serviceable area in the 3932. The system requires specific service clearances to ensure the fastest possible repair in the unlikely event that a part may need to be replaced. Failure to provide enough clearance to open the front and rear covers will result in extended service time.

The following describes some service clearance conditions that must be followed. (See Figure 12 on page 66.)

- The left side cover of the frame cannot be placed adjacent to a wall because of the front and back doors (Example **A**), but can be positioned next to obstacles such as poles or columns (Example **B**).
- The front cover on frame opens 58.3 mm (2.3 in) wider than the width of the frame plus side cover. However, for service repairs, the left side of the front of the machine should be positioned at least 457.2 mm (18 in) from the wall (Example **C**). The right side of the front of the machine should be positioned at least 58.3 mm (2.3 in) from the wall (Example **D**).
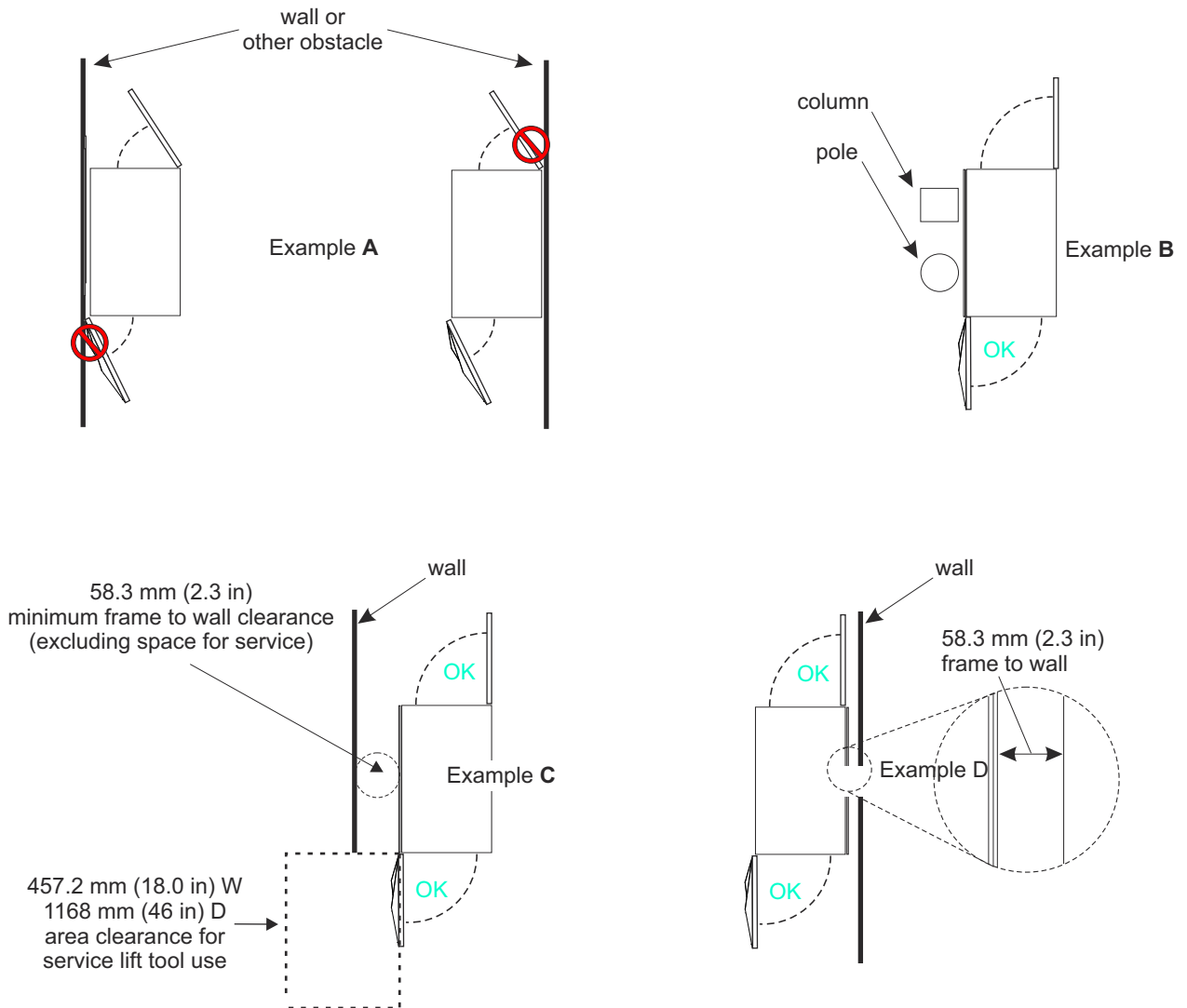
Figure 12. Detailed service clearances

Cooling recommendations for the room

The following illustration does not represent any particular server machine type, and is intended only to show hot and cold airflow and the arrangement of server aisles on the raised floor.

A typical 3932 uses chilled air, provided from under the raised floor, to cool the system. As shown below, rows of servers must face front-to front. Chilled air is usually provided through perforated floor panels placed in rows between the fronts of servers (the **cold** aisles shown in the figure). Perforated tiles generally are not be placed in the hot aisles. (If your particular computer room causes the temperature in the hot aisles to exceed limits of comfort for activities like system service, you may add as many perforated tiles as necessary to create a satisfactory comfort level.) Heated exhaust air exits the computer room above the computing equipment.

The cooling requirements that are listed in "ASHRAE declaration" on page 13 provide airflow requirements for a minimally and maximally configured system, and may not represent the cooling requirements for your specific system configuration.

To determine the specific airflow requirements for your system configuration, use the calculator tool available on Resource Link at *http://www.ibm.com/servers/resourcelink*.

Refer to Chapter 2, "Environmental specifications," on page 15 for specific data regarding temperature, humidity, and gaseous and particulate contamination.
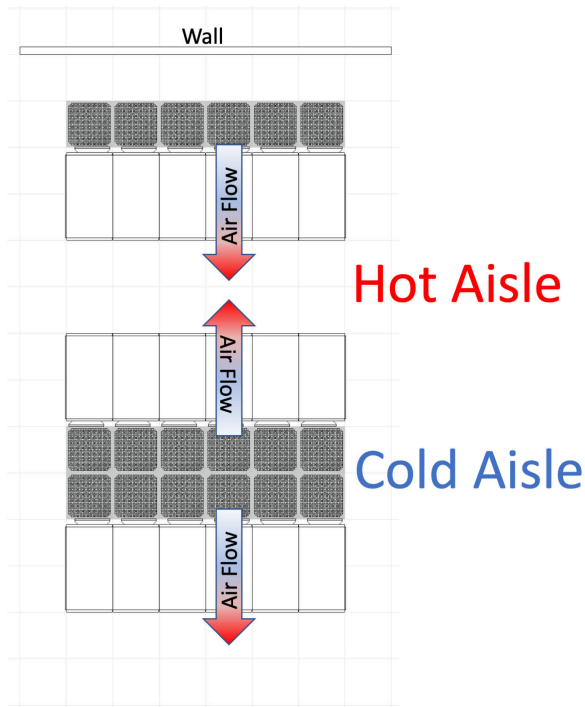
Hot and cold aisle cooling containment

More frequently, data centers are using hot and/or cold aisle cooling containment solutions to help with managing airflow, eliminating hot spots and improving energy efficiency. In most cases, the 3932 system can be used within these aisle cooling containment solutions. Below are general guidelines for assessing the installation of a 3932 in a hot or cold aisle cooling containment solution.

- Partitions used in the aisle cooling containment solution should be self-supporting and not attach to the frame for structural integrity.
- Care should be taken to ensure that the appropriate service clearances are maintained when the system is installed in the cooling containment solution. (See "Machine and service clearance areas" on page 65.)
- Consideration should be given to the airflow requirements of the 3932 system under the intended and abnormal operating conditions to assure sufficient airflow can be provided, particularly in cold aisle cooling containment systems. (See "Cooling recommendations for the room" on page 67.)
- Care should be taken to assure that frames across the aisle will not negatively impact the 3932 operation or conversely the impact of the 3932 on other frame equipment.

If you have questions regarding the installation of the 3932 in a hot or cold aisle cooling containment solution, please consult your installation planning representative. To assist in planning for a hot and cold aisle cooling containment system, **3-D graphic files** and **3-D computational fluid dynamics models** for use with computer aided design software have been made available on Resource Link at *http://www.ibm.com/servers/resourcelink*.

Additionally, with the tendency for hot aisle cooling containment systems to contain warmer and warmer temperatures, service personnel working in these areas must be more cognizant of heat stress hazards and be prepared to work safely under such conditions. Workers who are exposed to extreme heat or work in hot environments may be at risk of heat stress, which is the body's reaction to high temperatures. Preventing heat stress and being proactive about addressing its symptoms can eliminate or drastically reduce potential health risks associated with heat exposure. A common measure, the heat index, combines temperature and relative humidity to establish the human-perceived equivalent temperature, or how hot it "feels". This measure is used frequently in public health communications and can also be applied to hot work environments. The US Department of Labor developed the OSHA Heat Safety Tool app located at Occupational Safety and Health Administration for both the Android and iPhone platforms. The OSHA Heat Stress Tool can be used as a screening tool to allow workers to calculate the heat index for their work site by entering the temperature (degrees F) and % humidity. Based on the calculated heat index, the app displays a risk level including protective measures that should be taken for the risk level. For IBM Service personnel wanting more information, please consult Working in Temperature Extremes Within Data Centers.

Considerations for multiple system installations

When integrating a 3932 into an existing multiple-system environment, or when adding additional systems to an installed 3932, consider the following factors:

- **Thermal interactions**

  Although computer room floor space is valuable, for optimal cooling, it is recommended that 3932 machines have a 1220 mm (48 in) or 1200 mm (47.2 in) aisle between rows of systems to reduce surrounding air temperature. See "Cooling recommendations for the room" on page 67.

- **Floor placement**

  The 3932 must be precisely placed for the cable openings to match the floor cutouts. There is +/- 5 mm (0.2") tolerance for positioning the frame in relation to the floor tiles. This tolerance assumes edging around the tile cutouts that does not exceed 15 mm (0.6 in) width.

- **Floor loading**

  When trying to optimize floor space utilization, floor loading weight distribution rules may be inadvertently violated by overlapping weight distribution areas of adjacent machines. Obtain the services of a qualified structural engineer if you are uncertain of the floor load assessment for your computer room.

Chapter 4. Guide for raised floor preparation

This chapter provides recommendations and requirements for making the necessary openings in the raised floor for installation.

The drawings on the following pages are intended only to show relative positions and accurate dimensions of floor cutouts.

Raised floor cutouts should be protected by electrically non-conductive molding, appropriately sized, with edges treated to prevent cable damage and to prevent casters from rolling into the floor cutouts.

⚠️ **Attention:** The raised floor cutout dimensions that are provided reflect the _maximum_ floor cutout configuration supported, not including any cutout edge treatment. A smaller floor cutout may be required, depending on your specific system configuration.

Casters

The following graphic shows the physical dimensions around the casters.

⚠️ **Attention:** When positioning the server, be aware that the front casters swivels in a circle slightly larger than 121.92 mm (4.8 in) in diameter. The rear casters are fixed. Exercise care when working around floor panel cutouts.

*Note: This is an example; see following sections for more options

508.6 mm (20.02 in)

31 mm (1.22 in)

150 mm (5.9 in)

146.22 mm (5.76 in)

floor cut out
(flush with outside of rear door)

82.96 mm (3.27 in)

fixed caster

fixed caster

1208 mm (47.6 in)

703.7 mm (27.7 in)

879.6 mm (34.6 in)

swivel caster diameter 121.92 mm (4.8 in)

44.22 mm (1.74 in)

501.48 mm (19.74 in)

13.16 mm (0.52 in)

106.7 mm (4.20 in)

527.8 mm (20.78 in)

36.1 mm (1.42 in)

600.0 mm (23.62 in)
(without side covers)

front
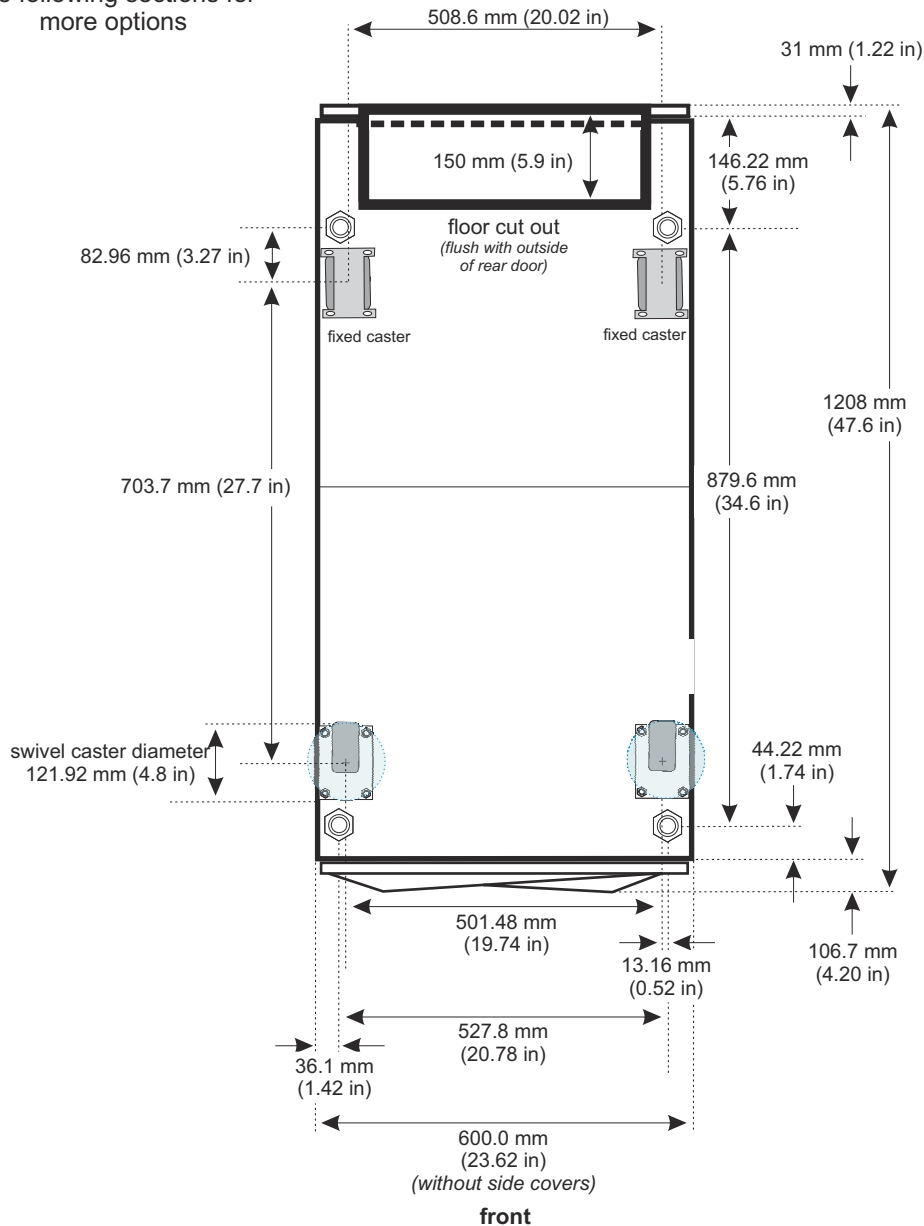
Procedure for cutting and placement of floor panels

> **Important:**
>
> 3932, fully configured, can weigh up to 806 kg (1778 lbs).
>
> **You must be certain that the raised floor on which you are going to install the server is capable of supporting this weight.** Contact your floor tile manufacturer and a structural engineer to verify that your raised floor is safe to support the 3932.
>
> Depending on the floor panel type, additional panel supports (pedestals) may be necessary to maintain the structural integrity of an uncut panel, or to restore the integrity of a cut floor panel. Consult the panel manufacturer and the structural engineer to ensure that the panel can sustain the concentrated loads.
>
> **Ensure adequate floor space is available to place the frames over the floor panels exactly as shown on the drawing**
>
> If the system's power line cords have low-smoke/zero-halogen (LSZH) construction, the floor cutout must be 150 mm x 450 mm, as shown, due to large cable bend radius. Non-LSZH line cords are more flexible and may use smaller floor cutout.

DANGER: Heavy equipment — personal injury or equipment damage might result if mishandled. (D006)

1. Identify the panels needed, and list the total quantity of each panel required for the installation.
2. Cut the required quantity of panels.
3. Additional panel supports (pedestals) are **recommended** to restore the structural integrity of the cut floor tile panels.
4. When cutting the panels, you may need to adjust the size of the cut for the thickness of the edge molding you are using. The dimensions shown do not include edge treatment.
5. For ease of installation, number each panel as it is cut as shown on the panel specification pages.
6. Use the raised floor diagram to install the panels in the proper positions.
7. The cut floor panels **must** be in place *before* the system is positioned on the floor.

On-grid frame placement

- **24 in (609 mm) floor panels** - English

  – A maximum cutout depth of 5.9 in (150 mm)

  – A minimum width of 3.0 in (75 mm) of material **must** remain at both ends of the cutout (150 mm x 450 mm maximum cutout)

- **600 mm (23.5 in) floor panels** - Metric

  – A maximum cutout depth of 150 mm (5.9 in)

  – A minimum width of 75 mm (3.0 in) of material **must** remain at both ends of the cutout (150 mm x 450 mm maximum cutout)

  Important: The 3.0 in (75 mm) measurements **does not** include any cutout edge treatment.

The following figures show the floor cutout options and recommended pedestals for *on-grid* frame placement, although other placement options are possible. If your floor cutout design is different from the options that are shown in the follow figures, consult with the floor tile manufacturer or a structural engineer.
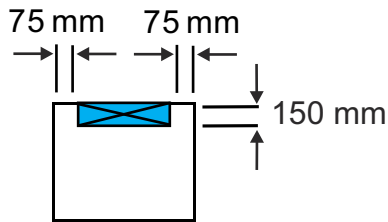
Figure 13. On-grid floor cutout options - 24 in (609 mm) or 23.5 in (600 mm) panels

All pedestals should be adjusted to contact the underside of each floor panel **before** the frames are rolled into place. Depending on your floor panel type, additional supports (pedestals) may be necessary to restore the structural integrity of cut panels.
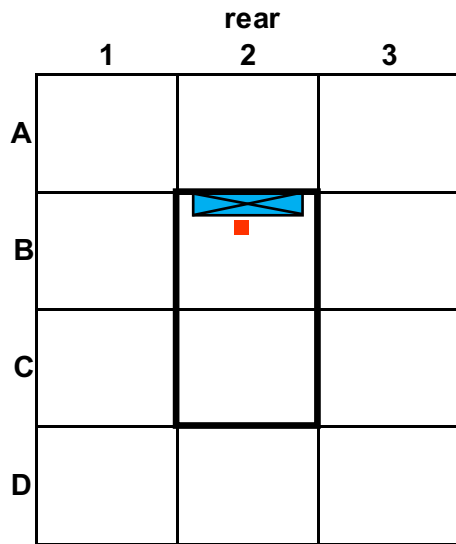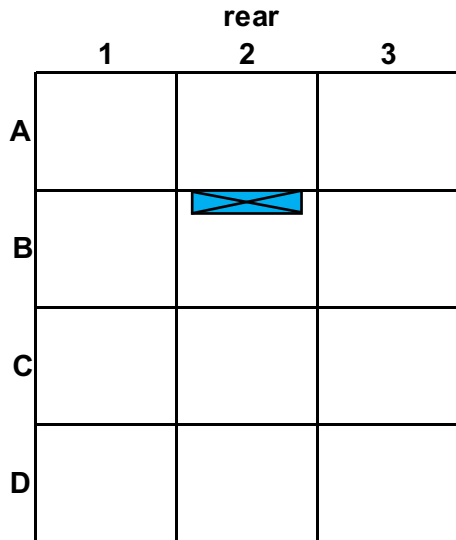
Figure 14. On-grid floor cutouts and minimum number of pedestals

Chapter 5. Power requirements

The 3932 is powered by Power Distribution Units (PDUs).

Feature code	Description	Comments
FC 0510	30A, 200-240 V AC (Delta)	Low Voltage - *three phase only*
FC 0511	32A, 200-240 V AC (WYE) OR 30/32A, 380-415 V AC (WYE)	Low Voltage - *single phase*[1] OR High Voltage - *three phase*
Note:		
1. Single phase option is offered with 1 CPC drawer.		

The 3932:

- Supports a maximum of 3 PCIe+ I/O drawers
- Supports 2 or 4 PDUs
- Requires 2 or 4 line cords, depending on number of PDUs.

General electrical power requirements

3932 requires the following power requirements:

System frame

- Supports 2 or 4 PDUs
- Requires 2 or 4 line cords, depending on number of PDUs.
- Voltage ranges:
  - Single phase
    - 32A, 200-240 V AC
  - Three phase
    - 30A, 200-240 V AC (Delta)
    - 30/32A, 380-415 V AC (WYE)

Notes:

- 480 V AC and HVDC <u>are not</u> supported.
- Single phase option is offered with 1 CPC drawer.

Refer to <u>Appendix D, "Dual power installation," on page 157</u> for the correct wiring method for your particular power distribution equipment.

Power and environmental estimation tool

Similar to previous systems, the power and environmental estimator tool for your 3932 system allows you to enter your precise server configuration to produce an estimate of power consumption. You can also use the tool to calculate the weight of your server.

Log on to Resource Link at *http://www.ibm.com/servers/resourcelink*. Navigate to **Tools**, then to **Power and Environmental Estimation Tool**. Specify the quantity for the features that are installed in your machine. This tool estimates the power consumption for the specified configuration. The tool does not verify that the specified configuration can be physically built.

The following information is required as *input*, in order to produce the listed *output* information.

- **Inputs**
  - CPC configuration
  - Line voltage
  - Temperature and altitude
  - Memory capacity
  - VFM
  - Flexible memory
  - PCIe+ I/O cards
- **Outputs**
  - Utility power
  - Heat load
  - Phase currents
  - Exhaust air temperatures
  - System airflow
  - System weights

Note: The exact power consumption for your machine will vary. The object of the tool is to produce an estimation of the power requirements to aid you in planning for your machine installation.

Actual power consumption after installation can be confirmed using the HMC **Monitors Dashboard** task or through the secure **HMC REST** interface.

Power Distribution Unit (PDU) power

Power installation considerations

The 3932 operates from 2 or 4 power cords, which provide redundant attachment to the electrical utility.

When properly connected to independent branch circuits, they provide system immunity to most types of power outage. See Appendix D, "Dual power installation," on page 157 for examples of typical redundant wiring facilities.

Note: The power cord sets provided are for use only with this product.

The power supplies at the front end of the system use active resistive load synthesis. Harmonic distortion of the current waveform is small enough that it need not be considered in planning the installation. The power factor is typically 0.95 or higher.

Supply type	Line-Line nominal input voltage	input frequency	Circuit Breaker (CB) current rating
2 or 4, single phase power cords	200-240 V AC	50/60 Hz (47 to 63 Hz with tolerance)	30/32A
2 or 4, 3-phase Delta power cords	200-240 V AC	50/60 Hz (47 to 63 Hz with tolerance)	30A
2 or 4, 3-phase WYE power cords	380-415 V AC	50/60 Hz (47 to 63 Hz with tolerance)	30/32A

⚠️ **Attention:**

- *IBM Service Personnel:* The task of using a meter and probes to take voltage measurements on receptacles/outlets must be performed by a Qualified Electrical Worker (QEW) or licensed electrician. In countries where IBM service personnel are not qualified to perform this task, the IBM service person must notify the customer that they must arrange for a QEW (a licensed electrician may be considered a QEW) to perform the receptacle testing.

- Refer to *IBM's Global Electrical Safety Program* for more information on QEW: https://d01db034.pok.ibm.com/q_dir/qmx/ef/qf2pl2.nsf/procnum/WHS-GS-0012?opendocument&login

PDU specifications

The following tables provide the number of PDUs and number of line cords required based on the number of CPC processor drawers and the number of PCIe+ I/O drawers in the machine configuration.

Table 27. Number of PDUs installed				
# of CPC drawers	# of PCIe+ I/O drawers			
	0	1	2	3
1	2	2	4	4
2	4	4	4	4

Important:

- Systems with 1 CPC drawer can be either single phase or three phase PDU powered.
- Systems with 2 CPC drawers <u>must</u> be three phase PDU powered.

Power specifications

The following tables provide system power consumption based on the number of CPC drawers and the number of PCIe+ I/O drawers with *maximum* configurations.

The **Power and Environmental Estimation** tool provides a more accurate estimation of the power consumption for your specified configuration and environment. See "Power and environmental estimation tool" on page 79.

Table 28. Utility power consumption

Processor option	Number of PCIe+ I/O drawers			
	0	1	2	3
FC 0672 Max 5 PUs 1 CP	2.19 kW	3.36 kW	4.50 kW	5.65 kW
FC 0673 Max 16 PUs 1 CP	2.28 kW	3.45 kW	4.59 kW	5.75 kW
FC 0674 Max 32 PUs 1 CP	3.57 kW	4.74 kW	5.88 kW	7.04 kW
FC 0675 Max 68 PUs 2 CPs	6.93 kW	8.11 kW	9.24 kW	10.4 kW

Important:

- Systems with 1 CPC drawer can be either single phase or three phase PDU powered.
- Systems with 2 CPC drawers <u>must</u> be three phase PDU powered.
- The power used in this table assumes the CPC process drawer and PCIe+ I/O drawers are plugged to the maximum with highest power features (ie. memory and I/O adapters and fanouts). Also assumed is that maximum ambient temperature is used.
- Typical configurations and data center conditions will result in lower power usage.

Customer circuit breakers

The following table shows the maximum circuit breaker ratings based on input voltage.

Table 29. Circuit breaker ratings based on input voltage - PDU

Line-Line Nominal Input Voltage Range (V)	System Rated Current (A)	Circuit Breaker
200 - 240 V AC	24A	30A
380 - 415 V AC	24A	32/30A

It is recommended, for simplicity and ease of upgrades, that the circuit breaker ratings in this table be used on all power cords for all installations. The actual power drawn (heat load) by any configuration will not be affected.

Note: Small currents can appear on the server earth ground connection under normal server operation.

For most reliable operation, circuit breakers that react to currents detected on ground (e.g. Earth Leakage Circuit Breakers or Residual Current Circuit Breakers) are not recommended for use with 3932. By internal design and grounding, 3932 is fully certified for safe operation without them (meets IEC, EN, UL, CSA 60950-1 and 62368-1 standards).

However, if leakage detection circuit breakers are required by local electrical practice, they can be used up to 100 mA. To safeguard against spurious tripping:

1. The Data Center ground grid should be constructed in accordance with best practices to avoid significant voltage gradients.
2. The facility power infrastructure should be as reliable as possible.
3. The utility connections from the breaker panel to the two or four power cord inputs should be reasonably equal in length or at least no one connection should be much shorter than the others.

If spurious tripping is experienced, corrections must be made in one or more of the above areas.

Supported power cords (PDU)

Plugs are shipped with the machine line cords as described in the following table. Power plugs listed in Table 30 on page 83 are approved for use with specified models and meet the relevant test laboratory or country/test-house standards. The power plug must be connected to a correctly wired and grounded receptacle. The customer is responsible for receptacle wiring.

⚠️ **CAUTION:** A mismatch in the wiring configuration (delta versus wye) between the IBM product and your facility AC voltage supply can cause significant product damage. Ensure that the PDUs of the product match the supply voltage and wiring configuration of your facility. If the number of wires in the power cord does not match the wiring configuration in your facility, or if the rated voltage on the product does not match the supply voltage in your facility, or if you have any questions about the connection method, do not connect the product to the supply voltage. Contact a certified electrician familiar with your installation, and IBM, for guidance. (C054)

Table 30. Supported PDU power cords
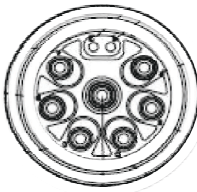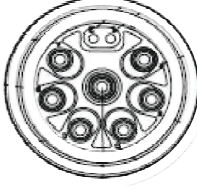
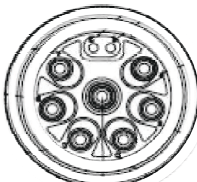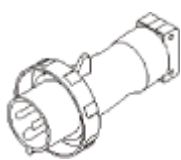| Feature code Countries Voltage Amperage Phase Length Wall plug	IBM system end	Customer end	Customer end (pin contacts)	Customer facility's branch circuit feed (Receptacle / Connector)[8]	IBM part number of cord[9]
FC 7823 USA, CAN ———— 240 VAC ———— 30 A ———— single phase ———— 4.3 m (14 ft) ———— NEMA L25-30P (twist lock)	plug: Souriau UTG		connector type: NEMA L25-30R	receptacle type: NEMA L25-30R	03KY168
FC 7892 USA, CAN, Latin America, Japan ———— 200 - 240 VAC ———— 30 A ———— single phase ———— 4.3 m (14 ft) ———— NEMA L6-30 (twist lock)	plug: Souriau UTG		connector type: NEMA L6-30R	receptacle type: NEMA L6-30R	03FM870

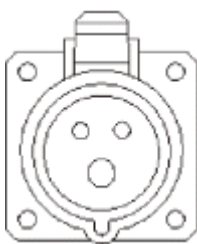Table 30. Supported PDU power cords (continued)
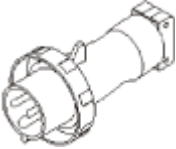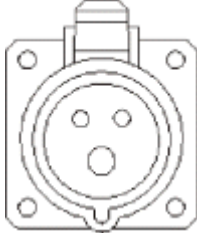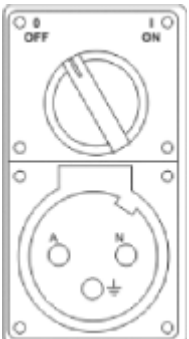
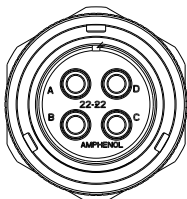| Feature code Countries Voltage Amperage Phase Length Wall plug	IBM system end	Customer end	Customer end (pin contacts)	Customer facility's branch circuit feed (Receptacle / Connector)[8]	IBM part number of cord[9]
FC 7893 USA, CAN, Latin America, Japan ———— 200 - 240 VAC ———— 30 A ———— single phase ———— 4.3 m (14 ft) ———— RS 3750DP or RS 9P33UO (Watertight)	plug type (showing pins): 3750DP		connector type: 3933 or 9C33U0	receptacle type: 9R33U0W or 3753	03FM871
FC 7894 AP, EMEA ———— 230 VAC ———— 32 A ———— single phase ———— 4.3 m (14 ft) ———— IEC 309, P+N+G	plug type (showing pins): HBL332P6W		connector type: HBL332C6W	receptacle type: HBL332R6W	03FM872
FC 7895 Australia and New Zealand ———— 230 - 240 VAC ———— 32A ———— single phase ———— 4.3 m (14 ft) ———— PDL	plug type (showing pins): 56P332		connector type: 56CR332	receptacle type: 56CV332	03FM874
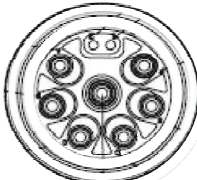
Feature code Countries Voltage Amperage Phase Length Wall plug	IBM system end	Customer end	Customer end (pin contacts)	Customer facility's branch circuit feed (Receptacle / Connector)[8]	IBM part number of cord[9]
FC 7896 Korea –––– 220 VAC –––– 30 A –––– single phase –––– 4.3 m (14 ft) –––– Korean plug SJ-P3302	plug: Souriau UTG		connector type: KP	receptacle type: KP	03FM875
FC 7897 AP, EMEA –––– 230 VAC –––– 32 A –––– single phase –––– 4.3 m (14 ft) –––– IEC 309, P+N+G –––– low smoke, halogen-free	plug: Souriau UTG		connector type: HBL332C6W	receptacle type: HBL332R6W	03FM873

Table 30. Supported PDU power cords (continued)
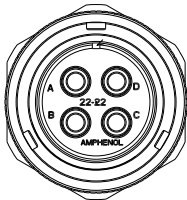
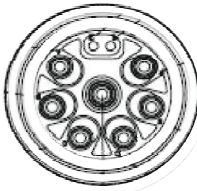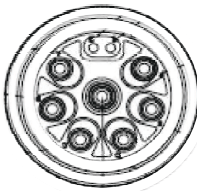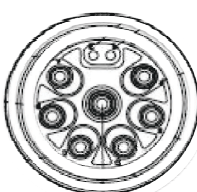| Feature code Countries Voltage Amperage Phase Length Wall plug	IBM system end	Customer end	Customer end (pin contacts)	Customer facility's branch circuit feed (Receptacle / Connector)[8]	IBM part number of cord[9]
FC 7944 USA, CNN [2], Japan –––– 250 V AC –––– 30 A plug (Delta) –––– three phase –––– 4.3 m (14 ft) –––– IEC 309 3P-4W	plug: Amphenol 02WN657		plug type: HBL430P9V04	receptacle type: HBL430R9W connector type: HBL430C9W	02WN660
FC 7945 World Trade [1] –––– 250 V AC –––– 30 A –––– three phase (Delta) –––– 4.3 m (14 ft) –––– Cut End	plug: Amphenol 02WN657	Cut End[3]	Cut End (lead labels) L1 L2 L3 N GND	(not specified)	03NH311

Table 30. Supported PDU power cords (continued)

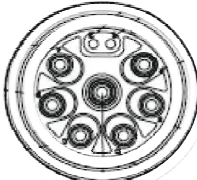| Feature code Countries Voltage Amperage Phase Length Wall plug	IBM system end	Customer end	Customer end (pin contacts)	Customer facility's branch circuit feed (Receptacle / Connector)[8]	IBM part number of cord[9]
FC 7946 USA, CNN [2], Japan ———— 400 V AC ———— 30/32 A ———— three phase (WYE) ———— 4.3 m (14 ft) ———— IEC 60309, 4P-5W	plug: Souriau UTG		plug type: HBL530P6V02	receptacle type: HBL530R6V02 connector type: HBL530C6V02	03FM499
FC 7947 World Trade [1] ———— 380-415 V AC ———— 32 A ———— three phase (WYE) ———— 4.3 m (14 ft) ———— Cut End	plug: Souriau UTG	Cut End[3]	Cut End (lead labels) L1 L2 L3 N GND	(not specified)	03GN439
FC 7948 World Trade [1] ———— 380-415 V AC ———— 32 A, LSZH ———— three phase (WYE) ———— 4.3 m (14 ft) ———— Cut End ———— low smoke, halogen-free	plug: Souriau UTG	Cut End[3]	Cut End (lead labels) L1 L2 L3 N GND	(not specified)	03FM501

Table 30. Supported PDU power cords (continued)
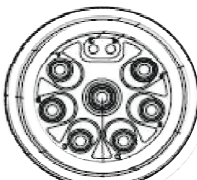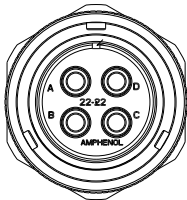
Feature code Countries Voltage Amperage Phase Length Wall plug	IBM system end	Customer end	Customer end (pin contacts)	Customer facility's branch circuit feed (Receptacle / Connector)[8]	IBM part number of cord[9]
FC 7974 USA, Canada, Mexico, Japan ———— 240 V AC ———— 30 A ———— single phase ———— 4.3 m (14 ft) ———— IEC 309, 2P-3W	plug: Souriau UTG		plug type: 330P6W	receptacle type: 330R6W connector type: 330C6W	03JJ281
FC 7976 World Trade ———— 380 - 415 V AC ———— 32 A ———— three phase (WYE) ———— 4.3 m (14 ft) ———— IEC 60309, 4P-5W	plug: Souriau UTG		plug type: 530P6W	receptacle type: 530R6W connector type: 530C6W	03KY961

Table 30. Supported PDU power cords (continued)

Feature code Countries Voltage Amperage Phase Length Wall plug	IBM system end	Customer end	Customer end (pin contacts)	Customer facility's branch circuit feed (Receptacle / Connector)[8]	IBM part number of cord[9]
FC 7978 World Trade ———— 250 V AC ———— 32 A ———— three phase ———— 4.3 m (14 ft) ———— IEC 309 3P-4W	plug: Amphenol 02WN657 		plug type: 430P9W	receptacle type: 430R9W connector type: 430C9W 	03KY960
FC 7979 World Trade ———— 380 - 415 V AC ———— 32 A ———— three phase (WYE) ———— 4.3 m (14 ft) ———— IEC 60309, 4P-5W ———— low smoke, halogen-free	plug: Souriau UTG 		plug type: 530P6W	receptacle type: 530R6W connector type: 530C6W 	03KY962

Table 30. Supported PDU power cords (continued)

Notes:

1. Except US, Japan, Australia, Korea, India, China, and all CNN.

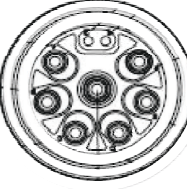2. CNN includes the following geographies: Bahamas, Turks & Caicos, Barbados, Burmuda, Guyana, Caymon Islands, Canada, Jamaica, Dutch Caribbean, Aruba, Bonnaire, Curacao, St. Marten NA, Anguilla, Antigua, BVI Tortola, Montserrat, St. Kitts & Nevis, St. Lucia, Dominica, Grenada, St. Vincent, Suriname Trinidad.

3. Cut end cord; no plug is provided. Plug is provided by the customer and is electrician-installed.

4. It is strongly recommended that you use a metal back box (*example* shown below) with our line cords using IEC-60309 plugs. Although in-line connectors and nonmetallic back boxes are available and

compatible, they are not recommended. These recommendations are based on the metal back box providing:

- An added level of protection against a mis-wired phase and ground reversal
- In some cases, a metal back box may be better for EMI mitigation
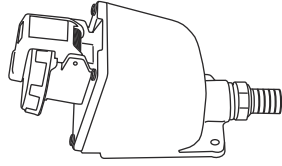
You may choose not to use a metal back box. In this case, please check your local code for specific requirements.

5. The customer must obtain the appropriate plugs and receptacles, based on existing electrical codes, where those plugs and receptacles are not provided with the system. These customer-provided plugs and receptacles should be installed by qualified electricians.

6. The power cord set(s) provided are for use only with this product.

7. If you choose to use a Hubbell receptacle, do NOT use the Hubbell C-Series Light Industrial 3.

8. If a receptacle is not available, then the connector that is listed should be used in its place.

9. IBM part numbers are subject to change.

Line cord wire specifications (PDU)

Line code usage location	Feature code	AWG # Type # of wires	Connector supplied	Bulk outside diameter mm (in)
USA, Canada 1-Phase (240 V AC) 14 ft	FC 7823	#10 AWG Type SJT	Yes	15.0 (0.60)
USA, Canada, LA, Japan 1-Phase (200-208, 240 V AC) 14 ft	FC 7892	#10 AWG Type SJT	Yes	15.0 (0.60)
USA, Canada, LA, Japan 1-Phase (200-208, 240 V AC) 14 ft	FC 7893	#10 AWG Type SJT	Yes	15.0 (0.60)
EMEA 1-Phase (230 V AC) 14 ft	FC 7894	#12 AWG Type HAR	Yes	16.0 (0.63)
Australia, New Zealand 1-Phase (230-240 V AC) 14 ft	FC 7895	#12 AWG Type HAR	Yes	16.0 (0.63)
Korea 1-Phase (220 V AC) 14 ft	FC 7896	#12 AWG Type HAR	Yes	16.0 (0.63)
EMEA 1-Phase (230 V AC) 14 ft	FC 7897	#12 AWG Type HAR/LSZH	Yes	16.0 (0.63)
USA, CNN, Japan 3-Phase (200 V AC), WYE 14 ft	FC 7944	#10 AWG Type ST	Yes	18.54 (0.73)
World Trade 3-Phase (250 V AC), WYE 14 ft	FC 7945	#10 AWG Type ST	No	18.54 (0.73)
USA, CNN, Japan 3-Phase (400 V AC), WYE 14 ft	FC 7946	#10 AWG Type ST	Yes	18.54 (0.73)
World Trade 3-Phase (380-415 V AC), WYE 14 ft	FC 7947	#10 AWG Type ST	No	18.54 (0.73)
World Trade 3-Phase (380-415 V AC), WYE 14 ft low smoke, halogen-free	FC 7948	#10 AWG HAR/LSZH	No	16.0 (0.63)
USA, Canada, Mexico, Japan 1-Phase (240 V AC) 14 ft	FC 7974	#10 AWG Type SJT	Yes	15.0 (0.60)
AP, EMEA 3-Phase (380 - 415 V AC) 14 ft	FC 7975	6.0mm H07RN-F 5G	Yes	16.0 (0.63)

Line code usage location	Feature code	AWG # Type # of wires	Connector supplied	Bulk outside diameter mm (in)
World Trade 3-Phase (380 - 415 V AC) 14 ft	FC 7976	4.0mm 03NG935	Yes	13.3 (0.52)
World Trade 3-Phase (250 V AC) 14 ft	FC 7978	4.0mm 03NG934	Yes	13.3 (0.52)
World Trade 3-Phase (380 - 415 V AC) 14 ft	FC 7979	#10 AWG HAR/LSZH	Yes	16.0 (0.63)

Notes:

1. Where plugs are provided, Hubbell is the plug supplier.

2. The customer must obtain the appropriate plugs and receptacles, based on existing electrical codes, where those plugs and receptacles are not provided with the system.

3. The power cord set(s) provided are for use only with this product.

Line physical protection

In US installations, the line cord must meet National Electric Code (NEC) requirements. When line cords are run on the surface of the floor, they must be protected against physical damage (See NEC 645-5). For other countries, the line cord requirements must meet local codes.

System power down with PDU power

Unlike previous systems, the 3932 is **not** equipped with an External On/Off switch.

To completely power down the system, the following actions must be taken:

1. Trip all of the panel circuit breakers that are powering the system.
2. Disconnect all of the system power cords from the source.

Grounding specifications

Every utility branch circuit, whether three or single phase, must contain an insulated equipment-grounding conductor that is separate from the phase and neutral conductors within the branch.

For 200 V AC through 240 V AC installations worldwide, the equipment-grounding conductor must match local electrical codes and must be green with or without one or more yellow stripes on the insulation. It is recommended that the ground wire be the same size as the phase conductor wires.

Conduit must not be used as the only grounding means. However, any conduit or cable shield must be connected at both ends in such a way that it is included in the grounding path, and in parallel with the grounding conductor it contains. Most electrical codes require that branch circuit wiring be located in the metallic conduit, or be made from shielded cable, if located under a raised floor. Even when not required by local regulations, some form of shield around the branch circuit wiring is strongly recommended as a means of reducing coupling of high-frequency electrical noise into signal and control cables.

Attention: Electrical bonding for safety is provided through the power line cords. If local codes or client requirements call for additional bonding, use _only_ the frame locations which are marked with this symbol: ⏚. Do **not** use the locations marked with this symbol: ⏛, as they are only intended to be used to ground existing parts that were installed in manufacturing.

For information about additional recommendations and requirements for equipment grounding, go to Resource Link at _http://www.ibm.com/servers/resourcelink_. See **General Information for Planning a Physical Site**.

Power cabling

You can route power cables using the following features:

- Through the top of the frame using the Top Exit cabling feature *without* top hat (**FC 7803**)
- Through the top of the frame using the Top Exit cabling feature *with* top hat (**FC 7802**)
- Through the bottom of the frame using the Bottom Exit cabling feature (**FC 7804**).

If you are planning to route the power cables through the top of the frame, your receptacle must drop to within 305 mm (1 ft) of the top of the frame and be no further than 305 mm (1 ft) from the front door or side cover of the frame.
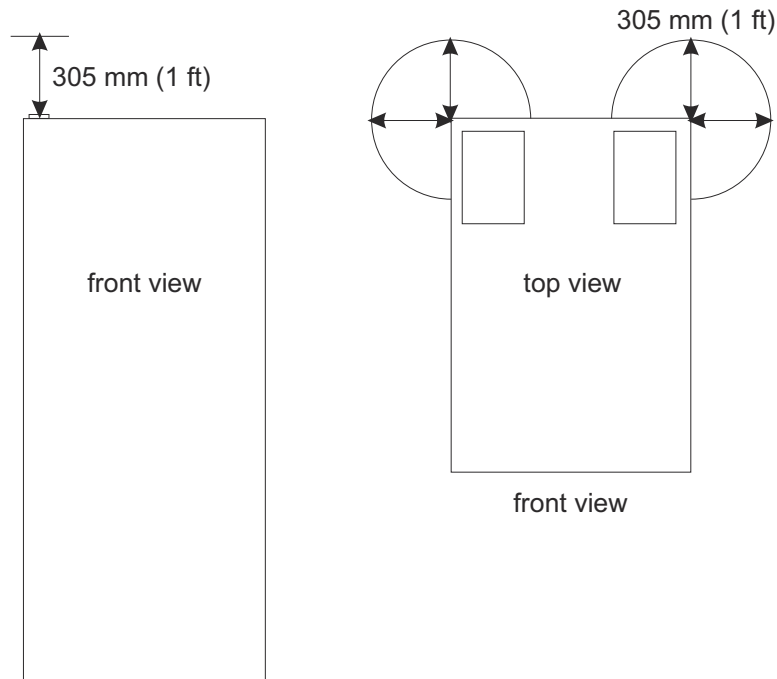
See Appendix C, "Top Exit cabling and Bottom Exit cabling specifications," on page 151 for information on the top exit cabling feature (FC 7802) and the bottom exit cabling feature (FC 7804).

Chapter 6. Hardware Management Console and Support Element communications

Support Element

The 3932 provides you with the following two options for management servers:

Dual 1U 2461 Support Elements (2461-SE3) - *Default*
> Functions as a Support Element (SE)

Dual 1U 2461 Hardware Management Appliance (2461-VA3) - *FC 0129*
> Functions as a Support Element (SE) and Hardware Management Console (HMC)

The two Support Elements or two Hardware Management Appliances share a compact keyboard/monitor/mouse (compact KMM) managed by a single Interface Adapter.

Note: Throughout the rest of this document, "Support Elements" refers to the dual 2461 Support Elements.

Power for the Support Elements or Hardware Management Appliance are supplied by the 3932 power supply, and there are no additional power requirements.

The Support Elements or Hardware Management Appliance on the 3932 connect to the LAN via the customer network switch. Then the Support Elements or Hardware Management Appliance connects to the Ethernet switches in the 3932. The Hardware Management Console also connects to the LAN via the customer network switch.

Hardware Management Console

If the 2461 Hardware Management Appliance (**FC 0129**) _is not_ ordered, a 2461 Hardware Management Console (**FC 0062** or **FC 0063**) is required to operate the 3932. The previous 2461 HMCs (FC 0083, FC 0082, FC 0095, or FC 0096) can be carried forward. A single console can support multiple machines and can be located remotely to the physical sites.

Note: Ensemble HMC configuration is no longer supported.

The Hardware Management Console consists of:

- The 2461 Hardware Management Console Tower (**FC 0062**) consists of:

  - A processor or system unit, including two Ethernet LAN adapters, capable of operating at 10, 100, or 1000 Mbps and will use removable UFDs to install Licensed Machine Code (LMC)
  - Optional HMC Tabletop KMM (keyboard, monitor, mouse) - _FC 0148_
  - The console requires a customer-supplied table to hold the KMM.

  See Appendix B, "Hardware Management Console physical specifications," on page 145 for physical specifications of the 2461 HMC Tower (**FC 0062**).

- The 2461 Hardware Management Console Rack Mount (**FC 0063**) consists of:

  - 1U HMC system unit, including two Ethernet LAN adapters, capable of operating at 10, 100, or 1000 Mbps and will use removable UFDs to install Licensed Machine Code (LMC)
  - Optional 1U HMC Rack Mount KMM (keyboard, monitor, mouse) - _FC 0154_
  - Three C13/C14 10 amp power jumper cables (2.8 m (9 ft))
  - The customer must provide the following:

    - A rack to hold the 1U Hardware Management Console and the 1U Rack Mount KMM
    - Three power receptacles, which provides C13 outlets for the C13/C14 power jumper cables -- two for the 1U HMC system unit and one for the KMM.

  See Appendix B, "Hardware Management Console physical specifications," on page 145 for physical specifications of the 2461 HMC Rack Mount (**FC 0063**).

The Hardware Management Console (**FC 0062**) requires two 110/120V AC outlets for USA and Canada. The Hardware Management Console (**FC 0063**) uses three PDU plug positions (two for the 1U HMC unit for USA and Canada. (Other power requirements are country dependent.)

An Ethernet switch will not be offered as a configurable feature on 3932. If an Ethernet switch is needed to manage the Ethernet connection between the Support Elements and HMCs, you must supply your own. It is recommended that the Ethernet switch support a speed of 1 Gbps.

The Ethernet switch requires a single 110/120V outlet for USA and Canada. (Other power requirements are country dependent.)

Physical specifications for the Hardware Management Console components are located in Appendix B, "Hardware Management Console physical specifications," on page 145.

Ethernet LAN switch support

The following is general information relevant to many Ethernet switches. Refer to the manufacturer's User's Guide that came with your switch or hub for installation instructions.

There must be an Ethernet switch or hub available to connect the Hardware Management Consoles to your LAN. The Ethernet switch or hub is a standalone unit located outside the frame and which operates on building AC power. An Ethernet switch will not be offered as a configurable feature on the 3932. You must supply your own Ethernet switch unless you are upgrading to a 3932.

Typical Ethernet switch/hub characteristics:

- 16 auto-negotiation ports
- 10/100/1000 Mbps data rate
- Full or half duplex operation
- Auto-MDIX on all ports
- Port Status LEDs
- 100 to 240 VAC, 50 or 60 Hz power

Ethernet switches supporting auto-MDIX on all ports use a straight-through cable between any two ports.

To provide redundancy for the HMCs, two switches or hubs should be used.

Ethernet network connection requirements

MUST READ:

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.

The preceding statement does NOT exclude using the network for private communications, such as connection to the Remote Support Facility.

On the 3932, the install team must connect the Ethernet adapters for any HMC(s) into an Ethernet switch. This switch can then be connected to J03 and J04 on the Support Elements. (See Figure 15 on page 100.)
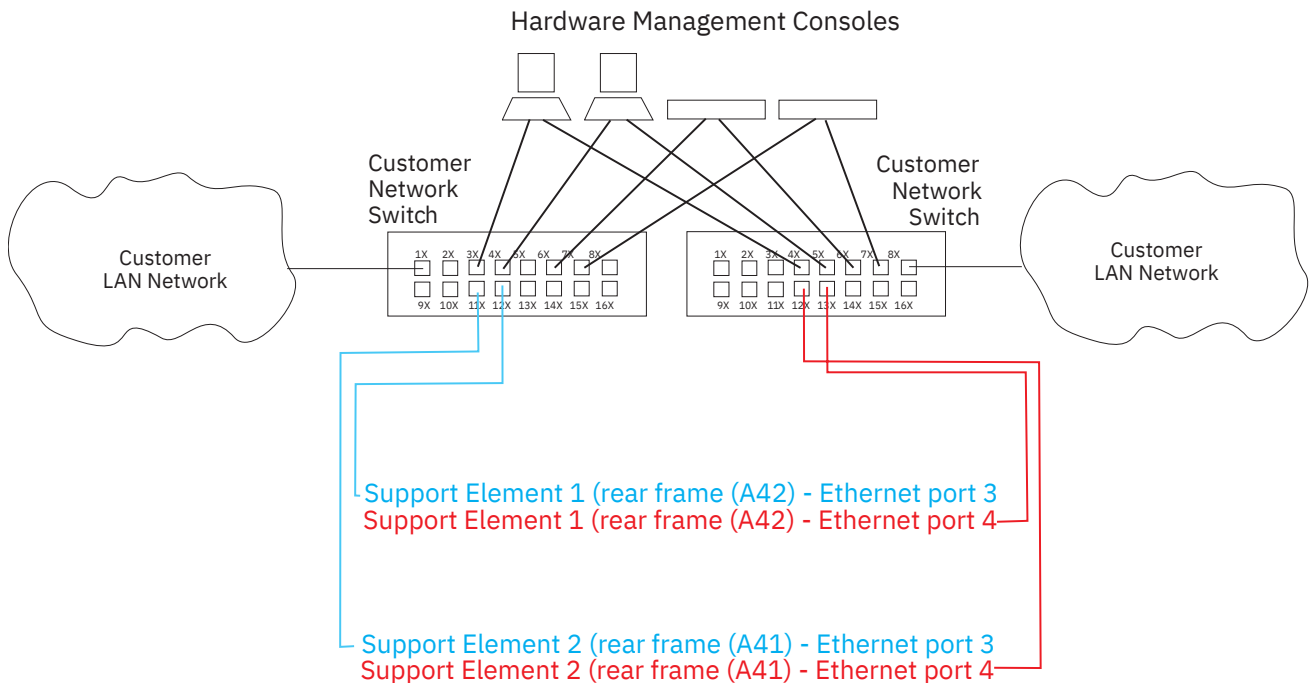
Figure 15. Two-switch configuration

Notes:

1. Connect customer LANs, via Ethernet switches, to Ethernet ports J03 and J04 on the Support Element servers. Customer **LAN 1 should be plugged into Ethernet port J03** on the Support Elements. Customer **LAN 2 should be plugged into Ethernet J04** on the Support Elements.

2. Never connect an HMC directly to Ethernet ports J03 and J04 on the Support Elements.

If the Hardware Management Appliance feature (**FC 0129**) is ordered on the 3932, the dual 1U servers function as a Support Element (SE) and a Hardware Management Console (HMC). See Figure 16 on page 101 for network connection requirements.
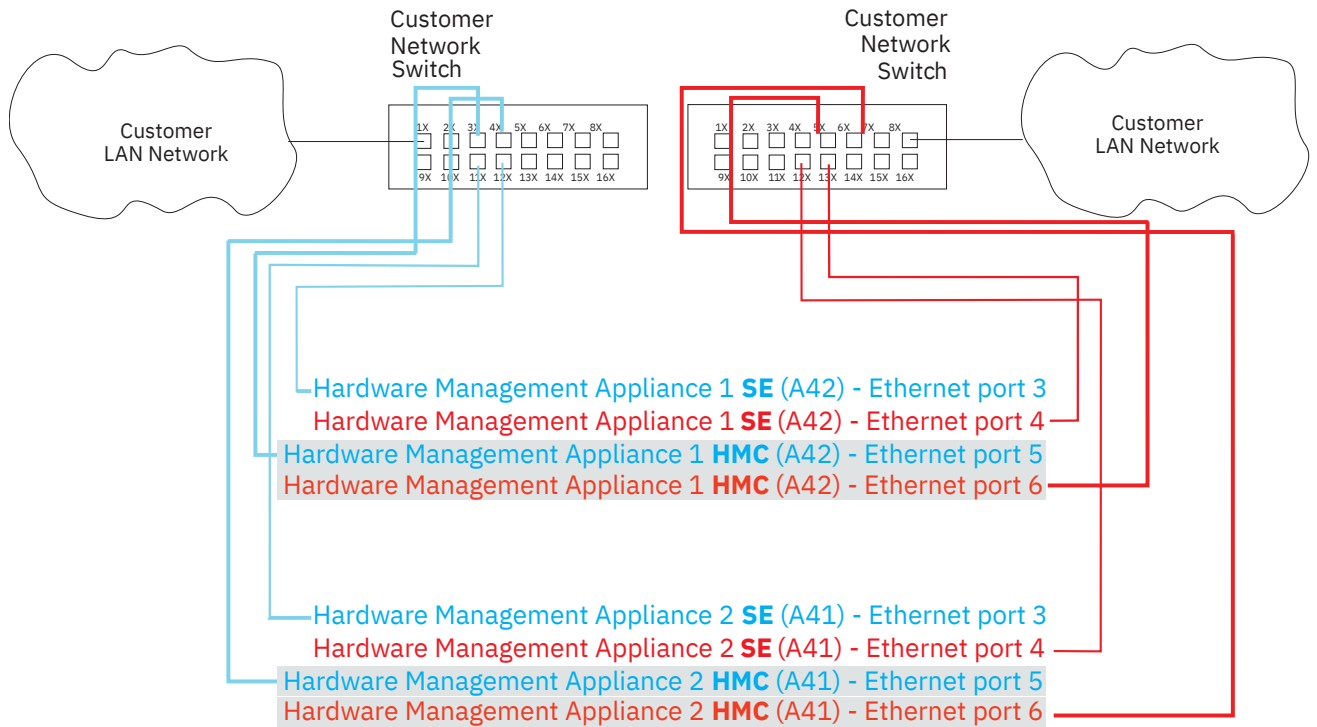
Figure 16. Two-switch configuration with Hardware Management Appliance (FC 0129)

Hardware Management Console and Support Element wiring options

A local Hardware Management Console must be connected to its Support Elements using Local Area Network (LAN) wiring. The Hardware Management Console and the Support Elements both come with Dual Ethernet LAN adapters.

The communication protocol (TCP/IP) used in Support Element to Hardware Management Console communication is defined for both adapters in the Support Elements.

Notes on wiring with multiple adapters:

1. The Hardware Management Console supports dual Ethernet paths to Support Elements. This allows automatic redundant network paths so that the failure of a single network has no affect on Hardware Management Console to Support Element communication.

2. When configuring multiple adapters the address must be defined in different subnets.

Trusted Key Entry (TKE)

The 3932 may have a Crypto Express8S (**FC 0908** or **FC 0909**), Crypto Express7S (**FC 0898** or **FC 0899**), Crypto Express6S (**FC 0893**), or Crypto Express5S (**FC 0890**) feature for applications where extensive data security is required. For these systems, there is a separate console available for authorized access to the Crypto feature specified. This console is named the Trusted Key Entry (TKE) workstation.

TKE 9.2 (**FC 0881**) is required to manage a Crypto Express7S feature. TKE 9.*x* is required to manage a Crypto Express6S or Crypto Express5S and the additional domains provided on the Crypto feature on the 3932.

The following table top TKE workstations include a system unit, flat panel display, mouse, keyboard, and line cord.

- **FC 0058**: TKE
- **FC 0088**: TKE 2461-TW3
- **FC 0086**: TKE 2461-TW2 (*carry forward only*)

The following rack-mounted TKE workstations include a system unit and a 1U console unit that holds the flat panel display and the keyboard.

- **FC 0057**: TKE Rack Mount
- **FC 0087**: TKE 2461-SE3
- **FC 0085**: TKE 2461-SE2 (*carry forward only*)

The built-in Ethernet adapter supports a link data rate of 10, 100, or 1000 Mbps. The built-in Ethernet adapter supports a link data rate of 10, 100, or 1000 Mbps.

> ⚠️ **Attention:** FC 0097 and FC 0098 can only be carried forward; however, to use with the 3932, they must be converted by replacing the installed Crypto adapter card with a 4768 TKE Crypto adapter card (FC 0844).

- Optional TKE Tabletop KMM (keyboard, monitor, mouse) - FC 0157

  Optional 1U TKE Rack Mount KMM (keyboard, monitor, mouse) - FC 0156

The TKE workstation attaches to the customer LAN, providing a security-rich, flexible method of providing master key and operational key entry to locally and remotely managed Cryptographic Coprocessor features.

TKE with optional Smart Card Reader (**FC 0891**), allows access to and use of confidential data on the Smart Card, protected by a user defined personal identification number (PIN) code providing secure storage, access, transport and entry of master and operational key parts into the TKE workstation. The following characteristics pertain to the Smart Card Reader:

- The Smart Card Reader is an optional security device that attaches to the TKE.

  FC 0891 contains two Smart Card Readers, two serial port "Y" adapters, two serial cables, and *20* blank smart cards. The cables provide both power source for the Smart Card Reader and the communication path between the Smart Card Reader and the TKE workstation.
  FC 0892 or **FC 0900** provide the ability to order additional blank Smart Cards. The Smart Card Reader is a corequisite for ordering additional Smart Cards.

- TKE logon profiles can be placed on smart cards, which provide enhanced control over the sign on processes.
- A TKE workstation and the TKE 7.2 or later level code are co-requisites for ordering the Smart Card Reader.
- If you currently have the Smart Card Reader feature (FC 0885) and Additional Smart Card feature (FC 0884), they can only be carried forward to TKE 9.2 as follows:

  - The smart card readers can be used on TKE 9.2 without any restrictions.

- – If you have initialized any smart cards as CA, TKE, IBM Enterprise PKCS#11 (EP11), or MCA smart cards, you can use them on your TKE 9.2 system without any restrictions.
- – If you have initialized any smart cards as IA or KPH smart cards, you cannot use them for migration tasks done with Crypto Express5S, Crypto Express6S or Crypto Express7S modules.

  Note: If data will eventually be applied to a Crypto Express5S, the collect and apply migration tasks must be performed from a TKE 9.2 using IA and KPH smart cards that were initialized on TKE 9.2.

- – A smart card from FC 0885 or 0884 can be initialized as any one of the 6 types (CA, TKE, EP11, MCA, IA or KPH) of smart cards on TKE 9.2.

To use the TKE function on 3932, the following must be installed:

FC 0908 or **FC 0909**: Crypto Express8S
FC 0898 or **FC 0899**: Crypto Express7S
FC 0893: Crypto Express6S
FC 0890: Crypto Express5S
FC 0881: TKE 9.2 LIC (Licensed Internal Code)
FC 3863: CP Assist for Cryptographic Function

Power requirements

- The TKE workstation (Tabletop) requires a single-phase feed from *one* customer-supplied outlet that provides one of the following voltage ranges:

  - – 100 V AC - 127 V AC (nominal range)
  - – 200 V AC - 240 V AC (nominal range)

- The TKE workstation (Rack Mount) requires a single-phase feed from *two* customer-supplied outlets that provide one of the following voltage ranges:

  - – 100 V AC - 127 V AC (nominal range)
  - – 200 V AC - 240 V AC (nominal range)

- The TKE KMM (Tabletop or Rack Mount) requires a single-phase feed from *one* customer-supplied outlet that provides the following voltage range:

  - – 100 V AC - 240 V AC (nominal range)

Power requirements

For your safety, a power cord with a grounded attachment plug is provided to use with this product. To avoid electrical shock, always use the power cord and plug with a properly grounded outlet. IBM power cords used in the United States and Canada are listed by Underwriter's Laboratories (UL) and certified by the Canadian Standards Association (CSA).

Important: The provided TKE power jumper cable supports **only** C13-C14 connections. It is the responsibility of the customer to plan for this configuration accordingly.

- The TKE workstation (Tabletop) requires a single-phase feed from *one* customer-supplied outlet that provides one of the following voltage ranges:
  - 100 V AC - 127 V AC (nominal range)
  - 200 V AC - 240 V AC (nominal range)
- The TKE workstation (Rack Mount) requires a single-phase feed from *two* customer-supplied outlets that provide one of the following voltage ranges:
  - 100 V AC - 127 V AC (nominal range)
  - 200 V AC - 240 V AC (nominal range)
- The TKE KMM (Tabletop or Rack Mount) requires a single-phase feed from *one* customer-supplied outlet that provides the following voltage range:
  - 100 V AC - 240 V AC (nominal range)

LAN connections

LAN cabling is a customer responsibility. To connect the TKE workstation with Ethernet to a LAN, a Category 5 Unshielded Twisted Pair (UTP) cable terminated with an RJ-45 connector is required.

Planning to load images to a system from a network (electronic code load)

If you are unable to use a USB flash memory drive or **FC 0846** has been ordered, then you can use the **Manage Console Recovery** task to reload a selected system with a selected Driver 51 code image over the network (electronically). These instructions require actions on this Hardware Management Console (HMC) and the selected target system.

The target system can be any hardware that supports Driver **51**.

During the installation of all systems with **FC 0846** the network setup to support electronic code load needs to be complete. For machines that do not want to use media or do not have access to Remote Support Facility (RSF), the installation is <u>not</u> complete until an FTP server is configured.

The following requirements and planning must be considered before using the capability to network load a target system.

- There must be one HMC at Version 2.16.0 on every unique network subnet where a Hardware Management Console, Support Element (SE), or Trusted Key Entry (TKE) workstation is connected.
- If only a 2.15.0 HMC is available refer to *IBM Z Electronic Code Load target system MCL requirements* (https://www.ibm.com/servers/resourcelink/lib03011.nsf/pages/zElectronicCodeLoadMcl?OpenDocument) and ensure the required MCL is installed.
- BEFORE installing a new IBM z16 (Model A01) system (that is, with SEs), the HMC must have the SE recovery code image available in the Recovery Image section of the **Manage Console Recovery** task. If it is not visible, the import capability of the **Manage Console Recovery** task can be used.
- All Hardware Management Console customer LAN interfaces on the HMC, running the **Manage Console Recovery** task, must be configured as static. (Do not use DHCP to obtain addresses.)
- The targeted console system must be reachable on a local (same) subnet from at least one of the HMCs customer LAN interfaces.
- The subnet to the target console system must not have a DHCP server on it.
- Multiple HMC servers are allowed on the same subnet serving different targets, but is not recommended.

Important: If you plan to use the electronic code load capability for target HMC or TKE systems at Driver 36 or Driver 41, you **must** ensure that the correct associated MCL is installed on your system before proceeding with the following instructions. Use the appropriate MCL listed below:

- D36C_HMC - MCL P41499.332
- D41C_HMC - MCL P46683.389
- D36C_TKE - MCL P42696.027
- D41C_TKE - MCL P46689.041

Chapter 7. Remote Support Facility (RSF) installation planning

The Remote Support Facility (RSF) provides communication to a centralized support network for problem reporting and other remote support services. Communication with the Remote Support Facility is provided using an Internet connection.

All transmissions are supported using the IBM enhanced support system. Transmission to the support system requires a Domain Name Server (DNS) to be available. It must be configured on the call-home server HMC or proxy server connecting to the internet.

Choosing a communications method for remote support

You must choose method for connecting your server to support system through the Remote Support Facility (RSF):

- A direct connection from the Hardware Management Console (HMC) to the internet. This method is fast, reliable, and uses the external customer firewall to control the connection.

- An indirect connection from the HMC to the internet by using a proxy server. This method has the advantages of the direct connection plus it allows your enterprise the added control of the proxy. Potential additional advantages include the possibilities of logging and audit facilities using the proxy server.

The following information is designed to provide your networking team with the information they need to enable the HMC to connect securely to the internet.

Security characteristics of Remote Support Facility communications include:

- Remote Support Facility (RSF) requests are always initiated from the HMC to IBM. No inbound connections are ever initiated from the support system.

- All communications between the HMC and IBM are secured using Transport Layer Security (TLS). This includes data encryption and host verification.

- Data sent to IBM consists solely of hardware problem information and configuration data. No application or customer data is transmitted.

Using the internet for remote support

The HMC can be enabled to connect directly to the Internet or to connect indirectly, through a proxy server that you provide. The decision to use either a direct or indirect Internet connection for remote support depends on the security and networking requirements of your enterprise.

Hardware Management Console Direct Internet Connection

If your Hardware Management Console can be connected to the Internet, and the external firewall can be set to allow established TCP packets to flow outbound to the IP addresses described in "Server address lists and host names" on page 110, you can use a direct connection between the HMC and the Internet. The use of Source Network Address Translation (SNAT) and masquerading rules to mask the HMC's source IP address are both acceptable.

Hardware Management Console Indirect Connection with Proxy Server

For the Hardware Management Console to communicate successfully, your proxy server must allow connections to the host names and IP addresses that are defined in the section below.

When using an indirect connection, you can choose whether the proxy is to be directed to connect to the support system using an IP address or using a host name. You can control the set of targets for that proxy using either a host name or IP address, depending upon the security policies of your installation. See "Server address lists and host names" on page 110 for the list of host names and IP addresses.

If your installation requires host name addressing, your proxy must be configured with a Domain Name Server.

Server address lists and host names

The internet-facing HMC or SSL Proxy requires outbound TCP/IP connections to be allowed to *esupport.ibm.com* port 443. When possible, use this hostname when you configure firewall and proxy rules. If needed, use the following IP addresses:

⚠️ **Attention:** It is important that the customer configures the following addresses during the planning phase to properly prepare the customer's network. The customer's network is required to allow connectivity to **both** current and new IP addresses listed in the tables below.

IPv4 addresses

Internet connectivity using IPv4 requires outbound connectivity to port 443 on the following IP addresses:

Table 31. IPv4 IP addresses and effective date notices

IPv4 address	Effective date notices
192.148.6.11	Effective March 1, 2024
129.42.21.70	Discontinue March 1, 2024
129.42.19.70	
129.42.18.70	
129.42.54.189	
129.42.56.189	Discontinue March 1, 2024
129.42.60.189	Discontinue March 1, 2024

IPv6 addresses

Internet connectivity using IPv6 requires outbound connectivity to port 443 on the following IP address:

Table 32. IPv6 IP addresses and effective date notices

IPv6 address	Effective date notices
2620:1f7:c010:1:1:1:1:11	Effective March 1, 2024
2607:f0d0:3901:33:129:42:21:70	Discontinue March 1, 2024
2607:f0d0:2601:13:129:42:19:70	
2607:f0d0:1f01:9f:129:42:18:70	
2620:0:6c0:200:129:42:54:189	Discontinue March 1, 2024
2620:0:6c0:200:129:42:56:189	
2620:0:6c2:200:129:42:60:189	Discontinue March 1, 2024

Bandwidth requirements

The 3932 Hardware Management Console (HMC) provides you with the option to download full system firmware images (AROMs) over RSF. The image files can be as large as 10 GB in size. Depending on the bandwidth available to the HMC or proxy servers that are used for RSF, downloads may take several hours to complete.

It is recommended that the HMC have at least a 10 Mbps internet connection available, for which a 5 GB file download would take approximately 1 hour.

Chapter 8. I/O cabling and connectivity

This chapter includes the following:

- A description of the top exit cabling and bottom exit cabling features.
- A description of the IBM Site and Facilities Services.
- A list of customer fiber optic cabling responsibilities if the services are not elected.
- A description of the 3932 channel feature connections.
- A description of the Fiber Quick Connect harness bracket feature offered for customer FICON cables.

I/O cabling

You can route I/O cables:

- Through the <u>top</u> of the frame using:
  - Top Exit Cabling feature with top hat (**FC 7802**), with or without Fiber Quick Connect (FQC) harness brackets.
  - Top Exit Cabling feature without top hat (**FC 7803**), routing cables directly through the top of the frame
- Through the <u>bottom</u> of the frame using the Bottom Exit cabling feature (**FC 7804**) with *optional* Fiber Quick Connect (FQC) harness brackets
- Through the bottom *or* top of the frame using the spine cable management hardware.

See Appendix C, "Top Exit cabling and Bottom Exit cabling specifications," on page 151 for information on the top exit cabling feature and the bottom exit cabling feature.

IBM Site and Facilities

IBM Site and Facilities has a comprehensive set of scalable solutions to address cabling requirements, from product-level to enterprise-level for small, medium, and large enterprises. These services fall into two major categories:

- IBM Facilities Cabling Services - fiber transport system
- IBM IT Facilities Assessment, Design, and Construction Services - optimized airflow assessment for cabling.

Planning and installation services for individual fiber optic cable connections are available. An assessment and planning for IBM Fiber Transport System (FTS) trunking components can also be performed.

These services are designed to be right-sized for your products or the end-to-end enterprise, and to take into consideration the requirements for all of the protocols and media types supported on IBM z16 Model A02, IBM LinuxONE Rockhopper 4 Model LA2, IBM z16 (Model A01), IBM LinuxONE Emperor 4 (Model LA1), IBM z15 Model T02 , IBM LinuxONE III Model LT2, z15, IBM LinuxONE III, z14 Model ZR1, Rockhopper II, z14 Models M01-M05, and Emperor II machines (for example: FICON, Coupling Links, OSA-Express) whether the focus is the data center, the Storage Area Network (SAN), the Local Area Network (LAN), or the end-to-end enterprise.

IBM Site and Facilities are designed to deliver convenient, packaged services to help reduce the complexity of planning, ordering, and installing fiber optic cables. The appropriate fiber cabling is selected based upon the product requirements and the installed fiber plant.

The services are packaged as follows:

- Under IBM Facilities Cabling Services, there is the option to provide IBM Fiber Transport System (FTS) trunking commodities (fiber optic trunk cables, fiber harnesses, panel-mount boxes) for connecting to other IBM z16 Model A02, IBM LinuxONE Rockhopper 4 Model LA2, IBM z16 (Model A01), IBM LinuxONE Emperor 4 (Model LA1), IBM z15 Model T02 , IBM LinuxONE III Model LT2, z15, IBM LinuxONE III, z14 Model ZR1, Rockhopper II, z14 Models M01-M05, and Emperor II machines. IBM can reduce the cable clutter and cable bulk under the floor. An analysis of the channel configuration and any existing fiber optic cabling is performed to determine the required FTS trunking commodities. IBM can also help organize the entire enterprise. This option includes enterprise planning, new cables, fiber optic trunking commodities, installation, and documentation.
- Under IBM IT Facilities Assessment, Design, and Construction Services there is the Optimized Airflow Assessment for Cabling option to provide you with a comprehensive review of your existing data center cabling infrastructure. This service provides an expert analysis of the overall cabling design required to help improve data center airflow for optimized cooling, and to facilitate operational efficiency through simplified change management.

Refer to the **Services** section of Resource Link at *http://www.ibm.com/servers/resourcelink* for further details.

Customer fiber optic cabling responsibilities

If you choose to plan and install your own I/O cabling, these are the specific tasks you must complete.

1. All cable planning and support

   - For cable management best practices and guidelines, see *3932 Single Frame External Cabling Best Practices* (https://www.ibm.com/support/pages/node/7001737).

2. All purchasing of correct qualified cables.

   ⚠️ **Attention:** The IBM Fiber Transport System (FTS) trunking feature is <u>not</u> offered with the 3932. The customer is responsible to engage third party vendors to purchase a fiber trunking solution, if desired.

3. All installation of any required fiber optic or OSA-Express copper cables

4. All routing of cables to correct back floor cutouts for proper installation to the machine

5. All labeling of cables with PCHID numbers for proper installation to the machine.

Failure to accomplish these cabling tasks properly could lead to additional service charges during the machine installation in order to correct any problems incurred.

All jumper cables, cable components, and connector options are available through IBM Global Services. Contact your IBM installation planning representative, IBM product specialist, or IBM Connectivity Services specialist for details.

Note: Customer cabling preparation does not include plugging cables into the 3932.

CAUTION: **Servicing of this product or unit is to be performed by trained service personnel only. (C032)**

FICON channel feature

FICON channels offer fast, efficient data transfer while allowing reuse of currently installed single mode and multimode fiber optic cables.

FICON Express32S

Delivers up to 32 Gbps link data rate to servers, switches, control units and storage devices. Provides support for IBM Fibre Channel Endpoint Security.

FICON Express16SA

Delivers up to 16 Gbps link data rate to servers, switches, control units and storage devices. Provides support for IBM Fibre Channel Endpoint Security.

FICON Express16S+

Delivers up to 16 Gbps link data rate to servers, switches, control units and storage devices.

Configuration information

Table 33 on page 114 lists the FICON features. These features support two modes of operation:

- FC - native FICON
- FCP - Fibre Channel Protocol - attachment to SCSI disks in Linux on IBM Z and z/VM® environments.

Table 33. FICON feature codes

Feature code	Description	Fiber type
FC 0462 (2 ports)	FICON Express32S SX (Short Wavelength)	multimode 50 and 62.5 micron
FC 0461 (2 ports)	FICON Express32S LX (Long Wavelength)	single mode 9 micron
FC 0437[1] (2 ports)	FICON Express16SA SX (Short Wavelength)	multimode 50 and 62.5 micron
FC 0436[1] (2 ports)	FICON Express16SA LX (Long Wavelength)	single mode 9 micron
FC 0428[1] (2 ports)	FICON Express16S+ SX (Short Wavelength)	multimode 50 and 62.5 micron
FC 0427[1] (2 ports)	FICON Express16S+ LX (Long Wavelength)	single mode 9 micron

Notes:

1. This feature can be carried forward to IBM z16 (Model A01).
2. All FICON Express® feature codes use LC Duplex connectors.
3. Each feature code represents a FICON base adapter with pluggable optic modules.
4. Short wavelength and long wavelength optic modules cannot be mixed on the same FICON base adapter.
5. Short wavelength and long wavelength features (FICON adapters) can coexist in the same PCIe+ I/O drawer.

See "FICON references" on page 116 for information about link distances and light loss budget.

The following illustrations show the FICON features, the ports on the feature, and the type of connector used.

FCs 0461/0462
FICON Express32S

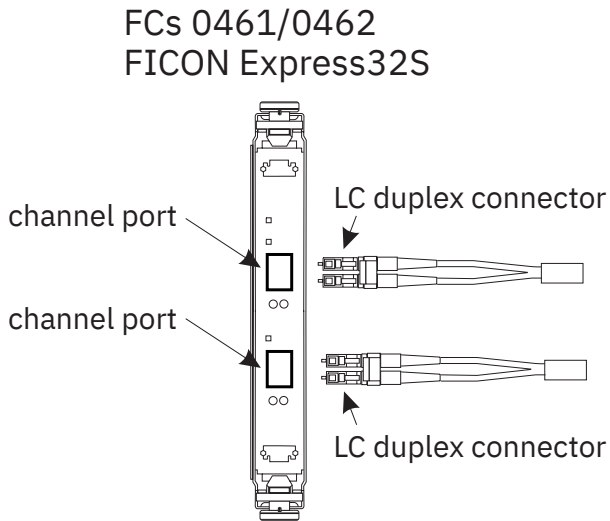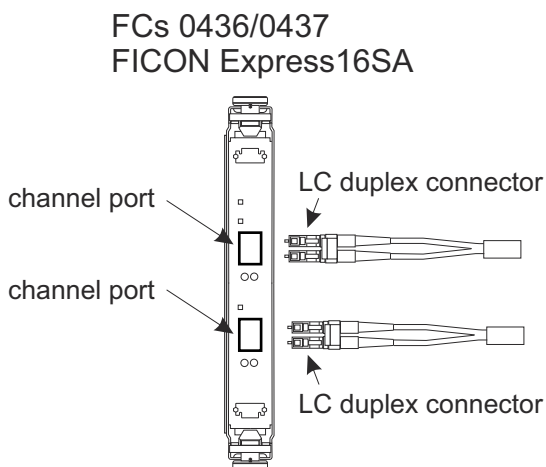channel port

LC duplex connector

channel port

LC duplex connector

Figure 17. FICON Exress32S features

FCs 0436/0437
FICON Express16SA

channel port

LC duplex connector

channel port

LC duplex connector

Figure 18. FICON Express16SA features

FCs 0427/0428
FICON Express16S+

channel port —→ LC duplex connector
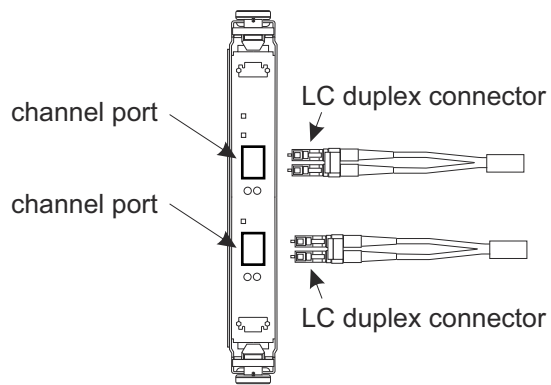
channel port —→

LC duplex connector

Figure 19. FICON Express16S+ features

FICON references

For additional information on planning for FICON channels see:

- *Planning for Fiber Optic Links (FICON/FCP, Coupling Links, Open Systems Adapters, zHyperLink Express, and RoCE Express)*
- *FICON Channel-to-Channel Reference*

OSA-Express features

Open Systems Adapter-Express (OSA-Express) features enable connectivity to industry-standard local area networks (LANs).

Configuration information

Table 34 on page 117 lists the supported OSA-Express features.

Table 34. OSA-Express feature codes

| Feature code	Feature description	Cable description	Connector type
FC 0460 (1 port)	OSA-Express7S 25 GbE LR 1.2	9 micron single mode	LC Duplex
FC 0459 (1 port)	OSA-Express7S 25 GbE SR 1.2	50 and 62.5 micron multimode	LC Duplex
FC 0458 (2 ports)	OSA-Express7S 1000BASE-T 1.2	Category 5 UTP copper wire	RJ-45
FC 0457 (1 port)	OSA-Express7S 10 GbE SR 1.2	50 and 62.5 micron multimode	LC Duplex
FC 0456 (1 port)	OSA-Express7S 10 GbE LR 1.2	9 micron single mode	LC Duplex
FC 0455 (2 ports)	OSA-Express7S GbE SX 1.2	50 and 62.5 micron multimode	LC Duplex
FC 0454 (2 ports)	OSA-Express7S GbE LX 1.2	9 micron single mode	LC Duplex
FC 0449[1] (1 port)	OSA-Express7S 25 GbE SR1.1	50 and 62.5 micron multimode	LC Duplex
FC 0446[1] (2 ports)	OSA-Express7S 1000BASE-T	Category 5 UTP copper wire	RJ-45
FC 0445[1] (1 port)	OSA-Express7S 10 GbE SR	50 and 62.5 micron multimode	LC Duplex
FC 0444[1] (1 port)	OSA-Express7S 10 GbE LR	9 micron single mode	LC Duplex
FC 0443[1] (2 ports)	OSA-Express7S GbE SX	50 and 62.5 micron multimode	LC Duplex
FC 0442[1] (2 ports)	OSA-Express7S GbE LX	9 micron single mode	LC Duplex
FC 0426[1] (2 ports)	OSA-Express6S 1000BASE-T	Category 5 UTP copper wire	RJ-45
FC 0425[1] (1 port)	OSA-Express6S 10 GbE SR	50 and 62.5 micron multimode	LC Duplex
FC 0424[1] (1 port)	OSA-Express6S 10 GbE LR	9 micron single mode	LC Duplex
FC 0423[1] (2 ports)	OSA-Express6S GbE SX	50 and 62.5 micron multimode	LC Duplex

Table 34. OSA-Express feature codes (continued)			
Feature code	**Feature description**	**Cable description**	**Connector type**
FC 0422[1] (2 ports)	OSA-Express6S GbE LX	9 micron single mode	LC Duplex

Notes:

1. This feature can be carried forward to IBM z16 (Model A01).

FCs 0454/0455
OSA Express7S
Gigabit Ethernet LX/SX 1.2

FCs 0456/0457
OSA Express7S
10 Gigabit Ethernet LR/SR 1.2
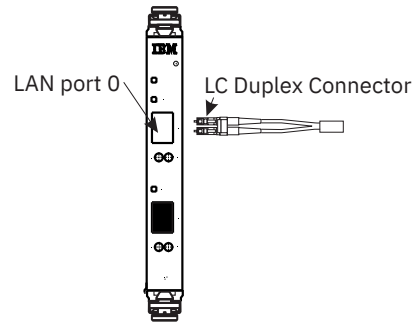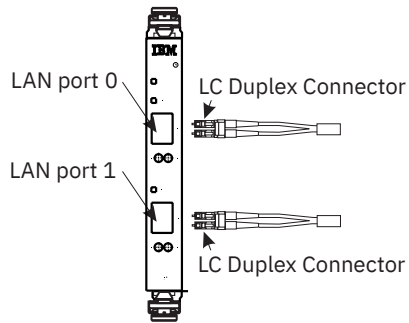
FCs 0458
OSA Express7S
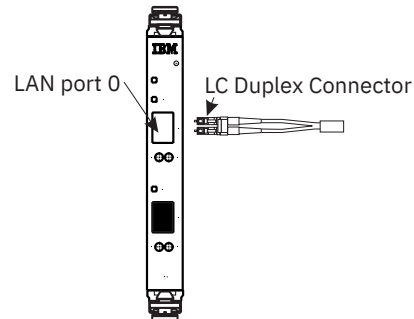1000Base-T Ethernet 1.2

FCs 0459/0460
OSA Express7S
25 Gigabit Ethernet LR/SR 1.2

Figure 20. OSA-Express7S 1.2 features

FCs 0442/0443
OSA Express7S
Gigabit Ethernet LX/SX

LAN port 0 — LC Duplex Connector

LAN port 1 — LC Duplex Connector

FCs 0444/0445
OSA Express7S
10 Gigabit Ethernet LR/SR

LAN port 0 — LC Duplex Connector

FC 0446
OSA Express7S
1000Base-T Ethernet

RJ-45 Connector

LAN port 0

LAN port 1

RJ-45 Connector

FC 0449
OSA Express7S
25 Gigabit Ethernet SR1.1

LAN port 0 — LC Duplex Connector

Figure 21. OSA-Express7S features

FCs 0422/0423
OSA Express6S
Gigabit Ethernet LX/SX

LAN port 0   LC Duplex Connector

LAN port 1

LC Duplex Connector
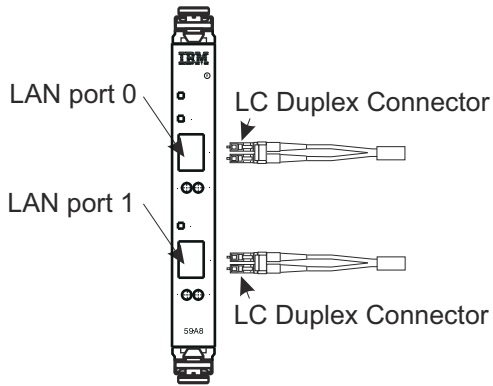
FCs 0424/0425
OSA Express6S
10 Gigabit Ethernet LR/SR

LAN port 0   LC Duplex Connector
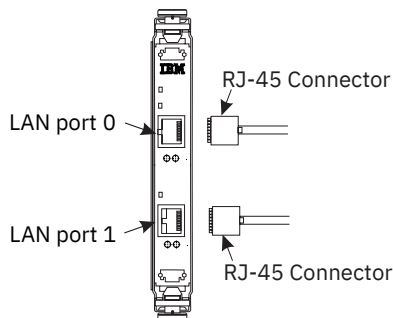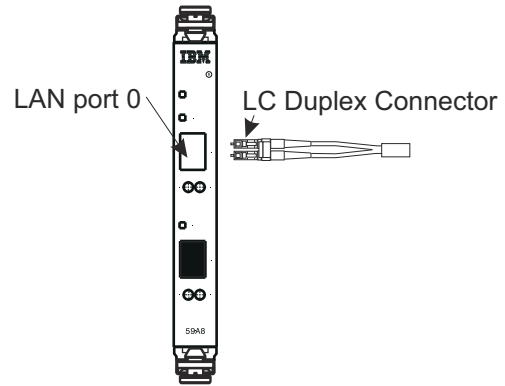
FC 0426
OSA Express6S
1000Base-T Ethernet

RJ-45 Connector

LAN port 0

LAN port 1

RJ-45 Connector

Figure 22. OSA-Express6S features

OSA-Express reference

For additional information on planning for OSA features, see:

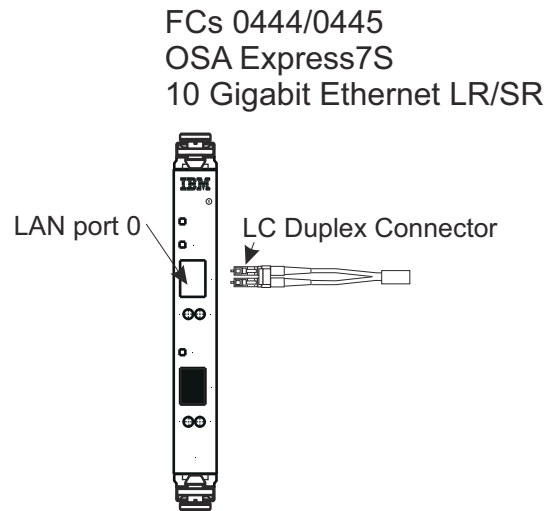* *Open System Adapter-Express Integrated Console Controller Dual Port User's Guide*
* *Open Systems Adapter-Express Customer's Guide and Reference*
* *Planning for Fiber Optic Links (FICON/FCP, Coupling Links, Open Systems Adapters, zHyperLink Express, and RoCE Express)*

I/O interconnect fanout cards

A PCIe+ Fanout card supports 2 copper PCIe 16 GBps interconnect cables. PCIe+ Fanouts are used to connect the CPC processor drawer to the PCIe+ I/O drawer(s).

Coupling link fanout cards

The 3932 supports the following coupling features.

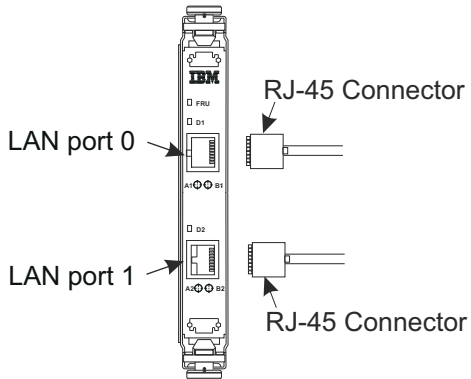| Feature code	Description	Maximum # of features	Maximum connections	Order increments per feature	Fiber type	Connector type
FC 0176 (2 ports)	Integrated Coupling Adapter1.1 (ICA SR1.1)	24	48 links	1	SX laser 50 micron	MTP
FC 0172 (2 ports)	Integrated Coupling Adapter (ICA SR)	24	48 links	1	SX laser 50 micron	MTP
FC 0434 (2 ports)	Coupling Express2 LR	32	64 links	1	9 micron single mode	LC Duplex

Integrated Coupling Adapter (ICA) SR feature

- Integrated Coupling Adapter1.1 (ICA SR1.1) - **FC 0176**
- Integrated Coupling Adapter (ICA SR) - **FC 0172**

ICA SR feature supports PCIe Gen3 for coupling communication between systems, and it resides in the PCIe fanout slot in the CPC drawer. If you are planning to install PCIe Gen3 Coupling or Sysplex links, you will have to place connected servers no further than 150 meters (492 feet) from each other.

PCIe Gen3 provides up to a 16.0 GBps* fiber optic connection between IBM z16, IBM z15, z14 ZR1, and z14. machines. A PCIe Gen3 fiber optic cable (150 m - 50 micron multimode OM4; 100 m - 50 micron multimode OM3) connects directly to a port on the ICA SR or ICA SR1.1 fanout card. It is recommended that you order ICA SR cabling through Anixter to get IBM qualified cables. For more information, see *Planning for Fiber Optic Links (FICON/FCP, Coupling Links, Open Systems Adapters, zHyperLink Express, and RoCE Express)* .

Note: * The link data rates, (for example, 6.0 GBps, 8.0 GBps, and 5 Gbps), do not represent the performance of the links. The actual performance is dependent upon many factors including latency through the adapters, cable lengths, and the type of workload.

- You can order ICA SR1.1 (**FC 0176**) in increments of one feature (2 ports), up to a maximum of 48 features (96 ports). You can also carry forward this feature.
- You can carry forward the ICA SR feature (**FC 0172**).
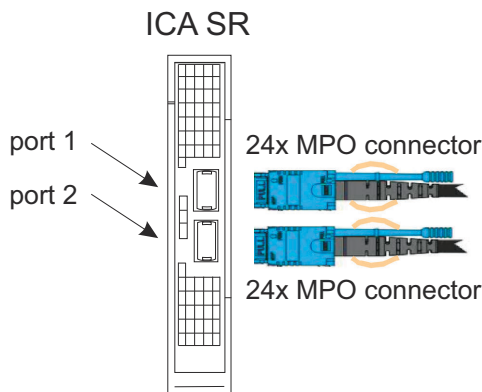
The following cables are all simplex 24-fiber cable assemblies, SX laser 50 micron, using MTP connectors on both ends.

Table 35. ICA SR cable part numbers		
Part number	Length meters (feet)	Cable type
00JA687	8.0 m (26.3 ft)	OM4
00LU282	10.0 m (32.9 ft)	OM4
00LU283	13.0 m (42.7 ft)	OM4
00JA688	15.0 m (49.3 ft)	OM4
00JA689	20.0 m (65.7 ft)	OM4
00LU284	40.0 m (131.3 ft)	OM4
00LU285	80.0 m (262.5 ft)	OM4
00LU286	120.0 m (393.8 ft)	OM4
00LU287	150.0 m (492.2 ft)	OM4
00LU288	custom length < 150.0 m (492.2 ft)	OM4
00JJ548	8.0 m (26.3 ft)	OM3
00LU290	10.0 m (32.9 ft)	OM3
00LU291	13.0 m (42.7 ft)	OM3
00JJ549	15.0 m (49.3 ft)	OM3
00JJ550	20.0 m (65.7 ft)	OM3
00LU292	40.0 m (131.3 ft)	OM3
00LU293	80.0 m (262.5 ft)	OM3
00LU294	100.0 m (328.1 ft)	OM3
00LU295	custom length < 100.0 m (328.1 ft)	OM3

Coupling Express2 LR feature (FC 0434)

Coupling Express2 LR feature (**FC 0434**) supports long-distance point-to-point coupling communications between IBM z16, IBM z15, z14 ZR1, and z14. machines.

The Coupling Express2 LR adapter connects to a card slot in the PCIe+ I/O drawer.

Coupling Express2 LR is a two-port, Ethernet-based coupling card with a data rate of 10.0 Gbps* and a maximum unrepeated distance of 10 km and a maximum repeated distance of 100 km with a qualified Dense Wavelength Division Multiplexing (DWDM) device. Coupling Express2 LR utilizes a 9 micron single mode cable that connects to the Coupling Express LR and Coupling Express2 LR card using LC Duplex connectors on both ends. It is recommended that you order Coupling Express2 LR cabling through Anixter to get IBM qualified cables. For more information, see *Planning for Fiber Optic Links (FICON/FCP, Coupling Links, Open Systems Adapters, zHyperLink Express, and RoCE Express)* .

Note: * The link data rates, (for example, 6.0 GBps, 8.0 GBps, 5 Gbps, and 10 Gbps), do not represent the performance of the links. The actual performance is dependent upon many factors including latency through the adapters, cable lengths, and the type of workload.

- You can order Coupling Express2 LR (**FC 0434**) in increments of one feature (2 ports), up to a maximum of 64 features (128 ports). Coupling Express2 LR supports up to four CHPIDs per port.

Coupling Express2 LR requires the presence of an IFP processor.

Coupling Express2 LR
FC 0434

port 1
port 2
LC Duplex Connector
LC Duplex Connector
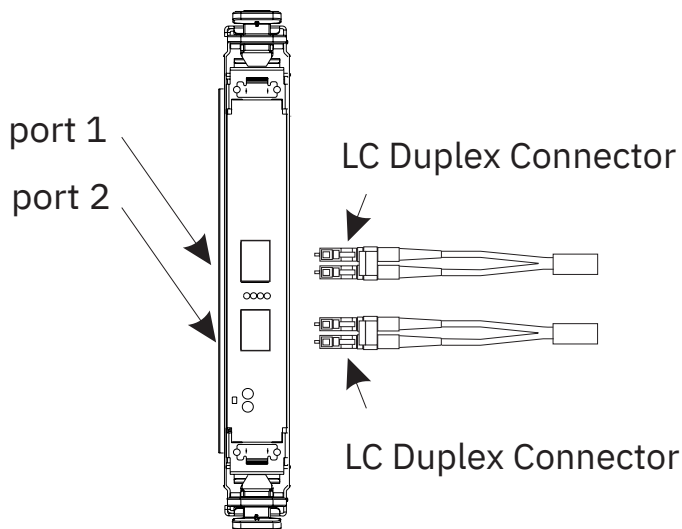
IBM Virtual Flash Memory (FC 0644)

IBM Virtual Flash Memory (**FC 0644**) is designed to help improve application availability and to handle paging workload spikes.

Ordering IBM Virtual Flash Memory can cause memory DIMMS to be installed when the machine is configured. Each feature provides 512 GB of memory. You can order up to 4 features.

Note: There is a possibility that ordering IBM Virtual Flash Memory may reduce the maximum orderable customer memory for a given model.

Native PCIe adapters

The following features utilize industry standard PCIe adapters (called native PCIe adapters). They physically plug into a mother card that provides Vital Product Data (VPD) and hot-plug capability. The features then plug into the PCIe+ I/O drawer.

Table 36. Native PCIe adapter feature codes

Feature code	Description
FC 0451	IBM zHyperLink Express1.1
FC 0431[1]	IBM zHyperLink Express
FC 0448	IBM Adapter for NVMe1.1[2]
FC 0453	25GbE RoCE Express3 LR
FC 0452	25GbE RoCE Express3 SR
FC 0441	10GbE RoCE Express3 LR
FC 0440	10GbE RoCE Express3 SR
FC 0450[1]	25GbE RoCE Express2.1
FC 0432[1]	10GbE RoCE Express2.1
FC 0430[1]	25GbE RoCE Express2
FC 0412[1]	10GbE RoCE Express2

Notes:

1. This feature can only be carried forward to IBM z16 (Model A01).

2. This feature is only available on IBM LinuxONE Emperor 4.

These native cards do not have CHPID assignments. They have Virtual Functions (VFs) that are defined in IOCP/HCD. PCHIDs are still applicable with native cards.

IBM zHyperLink Express

- zHyperLink Express1.1 - **FC 0451**

- zHyperLink Express - **FC 0431**

The zHyperLink Express feature is designed to provide fast access to data through reduce latency using point-to-point PCIe Gen3 connections with a maximum cable length of 150 meters (492 feet).

- You can order zHyperLink Express1.1 (**FC 0451**) in increments of 1 feature (2 ports per feature), up to a maximum of 16 features (32 ports).

- You can carry forward zHyperLink Express (**FC 0431**).

zHyperLink Express requires the presence of an IFP processor. The zHyperLink Express card requires a customer supplied cable. For PCIe Gen3 fiber optic cable information, see Table 35 on page 124 in "Integrated Coupling Adapter (ICA) SR feature" on page 123.

zHyperLink Express

port 1 — 24x MPO connector

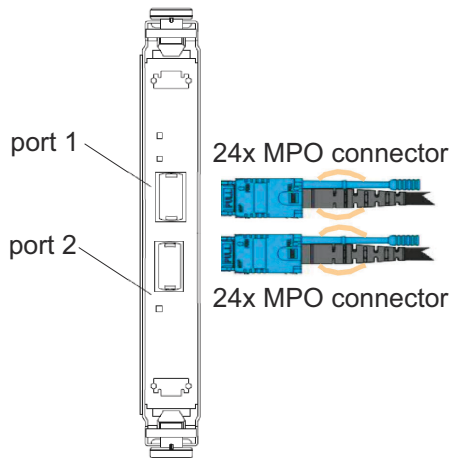port 2 — 24x MPO connector

Figure 23. zHyperLink Express feature

IBM Adapter for NVMe1.1 (FC 0448)

The IBM Adapter for NVMe (Non-Volatile Memory Express) feature utilizes NVMe to provide IBM LinuxONE Rockhopper 4 fast access to data stored on Solid State Drives (SSDs). NVM Express is an open collection of standards and information to fully expose the benefits of non-volatile memory in all types of computing environments from mobile to data center. NVMe™ is designed from the ground up to deliver high bandwidth and low latency storage access for current and future NVMe technologies.

IBM Adapter for NVMe details:

- Only available with IBM LinuxONE Rockhopper 4
- A zero port, single PCHID adapter card
- Order the adapter in increments of 1 feature, with maximum of 16 features
  - You can order the IBM Adapter for NVMe1.1 (**FC 0448**).

IBM provides the adapter card into which a vendor NVMe SSD can be plugged. The NVMe SSD is customer supplied and installed into the IBM adapter card by the IBM service representative.

Important:

Once installed, any future servicing of the customer supplied NVMe SSD requires a service contract to be in place. The servicing or replacement of the NVMe SSD by an IBM Service Representative is **not** covered under Warranty or Maintenance Agreement.

⚠️ **Attention:** The selection and purchase of the SSDs in this feature is the responsibility of the customer. The *IBM LinuxONE NVMe white paper* (https://www.ibm.com/downloads/cas/PDGXWWO3) lists the performance of SSDs that IBM has tested for LinuxONE. IBM can only comment on the functionality of the SSDs that have been tested. The customer assumes all risk in, and IBM is not responsible for, the use of SSDs as the functionality or performance may vary.

Notes

- The NVMe SSD must meet the following optional specification items:
  - Support 64 bit PCIe addressing
  - Support Host Controlled Thermal Management
  - Support Thermal Throttling
  - Support single port PCIe x4 only
- Specifications:
  - NVM Express 1.2b
  - PCI Express Base Specification Rev 3.1
  - Enterprise SSD Form Factor Version 1.0a (Single Port Only)
  - PCI Express Card Electro-Mechanical Spec. Rev 3.0
- Form Factor:
  - U.2 2.5'' (15 mm) Form factor U.2-compatiable connector (formerly SFF-8639)
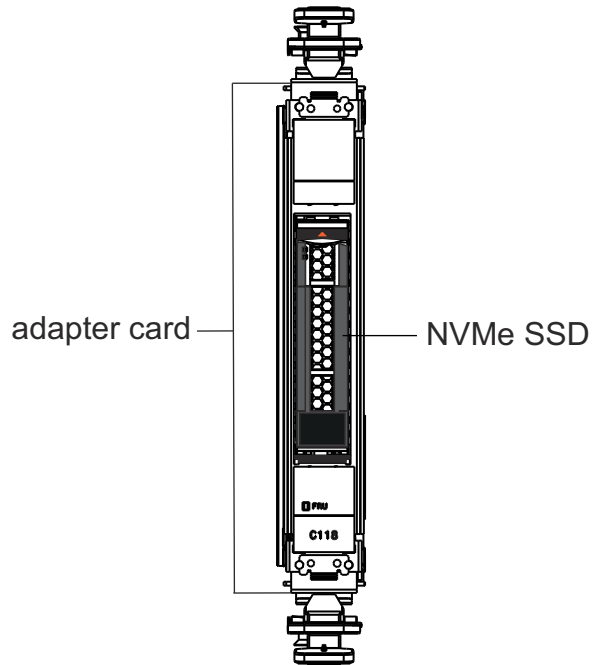 - 25W max power consumption

IBM Adapter for NVMe

Figure 24. IBM Adapter for NVMe feature

The IBM Adapter for NVMe feature resides in the PCIe+ I/O drawer.

IBM RoCE Express2 and RoCE Express3

RoCE stands for RDMA (Remote Direct Memory Access) over Converged Ethernet. Using any of the following IBM RoCE Express adapters, RDMA technology is available on Ethernet.

- 25GbE RoCE Express3 LR - **FC 0453**
- 25GbE RoCE Express3 SR - **FC 0452**
- 10GbE RoCE Express3 LR - **FC 0441**
- 10GbE RoCE Express3 SR- **FC 0440**
- 25GbE RoCE Express2.1 - **FC 0450** (*carry forward only*)
- 10GbE RoCE Express2.1 - **FC 0432** (*carry forward only*)
- 25GbE RoCE Express2 - **FC 0430** (*carry forward only*)
- 10GbE RoCE Express2 - **FC 0412** (*carry forward only*)

RDMA technology provides the capability to allow hosts to logically share memory. An IBM RoCE Express adapter, in conjunction with an OSA card, enables shared memory communications between two CPCs using a shared switch, which is customer supplied.

IBM RoCE Express adapters provide the following:

- Reduce network latency with memory-to-memory transfers utilizing Shared Memory Communications - Remote Direct Memory Access (SMC-R) in z/OS®. It is transparent to applications and can be used for LPAR-to-LPAR communication on a single z/OS system or server-to-server communication in a multiple CPC environment.
- Support single root I/O virtualization (SR-IOV). SR-IOV is a standard specification to help promote interoperability. 10GbE or 25GbE RoCE Express2 provide increased virtualization allowing RoCE to be extended to more workloads.
- Support Virtual Functions (VFs)
  - 10GbE or 25GbE RoCE Express2 support 127 Virtual Functions (VFs) per physical port for a total of 254 VFs per PCHID

Notes:

- You can order all IBM RoCE Express adapters in increments of 1 feature (2 ports per feature), up to a maximum of 8 features (16 ports).
- A CHPID number or CHPID type is not required.
- IBM RoCE Express adapters require the presence of an IFP processor.
- IBM RoCE Express adapters use existing Ethernet fabric (switches with Global Pause enabled), and requires a standard 10GbE or 25GbE switch depending on the speed specified (CEE enabled switch is not required).
- 25GbE RoCE Express2 requires the connection endpoint to also be 25GbE RoCE Express2.

FC 0453/0452
25 Gigabit Ethernet RoCE Express3

FC 0441/0440
10 Gigabit Ethernet RoCE Express3

LAN port 1

LC Duplex Connector

LAN port 2

LC Duplex Connector

LAN port 1
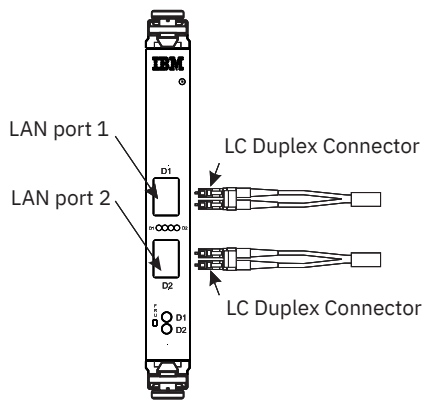
LC Duplex Connector

LAN port 2

LC Duplex Connector

Figure 25. RoCE Express3 features
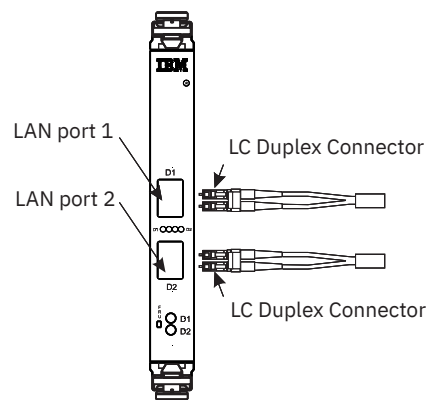
FC 0430/0450
25 Gigabit Ethernet RoCE Express2

FC 0412
10 Gigabit Ethernet RoCE Express2

LAN port 1

LC Duplex Connector

LAN port 2

LC Duplex Connector

LAN port 1

LC Duplex Connector

LAN port 2

LC Duplex Connector
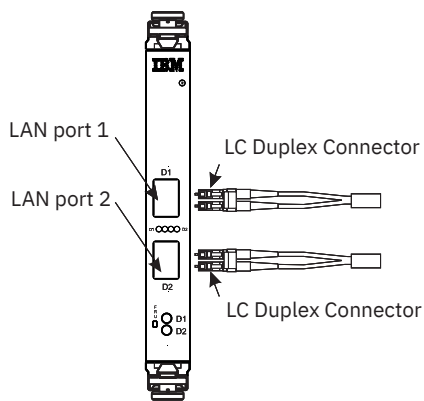
Figure 26. RoCE Express2 features
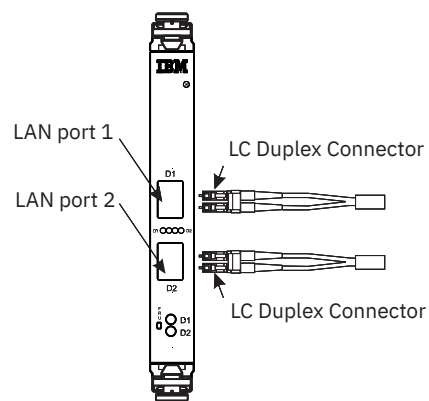
Time synchronization

Synchronized time is possible with a 3932 in a Sysplex environment using Server Time Protocol (STP). STP supports Coordinated Timing Networks (CTNs) where the 3932 machines in the network are configured to be in STP timing mode.

Server time protocol

Server Time Protocol (**FC 1021**) requires no special cables to create timing links with other servers.

You can use PCIe Gen3 (ICA SR feature (FC 0176 or FC 0172) fiber optic cables or Coupling Express LR (FC 0433) Ethernet cables to create the Sysplex. IBM z16 Model A02, IBM z16 (Model A01) or IBM LinuxONE Emperor 4 (Model LA1) can participate in a timing network with IBM z16 (Model A01), IBM LinuxONE Emperor 4 (Model LA1), IBM z15 Model T02 , IBM LinuxONE III Model LT2, z15, IBM LinuxONE III, z14 (Model ZR1), Rockhopper II, z14 (Models M01, M02, M03, M04, M05), and Emperor II.

External Time Source

An STP CTN has the capability of configuring as its time source a Network Time Protocol (NTP) time server or a Precision Time Protocol (PTP) time server that has a pulse per second (PPS) output signal. This type of external time device is available worldwide from several vendors that provide network timing solutions. The NTP and PTP timing networks are connected directly to the oscillator card(s) in the CPC drawer(s) because the NTP or PTP client runs in a firmware partition within the CPC drawer.

Precision Time Protocol (PTP) considerations: To exploit Precision Time Protocol (PTP) for STP, a PTP `TimeTransmitter` (PTP time source) must be present on the existing, Ethernet based management network. In addition, it is recommended that all network devices connected between the PTP time source and the CPC drawer(s) have PTP support enabled.

External Time Source (ETS) IP network considerations: When planning the Ethernet based External Time Source network, it is recommended that one or two subnets corresponding to ETS1 and ETS2 are routable to the desired NTP/PTP time source(s).

⚠️ **Attention:**

- One NTP or PTP time server can be configured to each PPS port.
- Connecting the pulse per second coaxial cable to the NTP or PTP time server may be done by either customer or service personnel.
- **ETS1**/**ETS2** ports support 1000BASE-T Ethernet connections with auto-negotiation up to 1 GbE full duplex.
- When installing ETS Ethernet cables, consider the minimum recommended bend radius. Generally, it is recommended that the bend radius of solid core Ethernet to be *no less than 8 times* the size of the outer jacket; consult your Ethernet vendor for exact specifications.
- Installation with *top exit (FC 7802) or (FC 7803)* feature:
  - ETS cables should enter the frame through the D hole at the ***top***, ***front*** of the A `frame`.
- Installation with *bottom exit (FC 7804)* feature:
  - ETS cables should be pre-installed and terminated with excess of 5.5 meters from the bottom cable exit point in the back of the A `frame`. This includes the (up to two) Ethernet cables required for **ETS1**/**ETS2** connections and the (up to two) coaxial cables for **PPS0**/**PPS1** (if configured).
  - During installation, these cables should be routed through the hole on the upper portion of the A `frame` and back down to CPC drawer A10/A15.
- For more information, see *3932 Single Frame External Cabling Best Practices* (https://www.ibm.com/support/pages/node/7001737).

The Ethernet output of the NTP or PTP time server is connected to the input Ethernet connector provided on the oscillator card on the 3932.

- If the 3932 has 1 CPC drawer, the PPS ports correspond to the oscillator cards as follows:
  - **PPS0** to port J02 of **OSC0** (H101) in CPC0 (A10)
  - **PPS1** to port J02 of **OSC1** (H102) in CPC0 (A10)
  - **ETS1** to port J03 of **OSC0** (H101) in CPC0 (A10)
  - **ETS2** to port J03 of **OSC1** (H102) in CPC0 (A10)
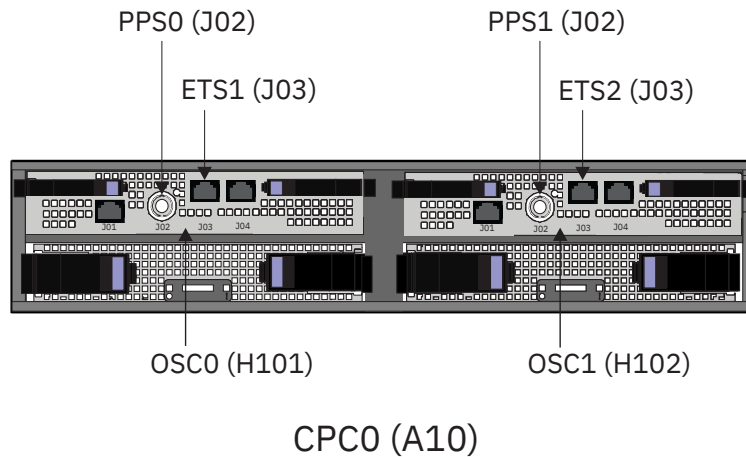

Figure 27. Single CPC drawer configuration - front view

- If the 3932 has *2 or more* CPC drawers, the PPS ports correspond to the oscillator cards as follows:
  - **PPS0** to port J02 of **OSC0** (H101) in CPC0 (A10)
  - **PPS1** to port J02 of **OSC0** (H101) in CPC1 (A15)
  - **ETS1** to port J03 of **OSC0** (H101) in CPC0 (A10)
  - **ETS2** to port J03 of **OSC0** (H101) in CPC1 (A15)

PPS1 (J02)

ETS2 (J03)

OSC0 (H101)   OSC1 (H102)

CPC1 (A15)

PPS0 (J02)

ETS1 (J03)

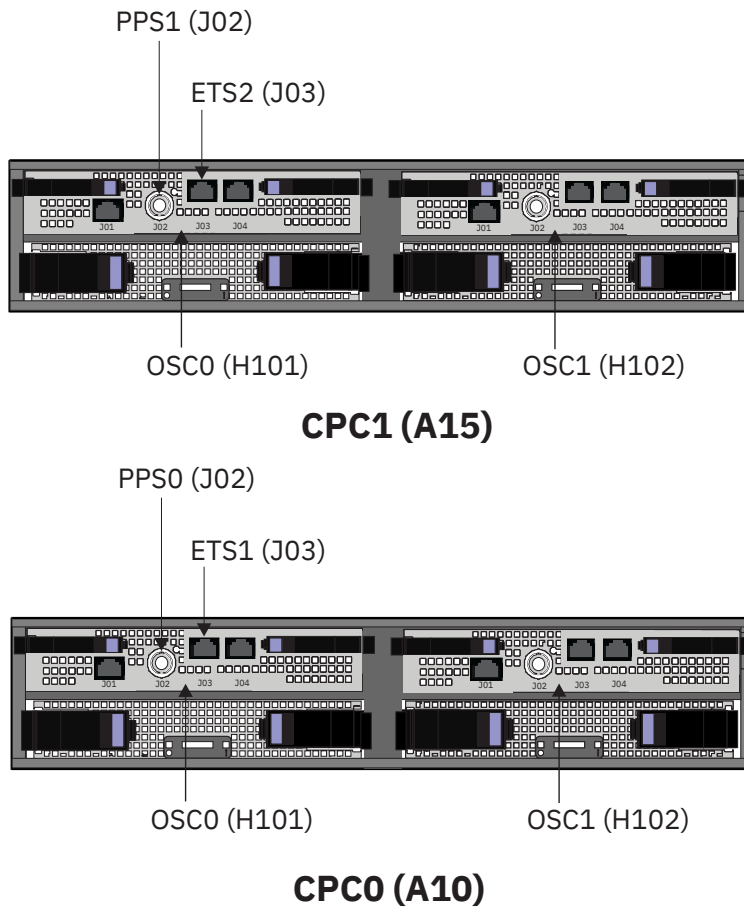OSC0 (H101)   OSC1 (H102)

CPC0 (A10)

Figure 28. Multiple CPC drawer configuration - front view

The pulse per second (PPS) port on the oscillator cards requires a signal with the characteristics listed in Table 37 on page 135. Your network timing solution vendor can assist with the necessary cabling and signal distribution hardware required to meet these characteristics for your specific machine installation.

With a low signal loss PPS distribution, timing solutions can be achieved to exceed 150 feet (45 meters) between the last distribution point and the oscillator card PPS port.

For the input signal received at the oscillator card PPS port, the rise time/fall time of the PPS signal must be shorter or equal to 50 microseconds.

Table 37. PPS signal characteristics

	Unit of measure	Minimum	Typical	Maximum
Voltage Level LOW	volt	0		0,15
Voltage Level HIGH	volt	3,2		5,2
Rise time	microsecond			50
Fall time	microsecond			50
Pulse width	millisecond	50	125	450

Ordering PPS cables

If you are planning to place this server in an STP-only Coordinated Timing Network using NTP or PTP with pulse per second as the external time source, you must supply the coaxial cables that connect the 3932 to the NTP/PTP server providing the PPS signal.

Note: When installing the PPS cable, you **must** connect the right angle adapter to the cable *before* you connect the cable to the 3932.

DANGER: **To prevent a possible shock from touching two surfaces with different protective ground (earth), use one hand, when possible, to connect or disconnect signal cables. (D001)**

Preparing configuration definition

The customer is responsible for preparing a definition of the I/O configuration for the new processor. You should use the PCHID report from the order process configurator as a guide for planning and defining the new configuration. Depending on the current operating environment there may be several methods for accomplishing this.

z/VM

If you use HCM and HCD, develop the configuration using HCM and HCD and store the information in an I/O Definition File (IODF). Otherwise, develop the IOCP statements necessary to define your configuration and use the level of the ICP IOCP program that supports the new processor to verify the input statements. You do not need to initially assign PCHID values to the channel paths in your configuration. You can use the CHPID Mapping Tool, available from Resource Link at *http://www.ibm.com/servers/resourcelink*, to aid you in assigning PCHIDs to CHPIDs. HCM and HCD users must build an IOCP input data set from a validated work IODF and use this as input to the CHPID Mapping Tool. The CHPID Mapping Tool updates the IOCP input and assigns PCHIDs to the CHPIDs.

Note: An IOCP input file that was created by HCM and HCD without PCHIDs must be migrated back into a HCM and HCD IODF after PCHID numbers have been added to the file by the CHPID Mapping Tool.

Inform the install team that plans are in place to use the "Build remote IOCDS" option in HCD to write the IOCDS. When you install a new processor that does not contain an IOCDS, you can use HCD to build an IOCP input deck, transfer the data set to the USB flash memory drive, and run the processor's IOCP stand-alone program. For more information, see *z/VM I/O Configuration*, SC24-6291.

z/VSE

Develop the IOCP statements necessary to define your configuration and use the level of the ICP IOCP program that supports the new processor to verify the input statements. You do not need to initially assign PCHID values to the channel paths in your configuration. You can use the CHPID Mapping Tool, available from Resource Link at *http://www.ibm.com/servers/resourcelink*, to aid you in assigning PCHIDs to CHPIDs. The CHPID Mapping Tool updates the IOCP input and assigns PCHIDs to the CHPIDs.

You can use the option "Build and manage IBM zSystem cluster IOCDSs, IPL attributes, and dynamic I/O changes" to update the selected I/O configuration data set for one or more processors.

z/OS HCD

Develop the configuration using HCD. You do not need to initially assign PCHID values to the channel paths in your configuration. You can use the CHPID Mapping Tool, available from Resource Link at *http://www.ibm.com/servers/resourcelink*, to aid you in assigning PCHIDs to CHPIDs. Build an IOCP input data set from a validated work IODF and use this as input to the CHPID Mapping Tool. The CHPID Mapping Tool updates the IOCP input and assigns PCHIDs to the CHPIDs. Migrate the modified IOCP input file back into a HCD IODF after PCHID numbers have been added to the file by the CHPID Mapping Tool. An IOCDS can then be written in preparation for an upgrade using a production IODF.

You can use the option "Build and manage IBM zSystem cluster IOCDSs, IPL attributes, and dynamic I/O changes" to update the selected I/O configuration data set for one or more processors.

When you install a new processor that does not contain an IOCDS, you can use HCD to build an IOCP input deck, transfer the data set to the USB flash memory drive, and run the processor's IOCP stand-alone program. For more information, see *z/OS Hardware Configuration Definition User's Guide*, SC34-2669.

Note:

Dynamic I/O for Standalone Coupling Facility enables dynamic activation of a new or changed IODF on a standalone coupling facility CPC, without requiring a re-IML or power-on reset (POR). This capability requires IBM z16 (Model A01) firmware support on the coupling facility CPC as well as z14 GA2 or later firmware support on the CPC where the HCD system is running. If you are planning to use the Dynamic

I/O for Standalone Coupling Facility capability on a CPC, you must use HCD on z/OS to configure your IODF/IOCDS appropriately for that CPC. No IODF/IOCDS updates are required on the CPC where the HCD itself is running. For more information, see *z/OS HCD User's Guide, SC34-2669*.

Chapter 9. Parallel sysplex planning

This chapter is intended to provide guidance to those customers who operate in a Parallel Sysplex environment. A Parallel Sysplex typically involves multiple processors and coupling facilities, shared I/O devices, and a host of interconnection possibilities. Detailed planning for a Parallel Sysplex is essential to meet technical objectives, such as performance and high availability, within the constraints of a specific raised floor configuration. Consider using the Fiber Optic Cabling Service to plan your sysplex environment. A list of tasks the Service can perform is provided under "IBM Site and Facilities" on page 112. Different technologies for servers, links and coupling facilities affect your ability to configure a productive sysplex.

The basic premise for a successful Parallel Sysplex installation is to centralize the physical location of the coupling facilities, and then position the sysplex servers around that center. Servers can be placed side-to-side. In addition to bringing the servers closer to the coupling facility, placing your server side-to-side provides for better management of hot and cold air flow.

Notes:

1. IBM z16 Model A02 can only participate in an STP-only timing network.

2. IBM z16 Model A02 can only communicate directly with IBM z16 Model A02, IBM z15 Model T02 , z15, z14 (Models ZR1, M01, M02, M03, M04, M05), z13®, and z13s using Coupling Express LR or ICA SR coupling links.

Following are some guidelines to help you better plan for multiple system interconnection. These are example configurations that would minimize the distance to the coupling facility.

⚠️ **Attention:** The IBM z16 Model A02 is a single frame system.

1. Position the coupling facilities (or servers with internal coupling facilities) in the center of an open area of raised floor large enough to accommodate all of the servers and other coupling facilities to which you want to connect.

☐ = 600 mm (23.5 in) floor tiles

🟦 = Perforated floor tile

▦ = Cold aisle, 1.22 m (48 in)

▨ = Hot aisle
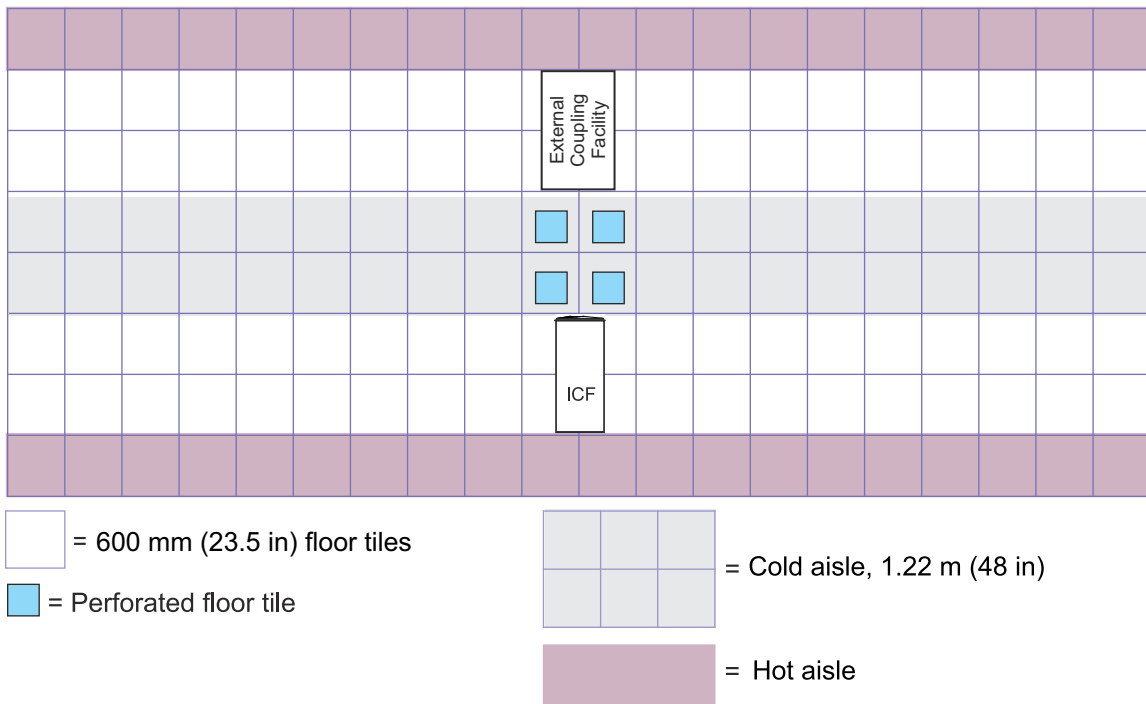
- Use physical planning information for each type of server/coupling facility you intend to add to the Parallel Sysplex to help determine how much floor space you will need.

- Remember to consider weight distribution, service clearances, power, and cooling for each piece of equipment you want to include.

2. Arrange the sysplex in two rows, with the fronts of servers and coupling facilities facing each other (see the illustration under "Weight distribution and multiple systems" on page 49). Allow a 1.22 m (48 in) aisle width between the rows. Although this may be a larger aisle than you have used before, your Parallel Sysplex will benefit from the improvement in cooling that a wider aisle provides. (See the illustration under "Cooling recommendations for the room" on page 67.)

   Note: The system air flow illustration shows a minimum aisle width of 941 mm (37 in). Although this width is adequate for a congested computer room floor, it is the **minimum** you should use. An aisle 1.22 m (48 in) wide will better serve the cooling and cabling needs of a Parallel Sysplex configuration.

- = 600 mm (23.5 in) floor tiles
- = Perforated floor tile
- = Cold aisle, 1.22 m (48 in)
- = Hot aisle
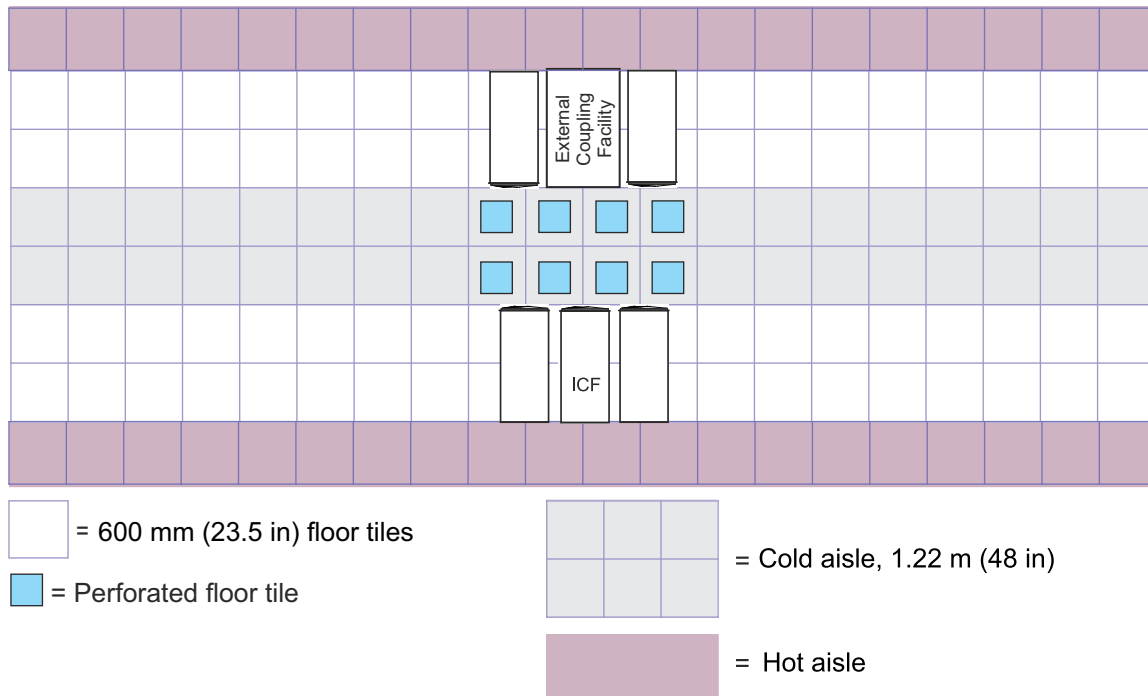
3. Sysplex connections can be made using Coupling Express LR or ICA SR cabling.
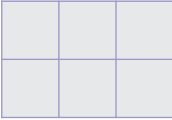
   Note: If you are planning to use ICA SR cabling, you must place connected servers no further than 150 m (492 ft) from each other.

4. As the Parallel Sysplex grows, add new servers evenly on either side of the central coupling facilities.
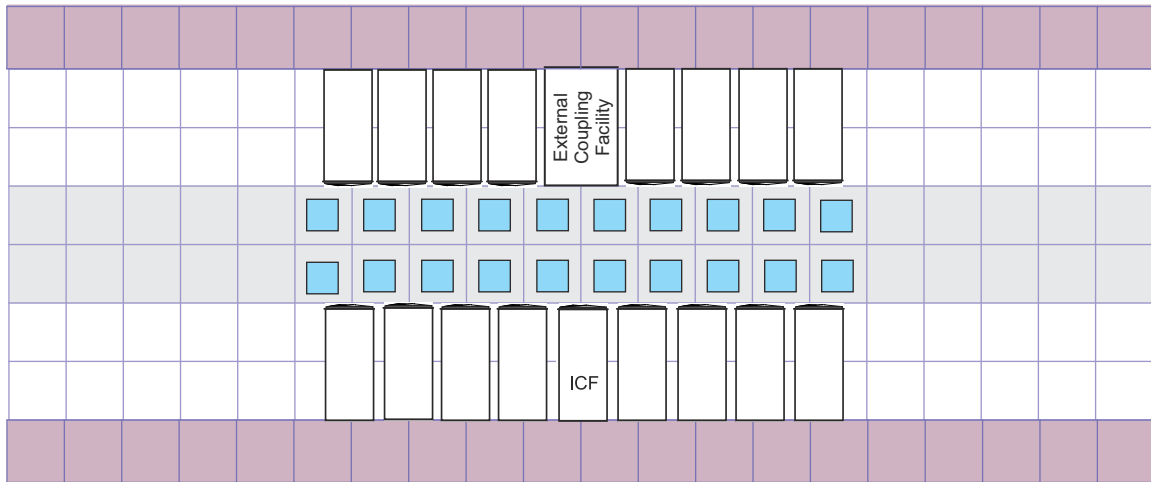
= 600 mm (23.5 in) floor tiles

= Perforated floor tile

= Cold aisle, 1.22 m (48 in)

= Hot aisle

5. As the Parallel Sysplex evolves, it is possible to add rows using Coupling Express LR or ICA SR coupling links to provide connectivity. With the equipment in these new rows centered on the original central coupling facilities, the Parallel Sysplex now assumes the shape of a diamond.

= 600 mm (23.5 in) floor tiles

= Perforated floor tile

= Cold aisle, 1.22 m (48 in)

= Hot aisle
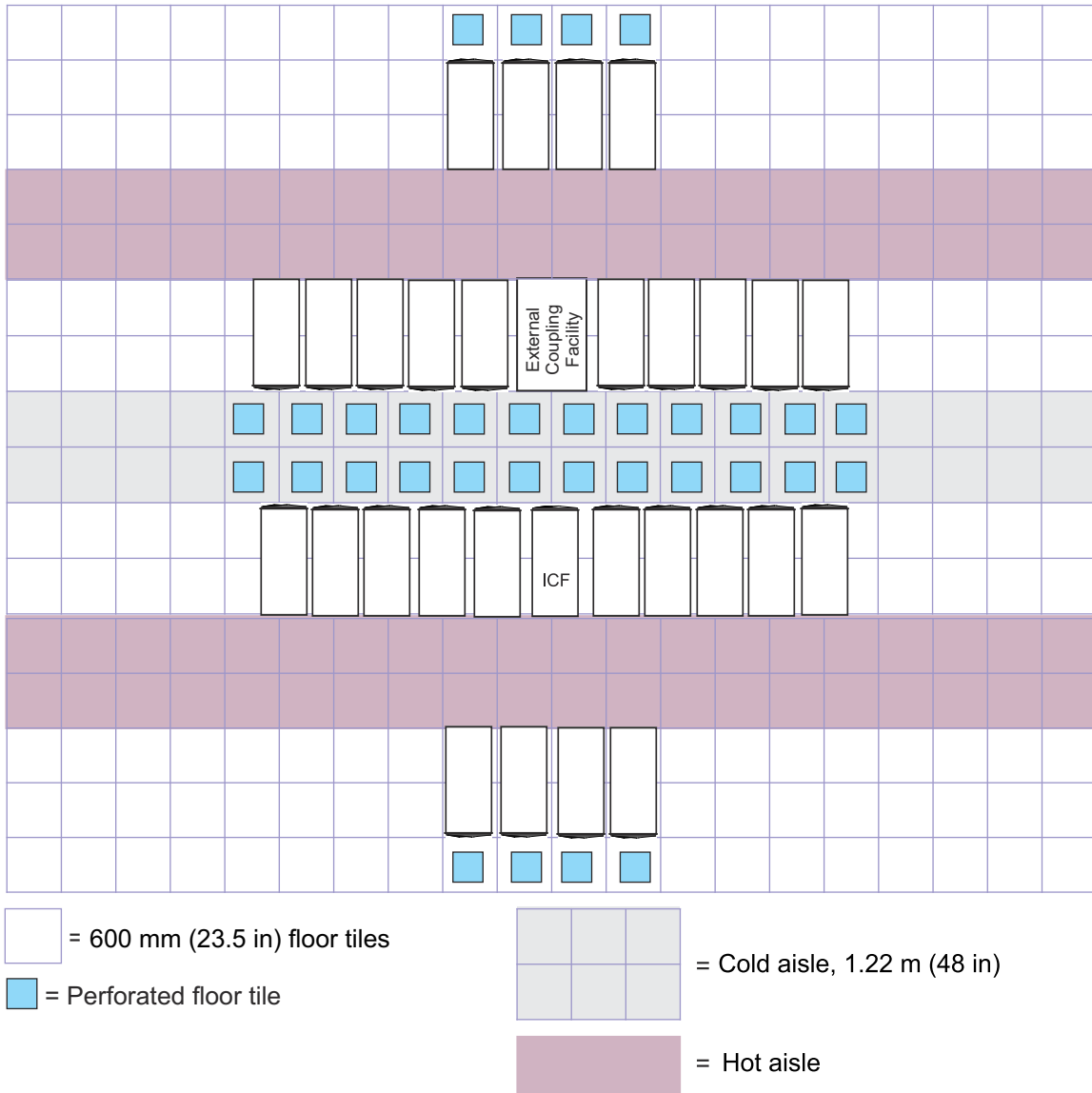
By following these guidelines, you will be able to configure a Parallel Sysplex, using the minimum amount of floor space, that meets your performance and availability objectives. The use of technology combinations - IBM z16 Model A02, IBM z15 Model T02 , z15, z14 (Model ZR1, M01, M02, M03, M04, M05), z13, and z13s machines and coupling facilities - may complicate your physical planning, but the basic strategies outlined here will result in a successful Parallel Sysplex environment.

Appendix A. IBM standard symbols

In Plan Views:

⊠ Cable Entry and Exit Area in the base of the machine. Locating dimensions are measured from the edge of the frame, not the cover. This does not indicate the floor cutout.

⊡ Cable Exit Area, recommended

⊕ Power Cord exit, 50/60 Hz

◕ Power Cord exit, 400 Hz

Power cords are supplied in 4.2 m (14 ft) lengths unless otherwise noted on the specification page. The length is measured from the symbol ⊕ or ◕.

Swinging Gate

Standard equipment outline (shows the machine with covers closed)

Optional equipment outline

Customer Engineer Indicator Panel
CE

In Cabling Schematics:

801 Indicates a cable group coming from a machine
800

503 Indicates a cable group going to a machine
504

Service Area Boundary
(Without feature) (Service clearances are measured from the machine with covers closed)

+ Casters
Locating dimensions are measured from the edge of the frame, not the cover.

○ Leveling pads or glides
(90 mm [3 1/2 in] typical diameter)
Locating dimensions are measured from the edge of the frame, not the cover.

□ Legs

Non-raised floor cable exit

Meter location
M

Unit Emergency Switch

Hinged Covers

Single

Bifold

Offset Bifold

Appendix B. Hardware Management Console physical specifications

This section contains information for the Hardware Management Console components applicable at the time of publication (determined by the edition notice at the front of this document). Specifications for your Hardware Management Console may differ from those presented below.

Note: All dimensions are considered nominal.

Notes for 2461 Rack Mount HMC (FC 0063):

- When planning to use the rack mounted HMC (FC 0063), you must provide the rack where the HMC and 1U KMM (keyboard, monitor, mouse) are installed. It is recommended that you install the rack-mounted HMC below the KMM in the customer-provided rack.
- For USA and Canada, the HMC (FC 0063) use two PDU plug positions for the two AC power supplies in the server. (Other power requirements are country dependent.)
- Do not block any air vents; usually 15 cm (6 in) of space provides proper airflow.
- Do not leave open spaces above or below an installed server in your rack cabinet. To help prevent damage to server components, always install a blank filler panel to cover the open space and to help ensure proper air circulation.
- Install the server only in a rack cabinet with perforated doors.
- Plan the device installation starting from the bottom of the rack cabinet.
- Install the heaviest device in the bottom of the rack cabinet.
- Do not extend more than one device out of the rack cabinet at the same time.
- Connect the server to a properly grounded outlet.
- Do not overload the power outlet when you install multiple devices in the rack cabinet.
- For FC 0063, install the server in a rack that has a minimum depth of 28.25 in (720 mm) and maximum depth of 30 in (762 mm).

Table 38. 2461 Rack Mount Hardware Management Console (FC 0063) specifications

FC 0063 - 2461 Rack Mount Hardware Management Console system unit specifications	
Dimensions	
Height	4.45 cm (1.75 in)
Width	48.26 cm (19 in)
Depth	71.12 cm (28.0 in)
Weight maximum configuration	15.97 kg (35.2 lb)
Power consumption	
Maximum power supply rating	up to 900W
Working level	200W
Input Power[1]	
Low range input voltage	90 Vrms - 137 Vrms (tolerance range) 100 V AC - 127 V AC (nominal range)
High range input voltage	180 Vrms - 265 Vrms (tolerance range) 200 V AC - 240 V AC (nominal range)
Input frequency range	47 - 63 Hz
Input kilovolt-amperes (kVA) (approximate)	
Minimum configuration	0.134 kVA
Maximum configuration	0.988 kVA
Environmental	
Server On	
Temperature	0° to 40° C (32° to 104° F)
Humidity, non-condensing:	
Dew point	-12° C (10.4° F)
Relative humidity	5% - 90%
Storage (non-operating)	
Temperature	-40° to 70° C (-40° to 158° F)
Relative humidity	5% - 100%
1. Power consumption and heat output vary with the number and type of optional features installed and the power-management optional features in use.	

Notes for 2461 HMC Tower (FC 0062):

- When installing the chassis, ensure that a minimum free air space is available around the system. The installation should have a minimum of 4 in - 6 in (101 mm -152 mm) behind the chassis and 7 in - 8 in (178 mm - 203 mm) in front of the chassis. Any front cabinet doors or access aisles must accommodate a 2461 HMC Tower (FC 0062) front chassis clearance of at least 7.0 in (178 mm) in order to provide proper clearance for the fan FRU. Ideally, a chassis clearance of 0.5 in - 1.5 in (13 mm -38 mm) above the system is desirable.

- The 2461 HMC Tower (FC 0062) are designed with ruggedness in mind, however, precautions should be observed to ensure safe and reliable performance. Place the chassis on a flat, stable surface capable of supporting both the system weight and any anticipated peripherals. Installation area should be secure and free from danger of liquid or airborne contaminants that could damage internal components as well as supporting all airflow requirements.

- To protect internal components from electrostatic damage, be sure to observe the following precautions when handling or storing the system:

  - The 2461 HMC Tower (FC 0062) has a net chassis weight of approximately 41.0 lbs. (18.59 kg). Use proper lifting techniques when moving and installing the system.
    CAUTION:

     or *or*

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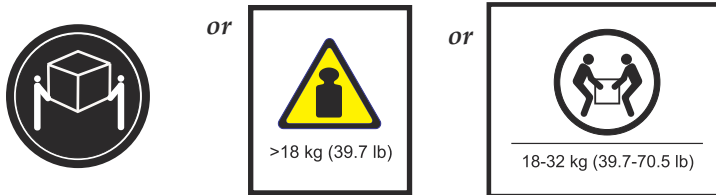
    The weight of this part or unit is between 18 and 32 kg (39.7 and 70.5 lb). It takes two persons to safely lift this part or unit.   (C009)

  - When removing or installing boards and sub-components, keep these components in their static-shielded bag and/or packaging until you are ready to for component installation.

  - Handle the sub-components by their edges.

  - Do not touch any sub-component I/O connector pins. Do not apply pressure or attach labels to the board-level subcomponents.

  - Use a personal grounding system, such as a wrist or heel strap(s) or ground yourself frequently by touching the metal chassis of the system before handling any subcomponents.

  - Ensure the systems external power source has a solid connection to an earth ground.

  - Use antistatic padding on all work surfaces when installing or removing subcomponents.

  - Avoid static-inducing carpeted areas.

Table 39. 2461 Hardware Management Console Tower (FC 0062) specifications

CPU:	Environment:	Electrical input:

• 3.3 GHz Intel Xeon E3-1225 v5
• 3.8 GHz Intel Xeon E3-1275 v6
  (Hardware Management
  Appliance only)
 	
Memory:
• Minimum: 32 GB (HMC), 64
  GB (Hardware Management
  Appliance)
• Maximum: 32 GB (HMC), 64
  GB (Hardware Management
  Appliance)
• Type: DDR4, ECC
• Slots: 4
• Supports: 32 GB (HMC), 64
  GB (Hardware Management
  Appliance)
 	
Hard drive:
• 2 TB SATA hard drive
 	
Video:
• AST2500
 	
Fans:
• Two side-removable hot-swap
  fans
 	
Power supply:
• One 900-watt AC
 	
Integrated function:
• Six Intel l350 Ethernet ports
• Two Intel l210 management
  Ethernet port
• Eight USB ports (USB 2.0 and
  USB 3.0)
	Operating:
	• Temperature: 0ºC - 40ºC
	  (32ºF - 104ºF)
	• Altitude: 3050 m (~10,000 ft)
	• Relative humidity: 5% - 90% @
	  -12ºC (10.4ºF) dew point, non-
	  condensing
	
	Storage (non-operating):
	• Temperature: -40ºC - 70ºC
	  (-40ºF - 158ºF)
	• Relative humidity: 5% - 100%
	
	Air flow:
	• 350LFM continuous airflow
	
	Size:
	• Height: 439.2 mm (17.29 in)
	• Depth: 492.25 mm (19.38 in)
	• Width: 215.9 mm (8.5 in)
	• Weight: approximately 18.59
	  kg (41.0 lb)
		• Sine-wave input (47-63 Hz)
		  required
		• Input voltage low range:
		  – 90 Vrms - 137 Vrms
		    (tolerance range)
		  – 100 V AC - 127 V AC
		    (nominal range)
		• Input voltage high range:
		  – 180 Vrms - 265 Vrms
		    (tolerance range)
		  – 200 V AC - 240 V AC
		    (nominal range)
		• Input kilovolt-amperes (kVA),
		  approximately:
		  – Minimum: 0.134 kVA
		  – Maximum: 0.988 kVA

Notes for 1U KMM (keyboard, monitor, mouse) console unit:

The 1U KMM (keyboard, monitor, mouse) console units include:

> **FC 0148** (for the 2461 HMC Tower unit)
> **FC 0154** (for the 2461 HMC Rack Mounted unit)
>
> **FC 0157** (for the 2461 TKE Tower unit)
> **FC 0156** (for the 2461 TKE Rack Mounted unit)

- The following are recommendations for placement of the KMM unit into the customer supplied rack:
  - If you are standing when using the KMM unit, place the unit in EIU locations 21, 22, or 23.
  - If you are sitting when using the KMM unit, place the unit in EIU locations 12, 13, or 14.
  - For special accommodations, you need to make adjustments in the placement of the KMM unit in the rack that meet your needs.
- For USA and Canada, the KMM unit uses one PDU plug position for the AC power supply in the KMM. (Other power requirements are country dependent.)
- **Elevated operating ambient** - If installed in a closed or multi-unit rack assembly, the operating ambient temperature of the rack environment might be greater than room ambient. Therefore, consideration should be given to installing the equipment in an environment compatible with the maximum ambient temperature (Tma) specified by the manufacturer.
- **Reduced air flow** - Installation of the equipment in a rack should be such that the amount of air flow required for safe operation of the equipment is not compromised.
- **Mechanical loading** - Mounting of the equipment in the rack should be such that a hazardous condition is not achieved due to uneven mechanical loading.
- **Circuit overloading** - Consideration should be given to the connection of the equipment to the supply circuit and the effect that overloading of the circuits might have on overcurrent protection and supply wiring. Appropriate consideration of equipment nameplate ratings should be used when addressing this concern.
- **Reliable earthing** - Reliable earthing of rack-mounted equipment should be maintained. Particular attention should be given to supply connections other than direct connections to the branch circuit (for example, use of power strips).

Table 40. 1U KMM (keyboard, monitor, mouse) console unit specifications

1U KMM console unit specifications (FC 0148 - 2461 HMC Tower unit) (FC 0154 - 2461 HMC Rack Mounted unit) (FC 0157 - 2461 TKE Tower unit) (FC 0156 - 2461 TKE Rack Mounted unit)	
Dimensions	
Height	45 mm (1.75 in) (in stored position)
Width	440 mm (17.3 in) (main chassis only, slide-rails not included)
Depth	440 mm (17.3 in) (chassis only, bezel in front not included, cable-management arm not included)
Weight	(11 lb) - Console Unit (25 lb) - Console Option Kit
LCD panel	
Size	17.3 inch diagonal
Display area (horizontal x vertical)	381.99 mm x 214.91 mm
Type	TFT active matrix
Pixel pitch (horizontal x vertical)	0.1989 (H) x 0.1989 (V) mm
Input Power	
Input voltage	AC - 100-240 VAC - 1 A (nominal range)
Input frequency range	50-60 Hz
Power Consumption	
Standard usage	9 watts
Maximum	11 watts
Power supply maximum	36 watts
Power saving	< 1 watt (at 100 VAC and 240 VAC)
Environmental - Temperature	
Operating	0° to 50° C (32° to 122° F)
Storage	-20° to 60° C (-4° to 140° F)
Environmental - Humidity	
Operating	20% to 90%
Storage	10% to 90%
Environmental - Altitude	
Operating	Maximum 5000 meters
Storage	Maximum 5000 meters

Appendix C. Top Exit cabling and Bottom Exit cabling specifications

On a raised floor, you can route power cables and I/O cables through the top of the frame **and** through the bottom of the frame. On a non-raised floor, you can route power cables and I/O cables through the top of the frame.

-
-

Top Exit Cabling specifications

For top exit cabling, you can use one of the following options:

- Top Exit cabling feature *with* top hat (**FC 7802**)
- Top Exit cabling feature *without* top hat (**FC 7803**)

Top Exit Cabling with top hat (FC 7802):

Cables can exit from the front of the top exit cabling enclosure (top hat) or the rear, depending on how you installed the top exit cabling enclosure. The cable retainer bracket (P/N 01PP055) must be attached to the top exit cabling enclosure at the location (front or rear) from which you want the cables to exit.

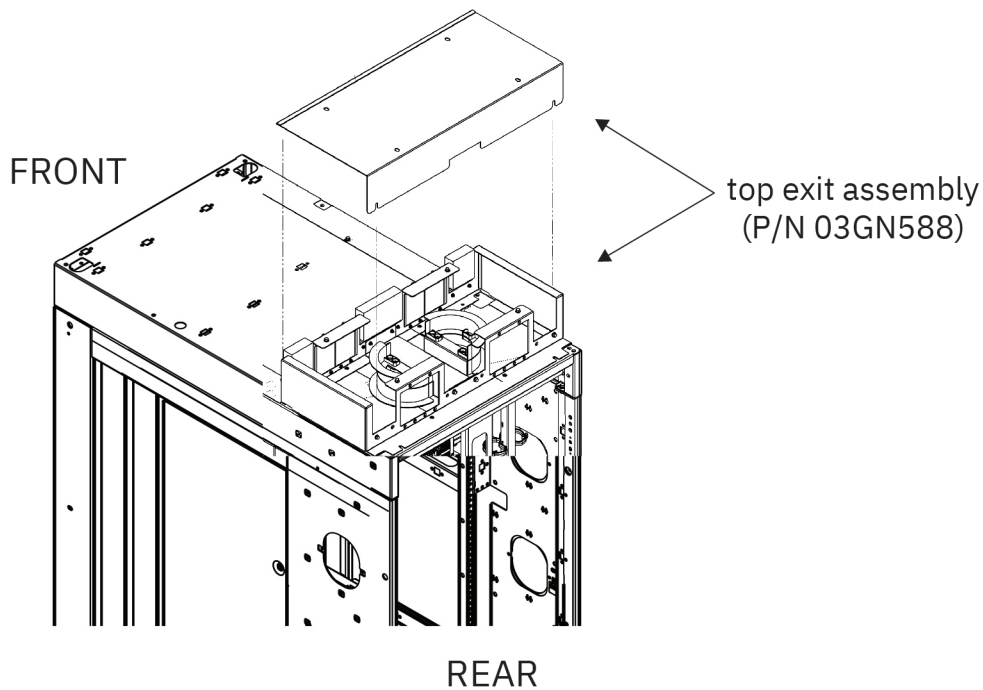Figure 29 on page 152 shows the cables exiting toward the front of the frame.

Figure 29. Top exit cabling feature - cables exiting to the front

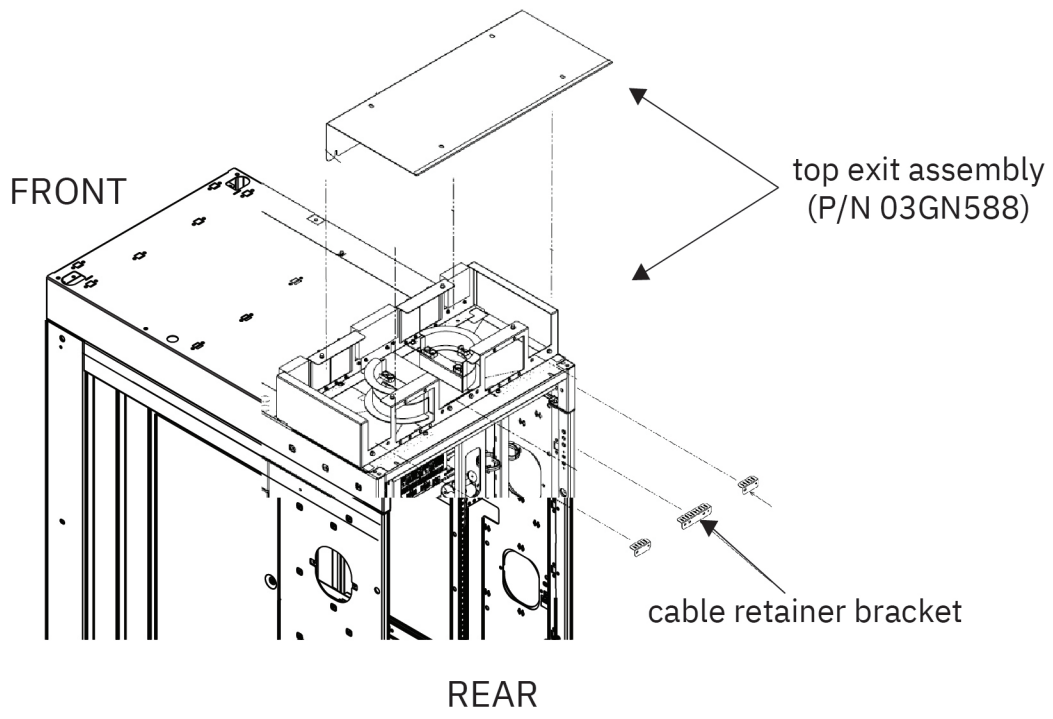Figure 30 on page 153 shows the cables exiting toward the rear of the frame.

FRONT

top exit assembly
(P/N 03GN588)

cable retainer bracket

REAR

Figure 30. Top exit cabling feature - cables exiting to the rear
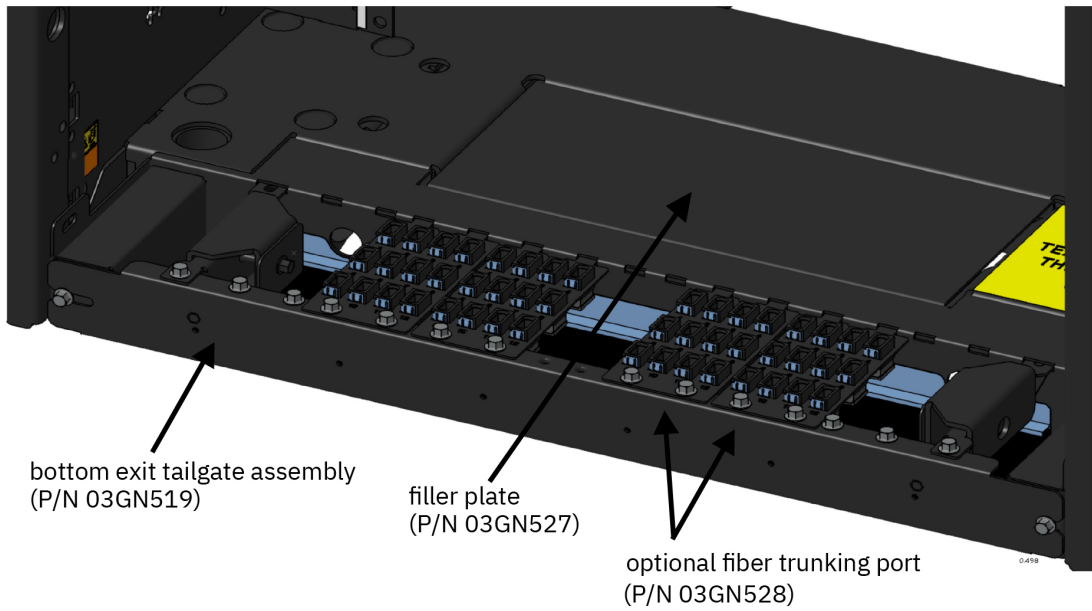
Top Exit Cabling without top hat (FC 7803):

When routing cables directly through the top of the frame, there are two slider plates on the top of the frame (one on each side of the rear of the frame) that can be slid opened partially and any gaps can be eliminated with self-sticking foam. This foam is included in the system ship group.

FRONT

slider plates

REAR
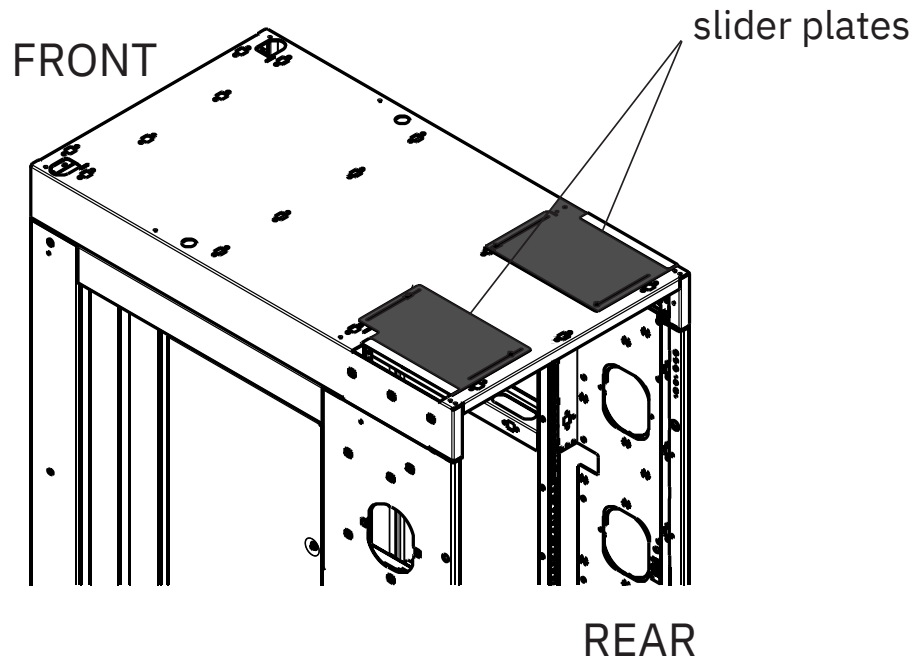
Bottom Exit Cabling specifications

For bottom exit cabling, you must use the Bottom Exit Cabling feature (**FC 7804**).

bottom exit tailgate assembly
(P/N 03GN519)

filler plate
(P/N 03GN527)

optional fiber trunking port
(P/N 03GN528)

Appendix D. Dual power installation

3932 is designed with a fully redundant PDU power system. Each computer has 2 or 4 line cords attached to 2 or 4 power input ports which, in turn, powers a fully redundant power distribution system within the computer.

The system line cords should be connected to the installation site's distribution panels accordingly, in which system availability is optimized.

The minimum recommended redundant connection requires the line cords from **odd** numbered PDU's (such as **PDU-A1** and **PDU-A3**), to be attached to a customer distribution power panel(s) that is *independent* of the customer distribution power panel(s) to which the line cords from **even** numbered PDU's (such as **PDU-A2** and **PDU-A4**), are attached.

This method of connection can prevent a system outage from occurring, caused by the loss of a power distribution panel or the tripping of an upstream breaker that is powering that distribution panel. Additional redundancy, such as independent switchgear, feed transformers, or power substations, can further improve the system's resistance to power outages.

The following figures show the recommended PDU power connections for 3932.

⚠️ **Attention:** Note that the line cords can exit the system from the top or bottom; top exit cabling is shown for illustrative purposes only.
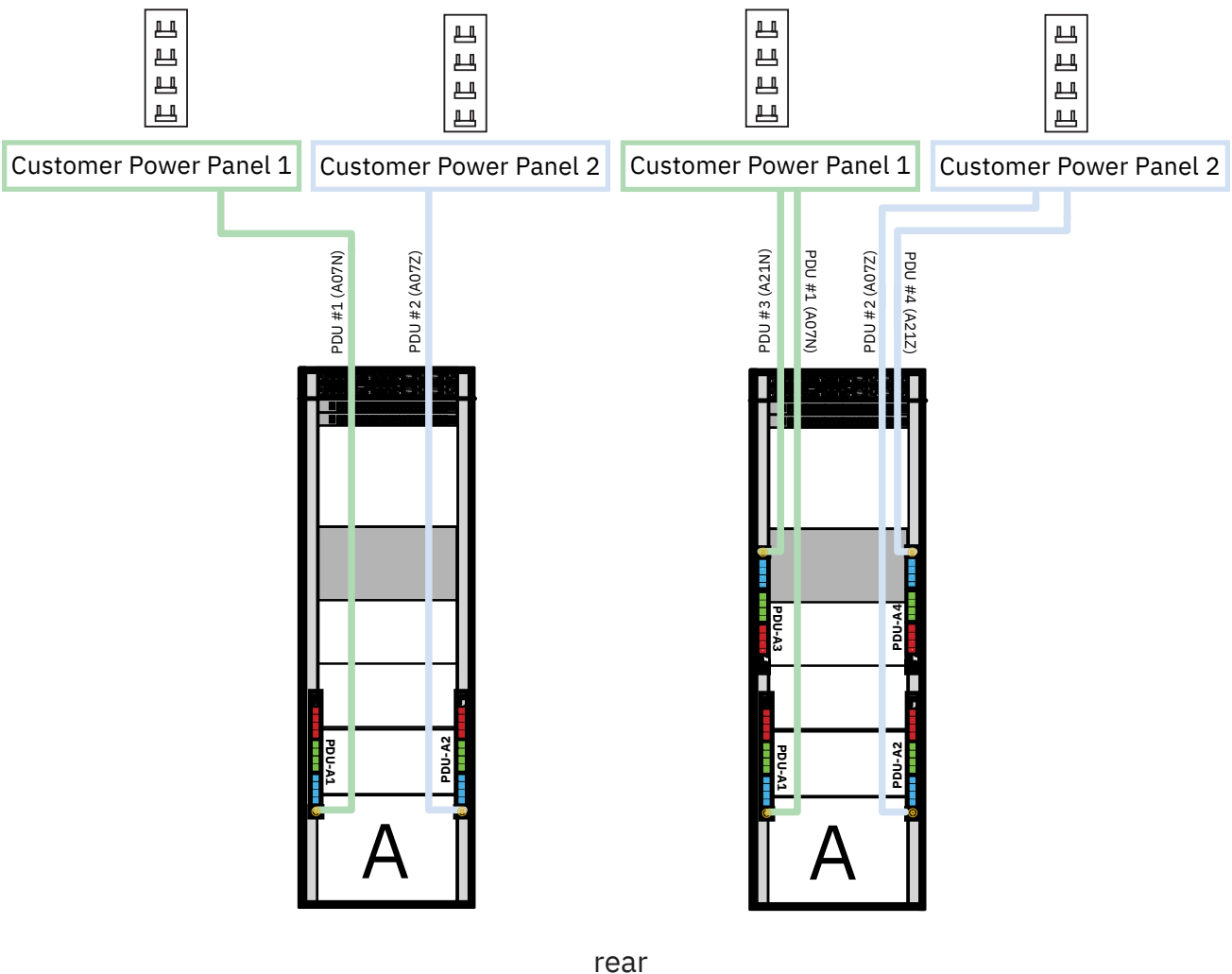

rear

Figure 31. A frame - PDU

Appendix E. Notices

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This product has been tested and found to comply with the limits for Class A Information Technology Equipment according to European Standard EN 55032. The limits for Class A equipment were derived for commercial and industrial environments to provide reasonable protection against interference with licensed communication equipment.

European Community contact:
IBM Deutschland GmbH
Technical Regulations, Department M372
IBM-Allee 1, 71139 Ehningen, Germany
Tele: +49 (0) 800 225 5423 or +49 (0) 180 331 3233
email: halloibm@de.ibm.com

Warning: This is a Class A product. In a domestic environment, this product may cause radio interference, in which case the user may be required to take adequate measures.

Japan Voluntary Control Council for Interference (VCCI) Notice

　この装置は、クラスＡ機器です。 この装置を住宅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

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要領に基づく定格入力電力値：IBM Documentation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

These statements apply to products greater than 20 A, single-phase.

高調波電流規格　JIS C 61000-3-2 準用品

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回路分類：6（単相、ＰＦＣ回路付）
換算係数：0

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高調波電流規格　JIS C 61000-3-2 準用品

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回路分類　：5（3相、ＰＦＣ回路付）
換算係数　：0

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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-Mitgliedsstaaten und hält die Grenzwerte der 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 EG 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.

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Generelle Informationen:

Das Gerät erfüllt die Schutzanforderungen nach EN 55024 und EN 55032 Klasse A.

Electromagnetic Interference (EMI) Statement - Russia

ВНИМАНИЕ! Настоящее изделие относится к классу А.
В жилых помещениях оно может создавать радиопомехи, для
снижения которых необходимы дополнительные меры

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