

IBM

*3931 Installation Manual for Physical  
Planning*

Level 00e



**Note:**

Before you use this information and the product it supports, read the information in “[Safety](#)” on page vii, Appendix E, “[Notices](#),” on page 205, and *IBM Systems Environmental Notices and User Guide*, Z125-5823.

This edition, GC28-7015-00e, applies to IBM z16 (Model A01) and IBM LinuxONE Emperor 4 (Model LA1). This edition replaces GC28-7015-00d.

There might be a newer version of this document in a **PDF** file available on **IBM Documentation**.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.

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# Safety

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## Safety notices

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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

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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: 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)**

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



## About this publication

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This publication contains information necessary for the planning of the physical installation of the 3931 system.

Unless otherwise stated, throughout this document "3931" refers to the IBM z16™ Model A01 or LinuxONE Emperor 4 Model LA.

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

## What is included in this publication

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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 31 gives plan views, service clearances, weight distribution, and cooling information for the system.
- Chapter 4, “Guide for raised floor preparation,” on page 85 contains information on preparation of the raised floor.
- Chapter 5, “Power requirements,” on page 93 provides power and line cord information.
- Chapter 6, “Hardware Management Console and Support Element communications,” on page 121 includes information on Hardware Management Console and Support Element communications.
- Chapter 7, “Remote Support Facility (RSF) installation planning,” on page 133 contains Remote Support Facility installation planning.
- Chapter 8, “I/O cabling and connectivity,” on page 137 discusses cable connectivity information.
- Chapter 9, “Parallel sysplex planning,” on page 169 provides information about operating in a Parallel Sysplex® environment.
- The appendices provide standard symbols, cabling specifications, power cabling schematic, and TKE/HMC physical specifications.
  - Appendix A, “IBM standard symbols,” on page 173
  - Appendix B, “Top Exit cabling and Bottom Exit cabling specifications,” on page 175
  - Appendix C, “Dual "facilities power distribution" installation,” on page 181
  - Appendix D, “HMA, HMC, and TKE physical specifications,” on page 197

## Related publications

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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.

- *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
- *IBM Z 3931 External Cabling Best Practices* (<https://www.ibm.com/servers/resourcelink/lib03011.nsf/pages/3931ExternalCablingBestPractices?OpenDocument>)

## Related HMC and SE console information

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

## Licensed Machine Code

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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 3931 and is copyrighted and licensed by IBM. Each 3931 is delivered with Licensed Machine Code that is customized to the specific machine ordered. The Licensed Machine Code enables the 3931 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 3931 requires that the Licensed Machine Code be reinstalled in the server at the new location. See the "Discontinuing the System" section in the *3931 Installation Manual* for the procedure about relocating a 3931.

## Accessibility features

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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

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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 A01	<a href="https://www.ibm.com/docs/en/systems-hardware/zsystems/Z16M-A01?topic=how-send-feedback">https://www.ibm.com/docs/en/systems-hardware/zsystems/Z16M-A01?topic=how-send-feedback</a>
IBM LinuxONE Rockhopper 4 Model LA1	<a href="https://www.ibm.com/docs/en/systems-hardware/linuxone/3931-LA1?topic=how-send-feedback">https://www.ibm.com/docs/en/systems-hardware/linuxone/3931-LA1?topic=how-send-feedback</a>

## Revisions

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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 *3931 Installation Manual for Physical Planning*, GC28-7015.


Table 1. Summary of changes	
Release level	Changes in level
00e	<p>This revision contains editorial changes and the following technical changes:</p> <ul style="list-style-type: none"> <li>• Note regarding nominal dimensions added to “System planning” on page 1, Chapter 3, “Models and physical specifications,” on page 31, and Appendix D, “HMA, HMC, and TKE physical specifications,” on page 197.</li> <li>• Clarification regarding floor loading calculations provided in “Floor loading examples” on page 58.</li> <li>• Corrected information and new line cord feature information added in “Supported power cords (PDU)” on page 100 and “Line cord wire specifications (PDU)” on page 105.</li> <li>• Important note added to “Grounding specifications” on page 118.</li> <li>• Updated figures provided for clarification in “Ethernet network connection requirements” on page 124.</li> <li>• Power cord requirements for “Trusted Key Entry (TKE)” on page 128 features added to “Power requirements” on page 130.</li> <li>• Corrected information in “Integrated Coupling Adapter (ICA) SR feature” on page 149 and “Coupling Express2 LR feature (FC 0434)” on page 151.</li> <li>• Corrected information regarding subnets in “External Time Source” on page 159.</li> <li>• Dual power installation diagrams for PDU power updated in Appendix C, “Dual facilities power distribution” installation,” on page 181.</li> </ul>
00d	<p>This revision contains editorial changes and the following technical changes:</p> <ul style="list-style-type: none"> <li>• Caution notice <b>C052</b> added to “Safety notices” on page vii.</li> <li>• New topic, “System planning videos” on page 2, is added to provide walk-through assistance with power planning for system.</li> <li>• Acoustical noise emission levels updated and added in “Acoustics” on page 26.</li> <li>• New IPv4 and IPv6 addresses added to “Server address lists and host names” on page 136.</li> <li>• Correction made and clarification provided in “External Time Source” on page 159.</li> </ul>
00c	<p>This revision contains editorial changes and the following technical changes:</p> <ul style="list-style-type: none"> <li>• Information for the <i>IBM LinuxONE Emperor 4 Model LA1</i> system is available.</li> </ul> <p> <b>Attention:</b> Unless otherwise stated, the “3931” refers to <u>both</u> the IBM LinuxONE Emperor 4 Model LA1 <b>and</b> IBM z16 Model A01.</p>
00b	<p>This revision contains editorial changes and the following technical changes:</p> <ul style="list-style-type: none"> <li>• Availability date for Bulk Power Assembly (BPA) feature updates, 4Q 2022.</li> <li>• System packaging specifications updated in “Shipping and packaging specifications” on page 37.</li> <li>• Floor loading clarification provided in “Floor loading examples” on page 58.</li> <li>• Further clarification provided in “External Time Source” on page 159.</li> </ul>

Table 1. Summary of changes (continued)

Release level	Changes in level
00a	<p>This revision contains editorial changes and the following technical changes:</p> <ul style="list-style-type: none"> <li>• ASHRAE information updated in <a href="#">“ASHRAE declaration”</a> on page 13.</li> <li>• Acoustical noise emission levels updated in <a href="#">“Acoustics”</a> on page 26.</li> <li>• Information for Bulk Power Assembly (BPA) feature, <i>available September 2022</i>, added to the following: <ul style="list-style-type: none"> <li>– <a href="#">Chapter 3, “Models and physical specifications,”</a> on page 31</li> <li>– <a href="#">Chapter 5, “Power requirements,”</a> on page 93</li> <li>– <a href="#">“Bulk Power Assembly (BPA) power”</a> on page 107</li> <li>– <a href="#">Appendix C, “Dual “facilities power distribution” installation,”</a> on page 181</li> </ul> </li> <li>• Ethernet Switch assignments (Figure 26 on page 126) added to <a href="#">“Ethernet network connection requirements”</a> on page 124.</li> <li>• Clarification provided in <a href="#">“Planning to load images to a system from a network (electronic code load)”</a> on page 131.</li> <li>• Clarification provided in <a href="#">“External Time Source”</a> on page 159.</li> <li>• Appendix D, <a href="#">“HMA, HMC, and TKE physical specifications,”</a> on page 197 added to provide reference to HMA, HMC, and TKE physical specifications.</li> </ul>

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# Chapter 1. Introduction

This chapter is intended to help you prepare your physical site for the installation of an 3931. 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 3931.

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## 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 3931 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 3931 server are *significantly* different from previous 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 3
- **Technical 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 *IBM Z 3931 External Cabling Best Practices* (<https://www.ibm.com/servers/resourcelink/lib03011.nsf/pages/3931ExternalCablingBestPractices?OpenDocument>) available on Resource Link.

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 Z system, then click **Visio® files**.

**Note:** All dimensions are considered nominal.

## System planning videos

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Review the referenced walk-through videos to familiarize yourself with the power planning requirements of the system.

### **Part 1 - *Getting started***

[Video Link](#)

### **Part 2 - *Pre-sales considerations***

[Video Link](#)

### **Part 3 - *Before your system arrives***

[Video Link](#)

## Site planning checklist

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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 137](#)
  - [“IBM Site and Facilities” on page 138](#)
- \_\_ 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 Z 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 Z 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 Z 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 137 and “IBM Site and Facilities” on page 138. 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 78.](#)
- \_\_ 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 *IBM Z 3931 External Cabling Best Practices* (<https://www.ibm.com/servers/resourcelink/lib03011.nsf/pages/3931ExternalCablingBestPractices?OpenDocument>) available on Resource Link.
  - \_\_ • 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 3931.

**CAUTION:** Servicing of this product or unit is to be performed by trained service personnel only. (C032)
- \_\_ 4. Complete the **Technical 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 3931.

**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 *IBM Z 3931 External Cabling Best Practices* (<https://www.ibm.com/servers/resourcelink/lib03011.nsf/pages/3931ExternalCablingBestPractices?OpenDocument>) available on Resource Link.

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. Move unit(s) to installation location.
- \_\_ 2. Place the unit(s) according to the machine clearance dimensions provided in [“Machine and service clearance areas”](#) on page 78.
- \_\_ 3. Unpack unit(s) according to the provided instructions.
- \_\_ 4. Call your service provider to install the unit(s).

## Customized planning aid

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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.

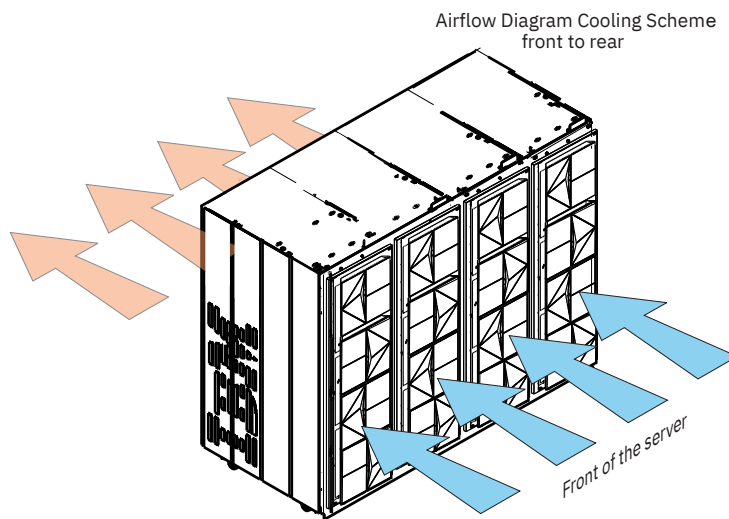
# ASHRAE declaration

## ASHRAE Declarations (Metric) for 3931



ASHRAE Class A3 Description	Typical Heat Release	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 3931 1 CPC drawer (FC 0667)	3.6	1362	2484	479	62.4 x 120.8 x 202	3048 <small>(dry bulb &lt;28°C)</small>	40 <small>(altitude &lt;914 m) (RH &lt;40%)</small>	24
Maximum Configuration MT 3931 4 CPC drawers (FC 0670 or 0671)	24	7459	14644	2666	249.6 x 120.8 x 202	3048 <small>(dry bulb &lt;28°C)</small>	40 <small>(altitude &lt;914 m) (RH &lt;40%)</small>	24

## ASHRAE Declarations (English) for 3931

ASHRAE Class A3 Description	Typical Heat Release	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 3931 1 CPC drawer (FC 0667)	12.3	802	1462	1056	24.6 x 47.6 x 79.5	10,000 <small>(dry bulb &lt;82°F)</small>	104 <small>(altitude &lt;3000 ft) (RH &lt;40%)</small>	75.2
Maximum Configuration MT 3931 4 CPC drawers (FC 0670 or 0671)	81.9	4390	9846	5879	98.4 x 47.6 x 79.5	10,000 <small>(dry bulb &lt;82°F)</small>	104 <small>(altitude &lt;3000 ft) (RH &lt;40%)</small>	75.2



**Notes:**

1. Airflow is designed to increase as the local ambient room temperature and/or altitude increases. Minimum airflow assumes an ambient temperature below 23° C (73° F) and altitude below 500 m (1650 ft). Nominal airflow assumes an ambient temperature of 25° C (77° F) and an altitude below 500 m (1650 ft). Maximum airflow is based on an ambient temperature of 40° C (104° F) or an altitude of 914 m (3000 ft).
2. Weights provided assume the following:
  - Optional Earthquake Kit (FC 8014 or 8015) is **not** installed
  - Optional balanced power plan-ahead (FC 3003) is **not** installed.
3. Dimensions do not include top exit cabling feature (FC 7898)
4. For ambient temperatures exceeding 25° C (77° 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.
5. Maximum ambient reduces 1° C (1.8° F) for every 175 m (574 ft) over 900 m (2953 ft). At 3048 m (10,000 ft), maximum allowable ambient temperature is 28° C (82° 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.



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## Chapter 2. Environmental specifications

The 3931 is among the most powerful group of mainframe processors ever built. Technology improvements have placed the 3931 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 3931 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 3931 offers.

The 3931 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 3931. It is strongly suggested that you strive for a long-term operating environment within the recommended specification range. The powerful computing the 3931 provides generates a great deal of heat that must be removed from 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:

<i>Table 2. Environmental specifications - table format</i>		
<b>Environment, Operating: <sup>9</sup></b>		
	<b>Recommended <sup>1,6</sup></b>	<b>Allowable <sup>2,3,4,5,6</sup></b>
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 <sup>7,8</sup>	
Particulate contamination	Cleanliness level of ISO 14644-1 Class 8 <sup>8</sup>	
<b>Allowable environment, Non-operating: <sup>10</sup></b>		
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 <sup>7,8</sup>	
<b>Environment, shipping: <sup>9</sup></b>		
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 for world trade locations. Domestic US locations will ship on casters with IBM-approved packaging	
<b>Environment, storage: <sup>11</sup></b>		
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 for world trade locations. Domestic US locations will ship on casters with IBM-approved packaging	

**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 [Figure 1 on page 18](#) 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.
  - d. During maintenance on any hardware, a properly tested and functioning wrist strap must be used by any personnel who contacts the system.
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.

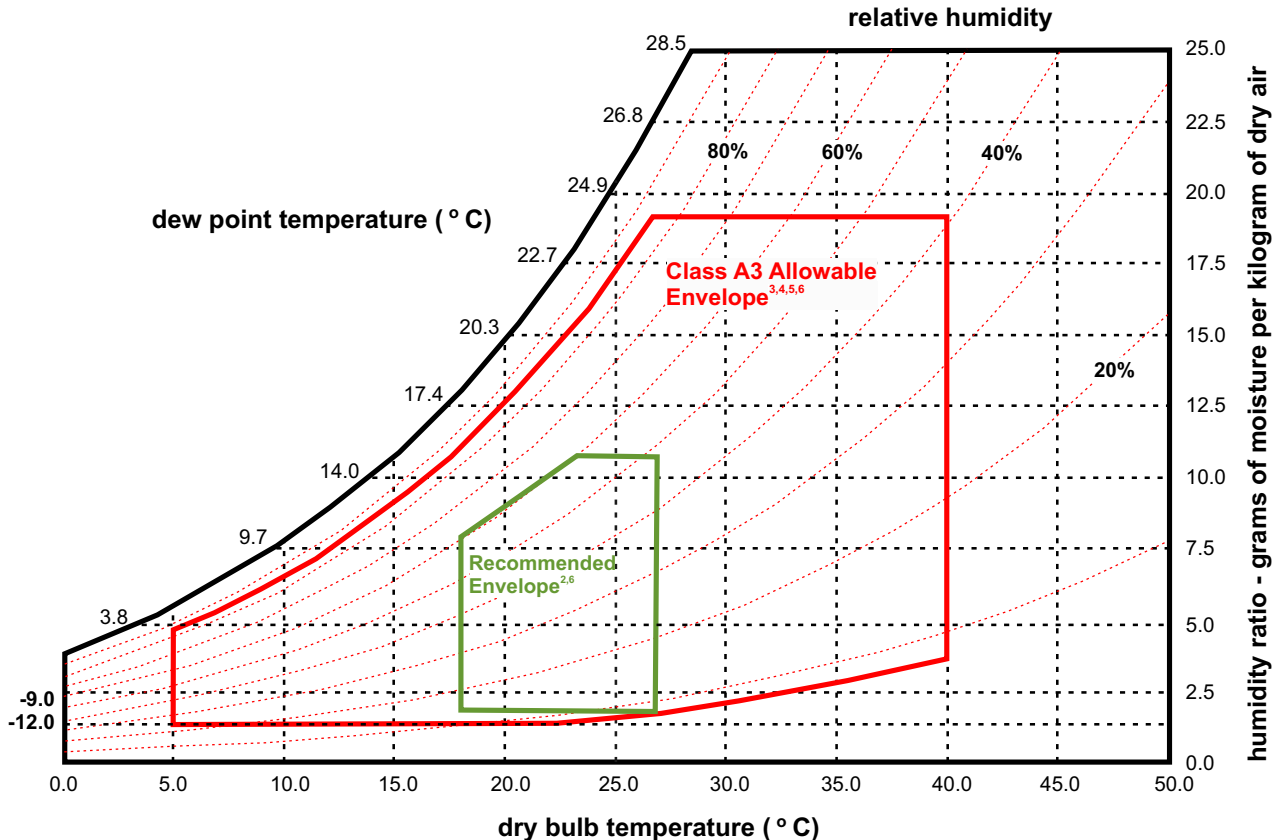


Figure 1. Environmental operating specifications - line graph format

**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.

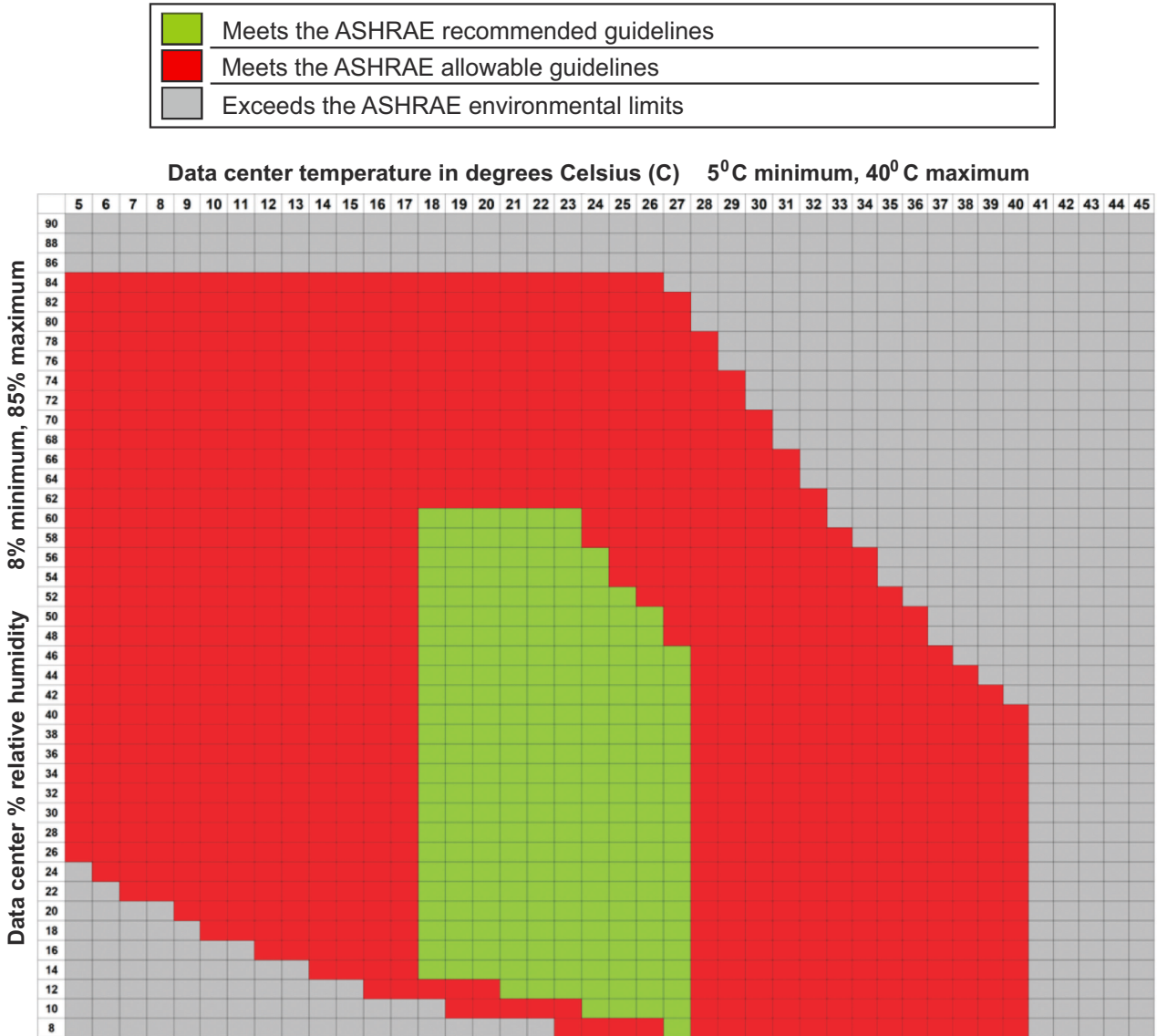


Figure 2. Environmental operating specifications - bar graph format

**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 3931.** Ideally, it would be best if the temperature and humidity controls are good enough to surround the service area of the 3931.

## System acclimation

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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 15°C (59°F). 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 both 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 (-40°C / -40°F to -20°C / -4°F)

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 (-20°C / -4°F to 0°C / 32°F)

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 (0°C / 32°F to 15°C / 59°F). 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 (15°C / 59°F 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 may 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 3931 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 3931 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 3931, there may be a provision of repair or replacement of 3931 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 <sup>1</sup> which states that the reactivity rate of copper coupons shall be less than 300 Angstroms per month ( $\text{\AA}/\text{month}$ , $\sim 0.0039 \mu\text{g}/\text{cm}^2\text{-hour}$ weight gain). <sup>2</sup> In addition, the reactivity rate of silver coupons shall be less than 200 $\text{\AA}/\text{month}$ ( $\sim 0.0035 \mu\text{g}/\text{cm}^2\text{-hour}$ weight gain). <sup>3</sup> 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	<p>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:</p> <ul style="list-style-type: none"> <li>• 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.</li> <li>• 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.</li> </ul> <p>The deliquescent relative humidity of the particulate contamination should be more than 60% RH.<sup>4</sup></p> <p>Datacenters must be free of zinc whiskers.<sup>5</sup></p>

**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<sub>2</sub>S and Cu<sub>2</sub>O 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<sub>2</sub>S 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. 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 3931.

### Acoustical noise emission levels

<i>Table 9. Acoustical noise emissions for the 3931</i>						
Declared noise emission values in accordance with ISO 9296 <sup>(1-8)</sup>						
Product description M/T 3931 Models A01 and LA1	Declared mean A-weighted sound power level $L_{WA,m}$ (B)		Declared mean A-weighted emission sound pressure level $L_{pA,m}$ (dB) ----- <i>bystander</i> ----- <i>front</i> ----- <i>rear</i>		Statistical adder for verification $K_v$ (B)	
	Operating	Idling	Operating	Idling	Operating	Idling
<ul style="list-style-type: none"> <li>• <b>Typical Configuration:</b> Two frames, two processor drawers, five PCIe+ I/O drawers, one radiator cooling unit, two Support Elements, and power distribution units</li> <li>• Typical workload</li> <li>• 23 °C, 500 m environment</li> </ul>	7.3 <sup>(9)</sup>	7.3 <sup>(9)</sup>	58 ----- 77 ----- 69	58 ----- 77 ----- 69	0.3	0.3
<ul style="list-style-type: none"> <li>• <b>Typical Configuration:</b> Two frames, two processor drawers, five PCIe+ I/O drawers, one radiator cooling unit, two Support Elements, and power distribution units</li> <li>• Typical workload</li> <li>• 25 °C, 500 m environment</li> </ul>	7.5 <sup>(9)</sup>	7.5 <sup>(9)</sup>	60 ----- 78 ----- 70	60 ----- 78 ----- 70	0.3	0.3
<ul style="list-style-type: none"> <li>• <b>Typical Configuration:</b> Two frames, two processor drawers, five PCIe+ I/O drawers, one radiator cooling unit, two Support Elements, and a bulk power assembly</li> <li>• Typical workload</li> <li>• 25 °C, 500 m environment</li> </ul>	7.8 <sup>(10)</sup>	7.8 <sup>(10)</sup>	64 ----- 78 ----- 73	64 ----- 78 ----- 73	0.3	0.3

Table 9. Acoustical noise emissions for the 3931 (continued)

Declared noise emission values in accordance with ISO 9296 (1-8)						
Product description M/T 3931 Models A01 and LA1	Declared mean A-weighted sound power level $L_{WA,m}$ (B)		Declared mean A-weighted emission sound pressure level $L_{pA,m}$ (dB) ----- <i>bystander</i> ----- <i>front</i> ----- <i>rear</i>		Statistical adder for verification $K_V$ (B)	
	Operating	Idling	Operating	Idling	Operating	Idling
<ul style="list-style-type: none"> <li>• <b>Maximum Configuration:</b> Four frames, four processor drawers, 12 PCIe+ I/O drawers, two radiator cooling units, two Support Elements, and power distribution units</li> <li>• Typical workload</li> <li>• 25 °C, 500 m environment</li> </ul>	7.9 <sup>(10)</sup>	7.9 <sup>(10)</sup>	63 ----- 80 ----- 72	63 ----- 80 ----- 72	0.3	0.3
<ul style="list-style-type: none"> <li>• <b>Maximum Configuration:</b> Four frames, four processor drawers, 10 PCIe+ I/O drawers, two radiator cooling units, two Support Elements, and two bulk power assemblies</li> <li>• Typical workload</li> <li>• 25 °C, 500 m environment</li> </ul>	8.1 <sup>(10)</sup>	8.1 <sup>(10)</sup>	66 ----- 80 ----- 75	66 ----- 80 ----- 75	0.3	0.3
<ul style="list-style-type: none"> <li>• <b>Maximum Configuration:</b> Four frames, four processor drawers, 12 PCIe+ I/O drawers, two radiator cooling units, two Support Elements, and power distribution units</li> <li>• Typical workload</li> <li>• 27 °C, 500 m environment</li> </ul>	8.0 <sup>(10)</sup>	8.0 <sup>(10)</sup>	65 ----- 81 ----- 74	65 ----- 81 ----- 74	0.3	0.3
<ul style="list-style-type: none"> <li>• <b>Typical Configuration:</b> Two frames, two processor drawers, five PCIe+ I/O drawers, one radiator cooling unit, two Support Elements, and power distribution units</li> <li>• Maximum workload</li> <li>• 45 °C, 914 m environment</li> </ul>	9.1	9.1	76 ----- 93 ----- 85	76 ----- 93 ----- 85	0.3	0.3

Table 9. Acoustical noise emissions for the 3931 (continued)

Declared noise emission values in accordance with ISO 9296 (1-8)						
Product description M/T 3931 Models A01 and LA1	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
<ul style="list-style-type: none"> <li>• <b>Maximum Configuration:</b> Four frames, four processor drawers, 12 PCIe+ I/O drawers, two radiator cooling units, two Support Elements, and power distribution units</li> <li>• Maximum workload</li> <li>• 45 °C, 914 m environment</li> </ul>	9.5	9.5	79 ----- 95 ----- 87	79 ----- 95 ----- 87	0.3	0.3
<ul style="list-style-type: none"> <li>• <b>Maximum Configuration:</b> Four frames, four processor drawers, 10 PCIe+ I/O drawers, two radiator cooling units, two Support Elements, and two bulk power assemblies</li> <li>• Maximum workload</li> <li>• 45 °C, 914 m environment</li> </ul>	9.4	9.4	78 ----- 93 ----- 88	78 ----- 93 ----- 88	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  $L_{WA,d}$ ), 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 3931:

- 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 (Model A01) Four-frame model*

Facts about the 3931:

- **System configuration**

- The 3931 can be a 1, 2, 3, or 4 frame system depending on your configuration.
- The 3931 offers a choice of power; Power Distribution Unit (PDU) or Bulk Power Assembly (BPA). For more information, see [Chapter 5, “Power requirements,” on page 93.](#)



**Attention:** The BPA power feature will be available on 4Q 2022. IBM z16 is planned to be the last generation of IBM Z server to support BPA.

- The 3931 can be powered from an AC source only. HVDC power source is not supported.
- The 3931 is radiator-cooled.
- The 3931 can be installed on a *raised floor* or *non-raised floor*.

- **Cable management**

- For the 3931, 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 7899**). See [“Bottom Exit Cabling specifications” on page 179](#) for more information.
  - For top exit cabling, you can order one of the following features:
    - Top Exit cabling feature (**FC 7898**) - provides additional enclosure hardware for installation on the top of the frame(s).
    - Base Top Exit cabling feature (**FC 7816**) - provides no additional hardware; cables are routed directly through the top of the frame(s).

See [“Top Exit Cabling specifications” on page 176](#) 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, 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 *IBM Z 3931 External Cabling Best Practices* (<https://www.ibm.com/servers/resourceLink/lib03011.nsf/pages/3931ExternalCablingBestPractices?OpenDocument>) available on Resource Link.

- **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 69](#) 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.
- The frames are shipped as separate units, fastened together at install time.

The 3931, fully configured, can weigh in excess of 3225 kg (7111 lb). **Be certain that the raised floor on which you are going to install the server is capable of supporting this weight.**

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

- There are separate shipping containers for the covers for each frame.

**Important:** When an incline or ramp needs to be traversed during system transport, the angle of inclination must be less or equal to  $10^{\circ}$  degrees. Angles that are greater than  $10^{\circ}$  degrees, 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 7898)
- Height Reduction feature (FC 9975)

### Frame dimensions

#### Notes:

- For systems with two or more frames, there will be frame spacer hardware pre-installed on the system.
  - If the system is being installed on 609 mm (24 in) on-grid floor tiles, the frame spacers must *remain* installed.
  - If the system is being installed on 600 mm (23.6 in) on-grid floor tiles, the frame spacers must be *removed*.
- The installation of side covers is optional on the 3931.

*Table 10. A frame dimensions*

<b>A frame/cover combination</b>	<b>Width mm (in)</b>	<b>Depth mm (in)</b>	<b>Height mm (in)</b>
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)	1207 mm (47.5 in)	2023 mm (79.7 in)
Frame A w/ covers and top exit feature	624 mm (24.6 in)	1207 mm (47.5 in)	2139 mm (84.2 in)

*Table 11. A and Z frame dimensions*

<b>A and Z frame/cover combination</b>	<b>Width mm (in) w/o frame spacers</b>	<b>Width mm (in) w/ frame spacers</b>	<b>Depth mm (in)</b>	<b>Height mm (in)</b>
Frames w/o covers	1200 mm (47.2 in)	1209.5 mm (47.6 in)	1070 mm (42.1 in)	2016 mm (79.4 in)
Frames w/ covers	1224 mm (48.2 in)	1233.5 mm (48.6 in)	1207 mm (47.5 in)	2023 mm (79.7 in)
Frames w/ covers and top exit feature	1224 mm (48.2 in)	1233.5 mm (48.6 in)	1207 mm (47.5 in)	2139 mm (84.2 in)

*Table 12. A, C, and Z frame dimensions*

<b>A, C, and Z frame/cover combination</b>	<b>Width mm (in) w/o frame spacers</b>	<b>Width mm (in) w/ frame spacers</b>	<b>Depth mm (in)</b>	<b>Height mm (in)</b>
Frames w/o covers	1800 mm (70.8 in)	1819 mm (71.6 in)	1070 mm (42.1 in)	2016 mm (79.4 in)
Frames w/ covers	1824 mm (71.8 in)	1843 mm (72.6 in)	1207 mm (47.5 in)	2023 mm (79.7 in)

Table 12. A, C, and Z frame dimensions (continued)

<b>A, C, and Z frame/cover combination</b>	<b>Width mm (in) w/o frame spacers</b>	<b>Width mm (in) w/ frame spacers</b>	<b>Depth mm (in)</b>	<b>Height mm (in)</b>
Frames w/ covers and top exit feature	1824 mm (71.8 in)	1843 mm (72.6 in)	1207 mm (47.5 in)	2139 mm (84.2 in)

Table 13. A and B frame dimensions

<b>A and B frame/cover combination</b>	<b>Width mm (in) w/o frame spacers</b>	<b>Width mm (in) w/ frame spacers</b>	<b>Depth mm (in)</b>	<b>Height mm (in)</b>
Frames w/o covers	1200 mm (47.2 in)	1209.5 mm (47.6 in)	1070 mm (42.1 in)	2016 mm (79.4 in)
Frames w/ covers	1224 mm (48.2 in)	1233.5 mm (48.6 in)	1207 mm (47.5 in)	2023 mm (79.7 in)
Frames w/ covers and top exit feature	1224 mm (48.2 in)	1233.5 mm (48.6 in)	1207 mm (47.5 in)	2139 mm (84.2 in)

Table 14. A, B, and Z frame dimensions

<b>A, B, and Z frame/cover combination</b>	<b>Width mm (in) w/o frame spacers</b>	<b>Width mm (in) w/ frame spacers</b>	<b>Depth mm (in)</b>	<b>Height mm (in)</b>
Frames w/o covers	1800 mm (70.8 in)	1819 mm (71.6 in)	1070 mm (42.1 in)	2016 mm (79.4 in)
Frames w/ covers	1824 mm (71.8 in)	1843 mm (72.6 in)	1207 mm (47.5 in)	2023 mm (79.7 in)
Frames w/ covers and top exit feature	1824 mm (71.8 in)	1843 mm (72.6 in)	1207 mm (47.5 in)	2139 mm (84.2 in)

Table 15. A, B, C, and Z frame dimensions

<b>A, B, C and Z frame/cover combination</b>	<b>Width mm (in) w/o frame spacers</b>	<b>Width mm (in) w/ frame spacers</b>	<b>Depth mm (in)</b>	<b>Height mm (in)</b>
Frames w/o covers	2400 mm (94.4 in)	2428.5 mm (95.6 in)	1070 mm (42.1 in)	2016 mm (79.4 in)
Frames w/ covers	2424 mm (95.4 in)	2452.5 mm (96.6 in)	1207 mm (47.5 in)	2023 mm (79.7 in)
Frames w/ covers and top exit feature	2424 mm (95.4 in)	2452.5 mm (96.6 in)	1207 mm (47.5 in)	2139 mm (84.2 in)

### Top Exit feature (FC 7898)

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 16. Top exit cabling enclosure (FC 7898) measurements

<b>Weight</b>	<b>Width</b>	<b>Depth</b>	<b>Height</b>
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)**

3931 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 3931, 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

The 3931 is shipped as crated systems that are protected with wooden shipping boxes and are mounted on pallets requiring commercial lift transportation. This packaging is used for **all**.

- *Example*



- Each frame is packaged separately in its own individual wooden crate.
- Each 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.
- 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 each individually packaged frame will vary significantly, depending on the system configuration.

*Table 17. Wooden crate specifications*

<b>Width mm (in)</b>	<b>Depth mm (in)</b>	<b>Height mm (in)</b>	<b>Weight kg (lb)</b>
939.8 mm (37 in)	1333.5 mm (52.5 in)	2286.0 mm (90 in)	254.0 kg (560 lb)

Within the system packaging, each frame is wrapped in a protective clear green Vapor phase Corrosion Inhibitor (VpCI) bag as shown below:





## Planning for system packaging and return packaging



**Attention:** Depending on your specific system configuration, the 3931 might require additional packaging equipment to ensure safe system transport. This additional packaging will likely be large in size and must 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)
Each frame (1, 2, 3 or 4 frames per your configuration)	940 mm (37 in)	1346 mm (53 in)	2286 mm (90 in)	1167 kg (2573 lb) <sup>1</sup>
Cover kit (1, 2, 3 or 4 kits per your configuration)	457 mm (18 in)	2134 mm (84 in)	1016 mm (40 in)	50 kg (110 lb)
Ship Group (up to 3x for largest configuration)	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)
Fill & Drain Tool	813 mm (32 in)	1016 mm (40 in)	1041 mm (41 in)	136 kg (300 lb)
1U TKE (if feature is ordered)	610 mm (24 in)	1016 mm (40 in)	508 mm (20 in)	18 kg (40 lb)
<b>Note:</b>				
1. The actual weight of the each individually packaged frame may vary significantly, depending on the system configuration.				

The following equipment must be remain on site:

- Fill and Drain Tool (and water jugs)
- Ship Group and Tool Kit
- Lift Tool

Contact your IBM marketing representative or Business Partner to choose the correct Return Package feature code to order and determine a return schedule.

Box Contents	Width mm (in)	Depth mm (in)	Height mm (in)	Weight kg (lb)
z15 plywood frame box (1, 2, 3 or 4 boxes per your configuration)	940 mm (37 in)	1346 mm (53 in)	2286 mm (90 in)	1167 kg (2573 lb) <sup>1</sup>
z15 cover kit (1, 2, 3 or 4 kits per your configuration)	457 mm (18 in)	2134 mm (84 in)	1016 mm (40 in)	50 kg (110 lb)
z14 plywood frame box (2)	940 mm (37 in)	1626 mm (64 in)	2311 mm (91 in)	304 kg (670 lb)
z14 cover kit (2)	1066 mm (42 in)	2184 mm (86 in)	1194 mm (47 in)	59 kg (130 lb)

## Cover set packaging

<i>Table 20. Cover set packaging specifications</i>				
	<b>Width mm (in)</b>	<b>Depth mm (in)</b>	<b>Height mm (in)</b>	<b>Weight kg (lb)</b>
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 7898

The Top Exit feature (FC 7898) is wrapped in a poly bag for packaging.

<i>Table 21. Top exit feature packaging specifications</i>				
	<b>Width mm (in)</b>	<b>Depth mm (in)</b>	<b>Height mm (in)</b>	<b>Weight kg (lb)</b>
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.

<i>Table 22. Height reduction feature packaging specifications</i>				
	<b>Width mm (in)</b>	<b>Depth mm (in)</b>	<b>Height mm (in)</b>	<b>Weight kg (lb)</b>
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 <sup>1</sup> (24 in)	1016.0 mm <sup>1</sup> (40 in)	355.6 mm <sup>1</sup> (14 in)	25.0 kg (55 lb)
alternate Support Element	609.6 mm <sup>1</sup> (24 in)	1016.0 mm <sup>1</sup> (40 in)	355.6 mm <sup>1</sup> (14 in)	25.0 kg (55 lb)
<b>Note:</b>				
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).				

## IBM z16 (Model A01) and IBM LinuxONE Emperor 4 (Model LA1) feature codes

IBM z16 (Model A01) and IBM LinuxONE Emperor 4 (Model LA1) each contain four feature codes based on the maximum number of configurable PUs.

Table 23 on page 41 lists the feature codes. You will use the feature codes to place your IBM z16 (Model A01) or IBM LinuxONE Emperor 4 (Model LA1) order.

Feature code	Description
0667	Model A01/Model LA1 1 CPC drawer 4 DCMs Maximum 39 configurable PUs
0668	Model A01/Model LA1 2 CPC drawers 4 DCMs Maximum 82 configurable PUs
0669	Model A01/Model LA1 3 CPC drawers 4 DCMs Maximum 125 configurable PUs
0670	Model A01/Model LA1 4 CPC drawers 4 DCMs Maximum 168 configurable PUs
0671	Model A01/Model LA1 4 CPC drawers 4 DCMs Maximum 200 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 24 on page 42](#) and [Table 25 on page 44](#).

Table 24. Model A01 (FC 0508) configurable PUs and options

Feature code	Description
FC 0667 (Max 39 configurable PUs)	<ul style="list-style-type: none"> <li>• 1 CPC drawer</li> <li>• 0-39 CPs</li> <li>• 0-39 IFLs</li> <li>• 0-33 uIFLs</li> <li>• 0-22 zIIPs</li> <li>• 0-29 ICFs</li> <li>• 1 IFP</li> <li>• 4 standard SAPs</li> <li>• 0-8 additional SAPs</li> <li>• 2 spares</li> <li>• I/O links: <ul style="list-style-type: none"> <li>– 12 PCIe+ Fanouts</li> </ul> </li> </ul>
FC 0668 (Max 82 configurable PUs)	<ul style="list-style-type: none"> <li>• 2 CPC drawers</li> <li>• 0-82 CPs</li> <li>• 0-82 IFLs</li> <li>• 0-70 uIFLs</li> <li>• 0-46 zIIPs</li> <li>• 0-82 ICFs</li> <li>• 1 IFP</li> <li>• 8 standard SAPs</li> <li>• 0-8 additional SAPs</li> <li>• 2 spares</li> <li>• I/O links: <ul style="list-style-type: none"> <li>– 24 PCIe+ Fanouts</li> </ul> </li> </ul>
FC 0669 (Max 125 configurable PUs)	<ul style="list-style-type: none"> <li>• 3 CPC drawers</li> <li>• 0-125 CPs</li> <li>• 0-125 IFLs</li> <li>• 0-107 uIFLs</li> <li>• 0-70 zIIPs</li> <li>• 0-125 ICFs</li> <li>• 1 IFP</li> <li>• 12 standard SAPs</li> <li>• 0-8 additional SAPs</li> <li>• 2 spares</li> <li>• I/O links: <ul style="list-style-type: none"> <li>– 36 PCIe+ Fanouts</li> </ul> </li> </ul>

Table 24. Model A01 (FC 0508) configurable PUs and options (continued)

Feature code	Description
FC 0670 (Max 168 configurable PUs)	<ul style="list-style-type: none"> <li>• 4 CPC drawers</li> <li>• 0-168 CPs</li> <li>• 0-168 IFLs</li> <li>• 0-144 uIFLs</li> <li>• 0-96 zIIPs</li> <li>• 0-168 ICFs</li> <li>• 1 IFP</li> <li>• 16 standard SAPs</li> <li>• 0-8 additional SAPs</li> <li>• 2 spares</li> <li>• I/O links:               <ul style="list-style-type: none"> <li>– 48 PCIe+ Fanouts</li> </ul> </li> </ul>
FC 0671 (Max 200 configurable PUs)	<ul style="list-style-type: none"> <li>• 4 CPC drawers</li> <li>• 0-200 CPs</li> <li>• 0-200 IFLs</li> <li>• 0-189 uIFLs</li> <li>• 0-126 zIIPs</li> <li>• 0-200 ICFs</li> <li>• 1 IFP</li> <li>• 22 standard SAPs</li> <li>• 0-8 additional SAPs</li> <li>• 2 spares</li> <li>• I/O links:               <ul style="list-style-type: none"> <li>– 60 PCIe+ Fanouts</li> </ul> </li> </ul>
<p><b>CP</b> - Central Processor  <b>SAP</b> - System Assist Processor  <b>IFL</b> - Integrated Facilities for Linux®  <b>ICF</b> - Integrated Coupling Facility  <b>zIIP</b> - z Integrated Information Processor  <b>IFP</b> - Integrated Firmware Processor</p>	

Table 25. Model LA1 (FC 0509) configurable PUs and options

Feature code	Description
FC 0667 (Max 39 configurable PUs)	<ul style="list-style-type: none"> <li>• 1 CPC drawer</li> <li>• 0-1 CPs **</li> <li>• 1-39 IFLs</li> <li>• 0-38 uIFLs</li> <li>• 0 zIIPs</li> <li>• 0 ICFs</li> <li>• 1 IFP</li> <li>• 4 standard SAPs</li> <li>• 0-8 additional SAPs</li> <li>• 2 spares</li> <li>• I/O links:               <ul style="list-style-type: none"> <li>– 12 PCIe+ Fanouts</li> </ul> </li> </ul>
FC 0668 (Max 82 configurable PUs)	<ul style="list-style-type: none"> <li>• 2 CPC drawers</li> <li>• 0-1 CPs **</li> <li>• 1-82 IFLs</li> <li>• 0-81 uIFLs</li> <li>• 0 zIIPs</li> <li>• 0 ICFs</li> <li>• 1 IFP</li> <li>• 8 standard SAPs</li> <li>• 0-8 additional SAPs</li> <li>• 2 spares</li> <li>• I/O links:               <ul style="list-style-type: none"> <li>– 24 PCIe+ Fanouts</li> </ul> </li> </ul>
FC 0669 (Max 125 configurable PUs)	<ul style="list-style-type: none"> <li>• 3 CPC drawers</li> <li>• 0-1 CPs **</li> <li>• 1-125 IFLs</li> <li>• 0-124 uIFLs</li> <li>• 0 zIIPs</li> <li>• 0 ICFs</li> <li>• 1 IFP</li> <li>• 12 standard SAPs</li> <li>• 0-8 additional SAPs</li> <li>• 2 spares</li> <li>• I/O links:               <ul style="list-style-type: none"> <li>– 36 PCIe+ Fanouts</li> </ul> </li> </ul>

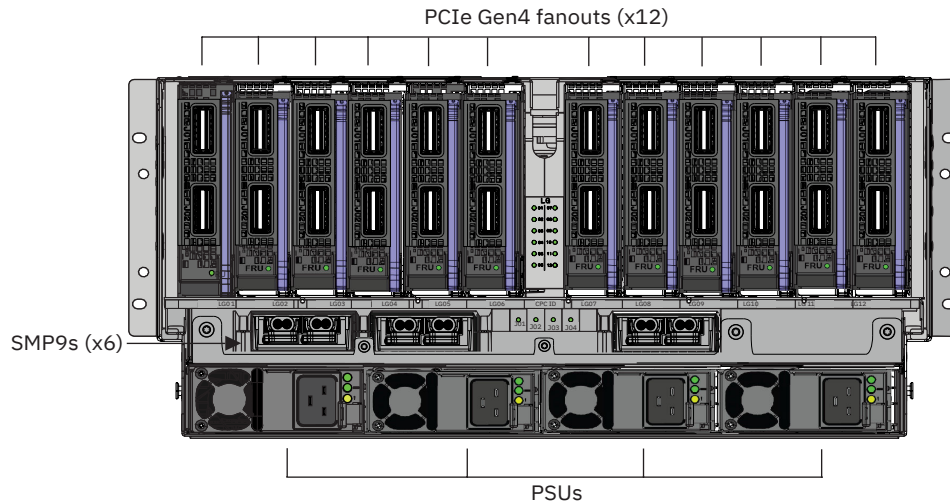
Table 25. Model LA1 (FC 0509) configurable PUs and options (continued)

Feature code	Description
FC 0670 (Max 168 configurable PUs)	<ul style="list-style-type: none"> <li>• 4 CPC drawers</li> <li>• 0-1 CPs **</li> <li>• 1-168 IFLs</li> <li>• 0-167 uIFLs</li> <li>• 0 zIIPs</li> <li>• 0 ICFs</li> <li>• 1 IFP</li> <li>• 16 standard SAPs</li> <li>• 0-8 additional SAPs</li> <li>• 2 spares</li> <li>• I/O links: <ul style="list-style-type: none"> <li>– 48 PCIe+ Fanouts</li> </ul> </li> </ul>
FC 0671 (Max 200 configurable PUs)	<ul style="list-style-type: none"> <li>• 4 CPC drawers</li> <li>• 0-1 CPs **</li> <li>• 1-200 IFLs</li> <li>• 0-199 uIFLs</li> <li>• 0 zIIPs</li> <li>• 0 ICFs</li> <li>• 1 IFP</li> <li>• 22 standard SAPs</li> <li>• 0-8 additional SAPs</li> <li>• 2 spares</li> <li>• I/O links: <ul style="list-style-type: none"> <li>– 60 PCIe+ Fanouts</li> </ul> </li> </ul>
<p><b>CP</b> - Central Processor  <b>SAP</b> - System Assist Processor  <b>IFL</b> - Integrated Facilities for Linux  <b>ICF</b> - Integrated Coupling Facility  <b>zIIP</b> - z Integrated Information Processor  <b>IFP</b> - Integrated Firmware Processor</p> <p><b>**</b> 1 CP for GDPS (Geographically Dispersed Parallel Sysplex) Virtual Appliance</p>	

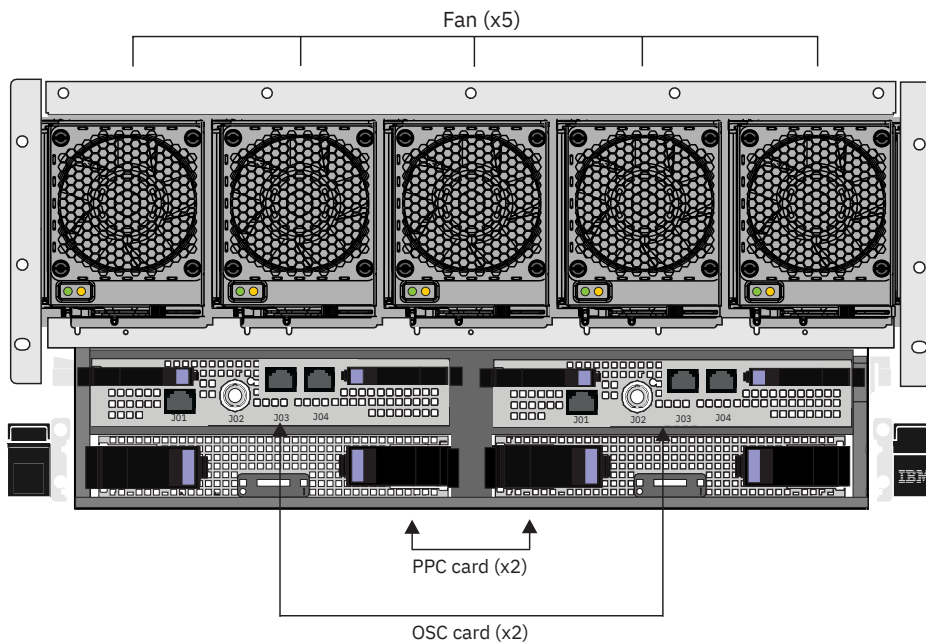
## CPC processor drawer

The 3931 supports up to 4 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**
  - 6 SMP9 (Symmetric Multiprocessing) ports
  - 3-4 Power Supply Units (PSUs)



- In the **front** of the CPC drawer:
  - 5 Fans
  - 2 Oscillator cards (OSC)
  - 2 Processor Power Control (PPC) cards





## CPC Reserve features

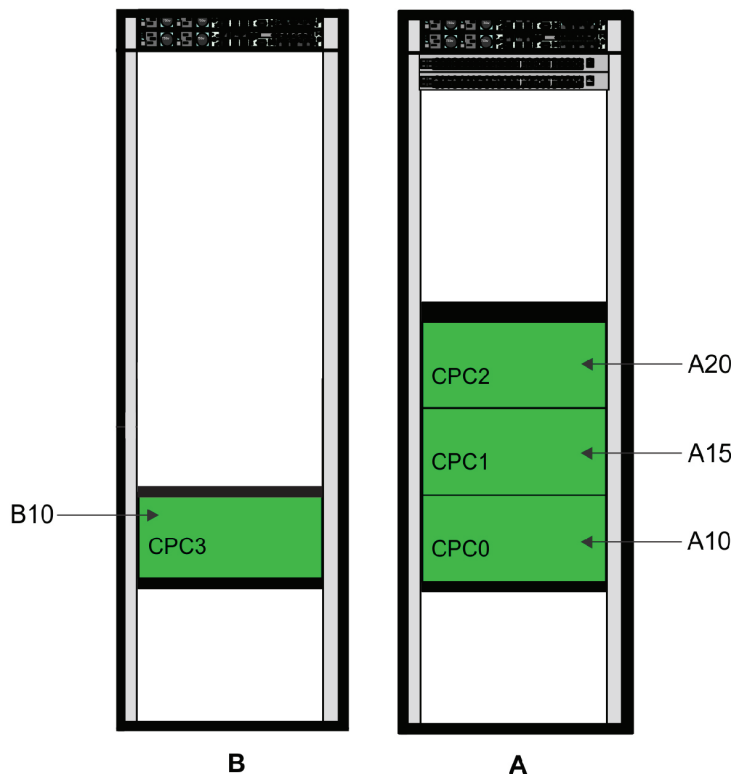
The following features are offered to give customers the ability to preserve CPC drawer locations in the 3931 for future growth and usage.

### CPC1 Reserve (FC 2981)

Reserves the EIA location A15 for a future Max82 or Max125 upgrade.

### CPC2 Reserve (FC 2982)

Reserves the EIA location A20 for a future Max125 upgrade.



## PCIe+ I/O drawers

The 3931 supports PCIe+ I/O drawers. The number of drawers supported is dependent on the system configuration.

The 3931 system with BPA power supports up to 10 PCIe+ I/O drawers.

The 3931 system with PDU power supports up to 12 PCIe+ I/O drawers.



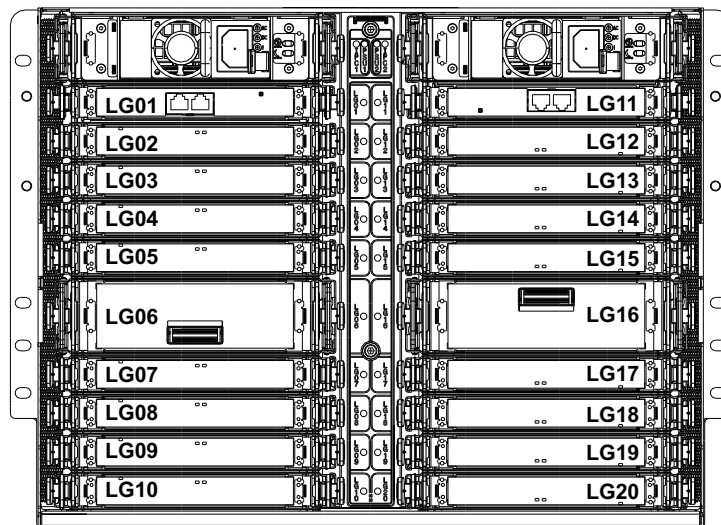
**Attention:** If the 3931 is configured with 1 CPC drawer, a maximum of 6 PCIe+ I/O drawers are supported.

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 PCIe+ Interconnect cards (FC 0421) plugged as both domains will initially be activated. They are plugged in locations **LG06** and **LG16**.
- Requires 2 Flexible Support Processors (FSPs) plugged in locations **LG01** and **LG11**.



PCIe+ I/O drawer rear view

## System upgrades

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The following upgrades are supported:

- 8561 (z15™) T01 water-cooled model to 3931 (IBM z16 (Model A01))
- 8561 (z15) T01 radiator-cooled model to 3931 (IBM z16 (Model A01))
- 3906 (z14) M0x water-cooled models to 3931 (IBM z16 (Model A01))
- 3906 (z14) M0x radiator-cooled models to 3931 (IBM z16 (Model A01))

The following upgrades are **not** supported:

- Any 8561 (IBM Linux One III Model LT1) model to 3931 (IBM z16 (Model A01))
- Any 8562 (IBM z15 Model T02 ) model to 3931 (IBM z16 (Model A01))
- Any 3906 (LinuxONE Emperor II) LMx models to any 3931 (IBM z16 (Model A01))
- Any 3907 (z14 ZR1) model to 3931 (IBM z16 (Model A01))
- Any model to 3931 (IBM LinuxONE Emperor 4 (Model LA1))

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

## Differences between IBM servers

Comparison information is provided here for those who may be placing an 3931 on a raised floor with another IBM Z server.

*Table 26. Differences between multi-frame servers*

System family	Depth (with covers)	Height (with covers)	Width (with covers)	Weight (Maximum)
z13 <sup>®</sup> or Emperor (2964) <i>radiator-cooled</i>	1869.5 mm (73.6 in)	2014.3 mm (79.3 in)	784.9 mm (30.9 in)	2784.6 kg (6139 lb)
z13 or Emperor (2964) <i>water-cooled</i>	1971.1 mm (77.6 in)	2014.3 mm (79.3 in)	784.9 mm (30.9 in)	2801.9 kg (6177 lb)
z14 or Emperor II (3906) <i>radiator-cooled</i>	1860.0 mm (73.2 in)	2014.3 mm (79.3 in)	784.9 mm (30.9 in)	2784.6 kg (6139 lb)
z14 or Emperor II (3906) <i>water-cooled</i>	1964.0 mm (77.3 in)	2014.3 mm (79.3 in)	784.9 mm (30.9 in)	2801.9 kg (6177 lb)
z15 or IBM LinuxONE III (8561) <i>radiator-cooled</i>	1208 mm (47.6 in)	2020 mm (79.5 in)	2424 mm (95.4 in) <i>4 frames</i>	2850 kg (6284 lb) <i>4 frames</i>
z15 or IBM LinuxONE III (8561) <i>water-cooled</i>	1309 mm (51.6 in)	2020 mm (79.5 in)	2424 mm (95.4 in) <i>4 frames</i>	3201 kg (7056 lb) <i>4 frames</i>
IBM z16 (Model A01) or IBM LinuxONE Emperor 4 (3931) <i>radiator-cooled</i>	1207 mm (47.5 in)	2020 mm (79.5 in)	2424 mm (95.4 in) <i>4 frames</i>	2850 kg (6284 lb) <i>4 frames</i>

### Notes:

1. The installation of side covers is optional on the 3931. For system dimensions *without* covers, see [“Physical dimensions”](#) on page 34.
2. This weight does not 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 3931. Plan views, physical dimensions, service clearances, aisle spacing, and power and cooling requirements may be substantially different.

## Plan views

The following graphics provide a visual representation of the 3931 physical dimensions.

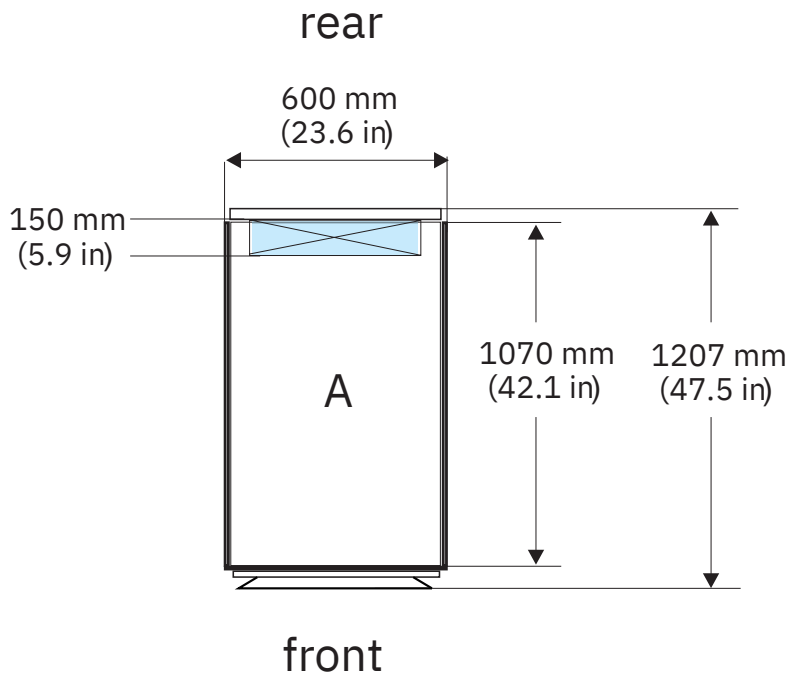
For installations planning to use top exit power cords, the frame openings for these cords are on the top of the left front and right rear corners of the frame.

### Notes:

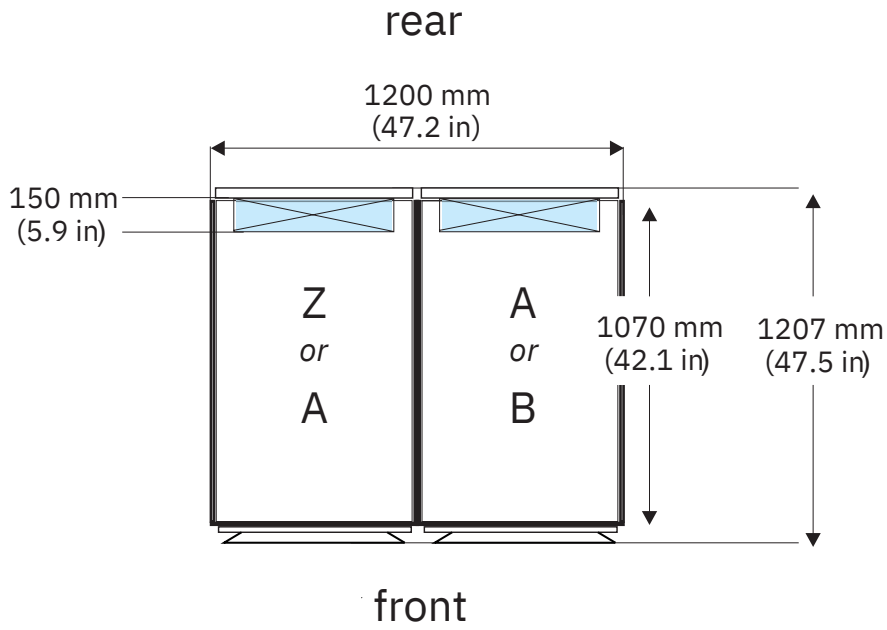
- The 3931 is shipped with frame spacer hardware pre-installed to allow for proper alignment of the system on the floor tiles, when positioning the frames. The overall system width is affected. For more information, see [“Physical dimensions”](#) on page 34.
- The physical dimensions provided in the following graphics do not include the optional side covers.

## Plan views for radiator-cooled system

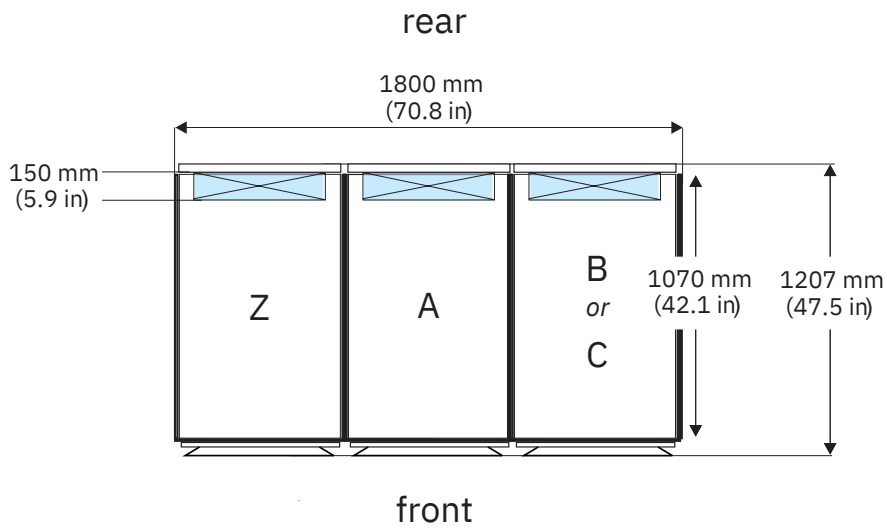
### Single frame



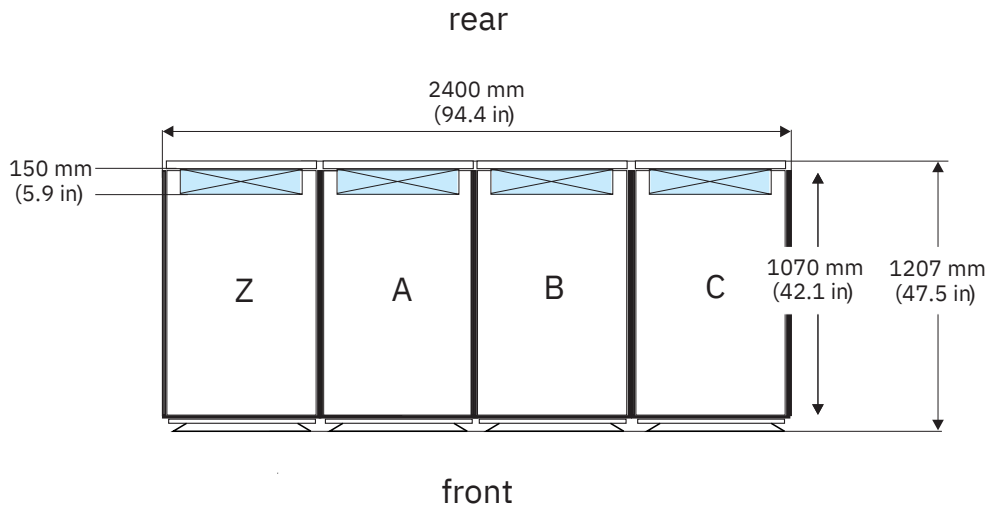
**Two frames**



**Three frames**



### Four frames



## 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 3931. 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 56.
- For floor loading examples, see [“Floor loading examples”](#) on page 58.

The following figures, and tables in [“System weight examples”](#) on page 56, show sample floor loading values for the 3931.

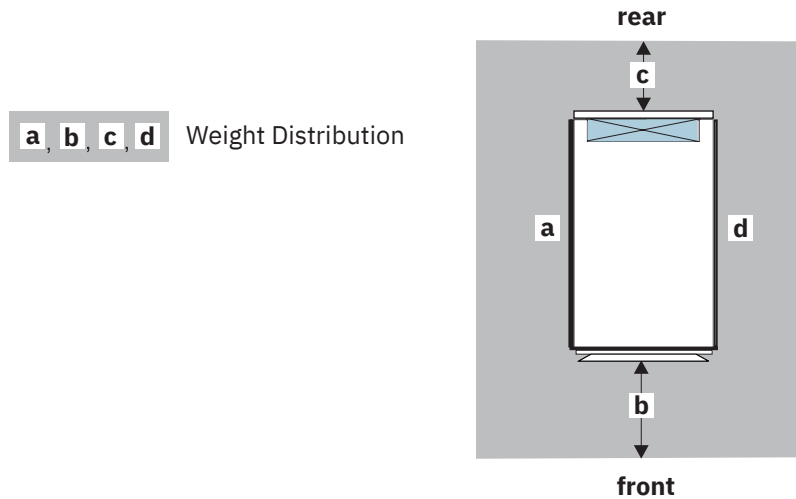


Figure 4. One frame

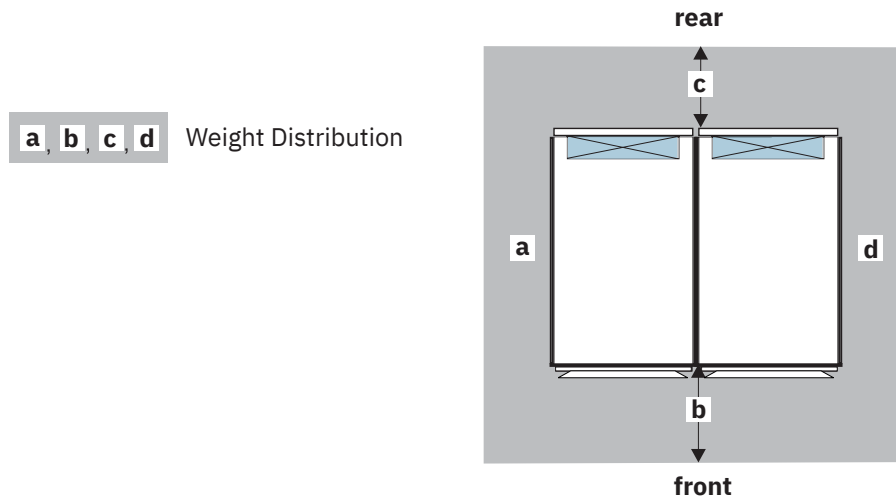


Figure 5. Two frames



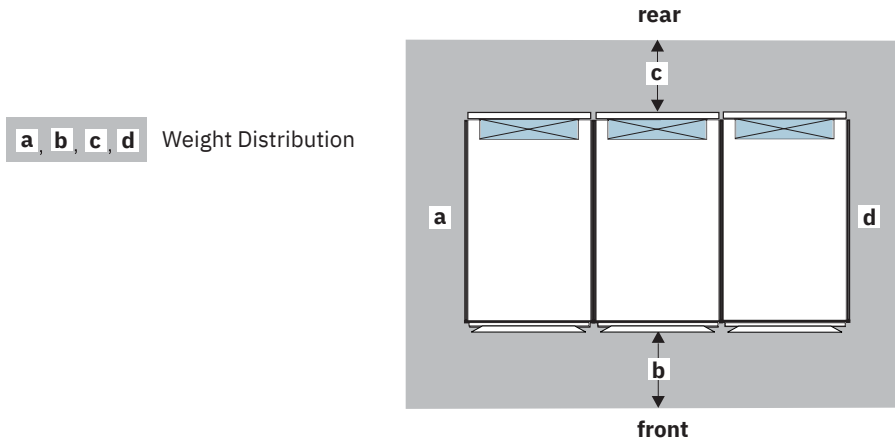


Figure 6. Three frames

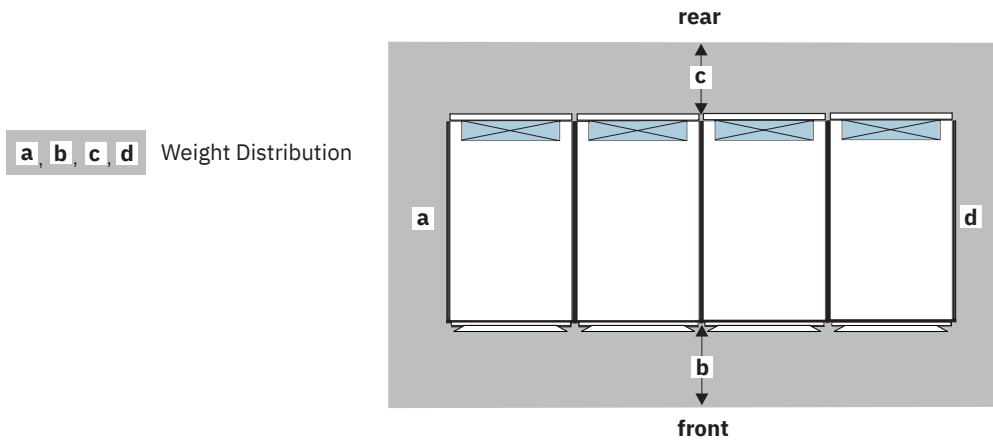


Figure 7. Four frames

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 *maximum* system configurations on the 3931.

The **Power and Weight Estimation** tool includes weight data and provides a more accurate weight for your particular configuration. See [“Power and weight estimation tool”](#) on page 95.



### 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 do not include Earthquake Kit hardware.
  - The Earthquake Kit hardware weighs approximately 43 kg (95 lbs).
- All estimated weights reflect a *maximum* populated system for each possible frame configuration.
- Actual weight varies and can only be determined by an exact specification of content.

### PDU power

Table 27. Weights for maximum machine configurations (PDU)					
Frame config	Individual frame weights kg (lbs)				Total weight kg (lbs)
	Z frame	A frame	B frame	C frame	
<b>A</b>	-	759 kg (1673 lbs)	-	-	759 kg (1673 lbs)
<b>ZA</b>	712 kg (1570 lbs)	739 kg (1630 lbs)	-	-	1451 kg (3200 lbs)
<b>ZAC</b>	712 kg (1570 lbs)	720 kg (1587 lbs)	-	740 kg (1633 lbs)	2172 kg (4790 lbs)
<b>AB</b>	-	739 kg (1630 lbs)	704 kg (1552 lbs)	-	1443 kg (3182 lbs)
<b>ZAB</b>	712 kg (1570 lbs)	720 kg (1587 lbs)	704 kg (1552 lbs)	-	2136 kg (4709 lbs)
<b>ZABC</b>	712 kg (1570 lbs)	720 kg (1587 lbs)	685 kg (1509 lbs)	550 kg (1213 lbs)	2667 kg (5879 lbs)

**BPA power**

*Table 28. Weights for maximum machine configurations (BPA)*

Frame config	Individual frame weights kg (lbs)				Total weight kg (lbs)
	Z frame	A frame	B frame	C frame	
<b>A</b>	-	743 kg (1639 lbs)	-	-	743 kg (1639 lbs)
<b>ZA</b>	622 kg (1371 lbs)	724 kg (1596 lbs)	-	-	1346 kg (2967 lbs)
<b>ZAC</b>	622 kg (1371 lbs)	704 kg (1553 lbs)	-	563 kg (1241 lbs)	1889 kg (4165 lbs)
<b>AB</b>	-	724 kg (1596 lbs)	618 kg (1362 lbs)	-	1342 kg (2958 lbs)
<b>ZAB</b>	622 kg (1371 lbs)	704 kg (1553 lbs)	618 kg (1362 lbs)	-	1944 kg (4286 lbs)
<b>ZABC</b>	622 kg (1371 lbs)	704 kg (1553 lbs)	598 kg (1319 lbs)	713 kg (1573 lbs)	2637 kg (5816 lbs)

## Floor loading examples

The following tables provide *estimated* floor loading values for the various system configurations of CPC and PCIe+ I/O drawers.

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 and machine area variability, the following tables cannot cover all of the possible system configurations. The following tables provide the absolute 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<sup>2</sup> (200 lbs/ft<sup>2</sup>).

- The **minimum** floor loading values are for a stand-alone installation with 5 ft of clearance space all the way around the system. This scenario assumes that the floor is a non-raised floor (15 lbs/ft) and a maximum exterior clearance of 5 ft.
- The **maximum** floor loading values are for a system that is being installed in the middle of an existing row. This scenario assumes that the floor is raised floor (25 lbs/ft), 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<sup>2</sup> (5 lbs/ft<sup>2</sup>) to the *maximum* floor loading values

1.5 kg/M<sup>2</sup> (3 lbs/ft<sup>2</sup>) 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.

$$FL \text{ (lbs/ft}^2\text{)} = k + (w - 120 * n) / ((4 + a + d) * (2 * n + c + b))$$

**k** = 25 (raised floor environment) or 15 (non-raised floor environment)

**w** = System weight (lbs)

**n** = Number of frames (1, 2, 3 or 4)

**a** = Left side clearance dimension

**b** = Front clearance dimension

**c** = Rear clearance dimension

**d** = Right side clearance dimension

See [“Weight distribution and floor loading”](#) on page 54 for sample floor loading figures of the 3931.

**PDU power**

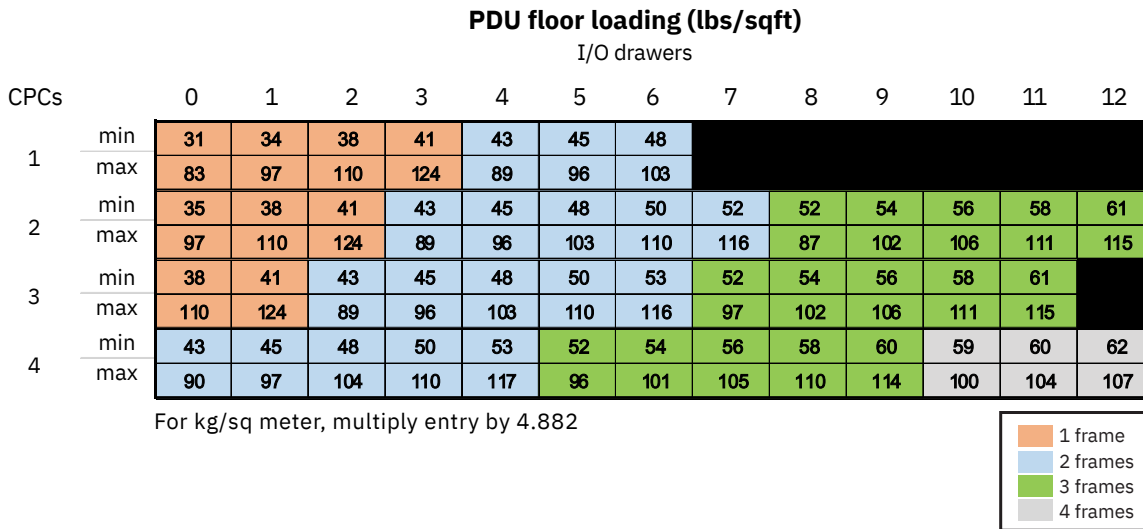


Figure 8. Floor loading for PDU powered system

**BPA power**

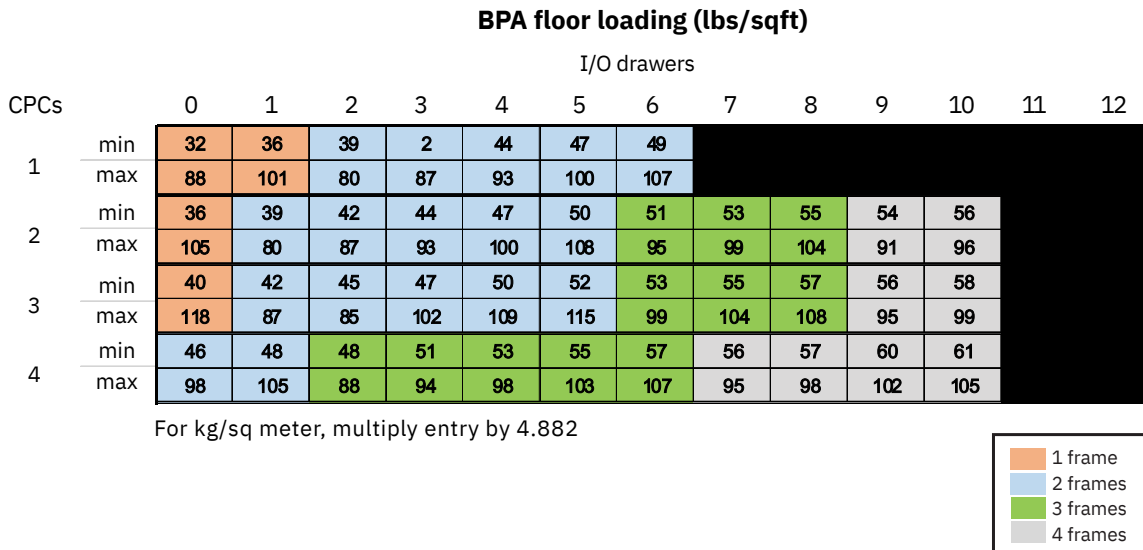


Figure 9. Floor loading for BPA powered system

## 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
- Chilled water delivery
- Thermal interaction
- Cable locations
- Floor tile cutouts.

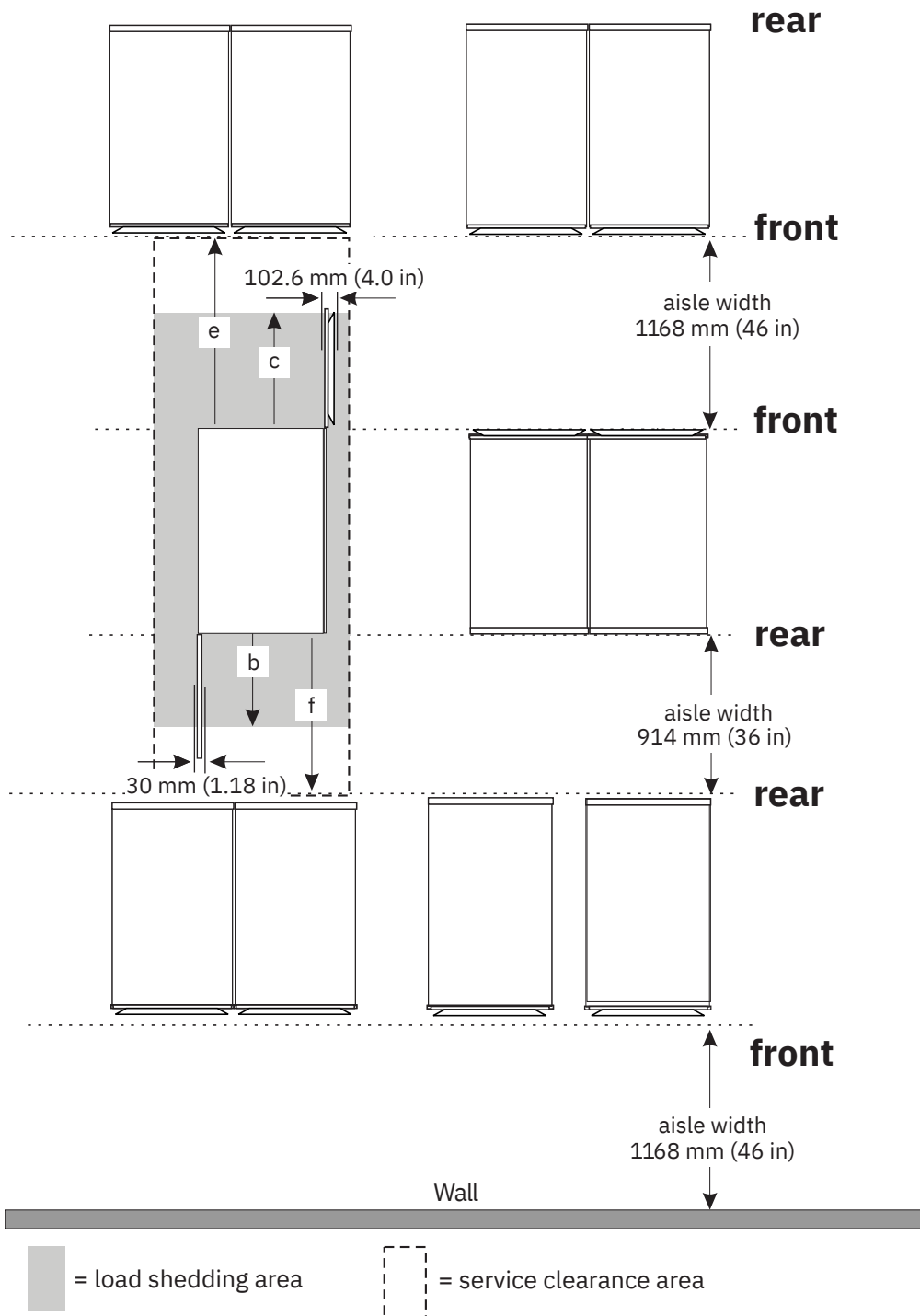


Figure 10. Aisle and service clearances

## Structural integrity, seismic support, and system mobility

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The 3931 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 3931 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 3931 tested and verified.

**Note:** The vibration and shock levels given here are the levels that 3931 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 [Table 29 on page 63](#).

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 29. Truck, air, rail, and ocean vibration spectrum *		
Frequency (Hz)	G <sup>2</sup> /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 (1.0 m/s) velocity change  
 2 times free fall drops at 55.6 in/s (1.4 m/s) velocity change
- System level or the frame with its drawers installed – *in all four sides horizontal direction*  
 1 time at 39.3 in/s (1.0 m/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 [Table 29 on page 63](#) 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 3931 systems while running are verified to meet the vertical vibration level given in [Table 30 on page 64](#) and [Figure 11 on page 65](#) without any functional degradation. The 3931 is verified to be able to withstand five vertical shock inputs 3.5 g with 3 ms half sine pulse width.

<i>Table 30. Random vibration PSD profile breakpoint <sup>1</sup></i>									
<b>Class</b>	<b>5 Hz</b>	<b>17 Hz</b>	<b>45 Hz</b>	<b>48 Hz</b>	<b>62 Hz</b>	<b>65 Hz</b>	<b>150 Hz</b>	<b>200 Hz</b>	<b>500 Hz</b>
V1L/V2	$2.0 \times 10^{-7}$	$2.2 \times 10^{-5}$	$2.2 \times 10^{-5}$	$2.2 \times 10^{-5}$	$2.2 \times 10^{-5}$	$2.2 \times 10^{-5}$	$2.2 \times 10^{-5}$	$2.2 \times 10^{-5}$	$2.2 \times 10^{-5}$
<b>Notes:</b>									
1. All values in this table are in $g^2/Hz$ .									
2. For reference only. No test required.									

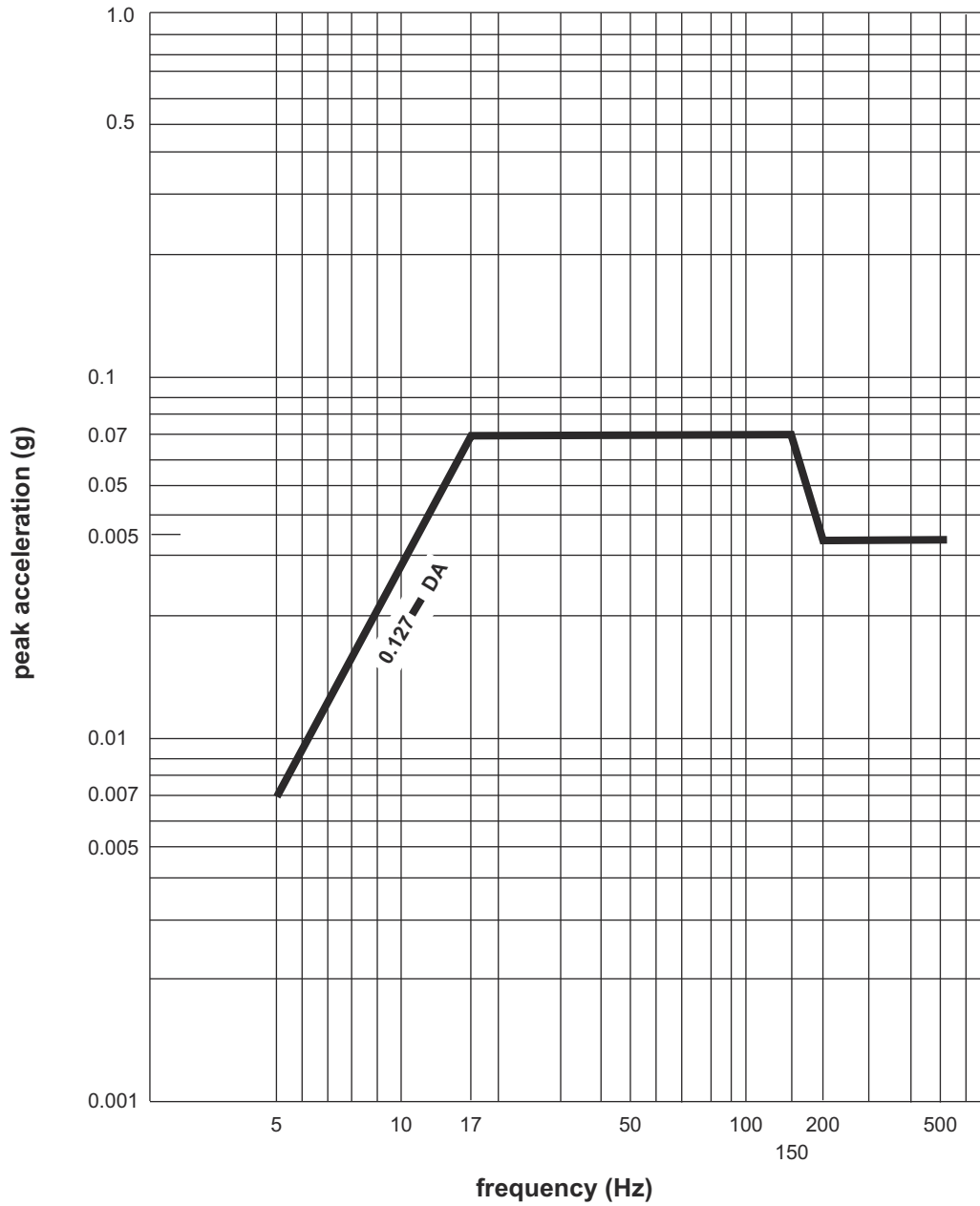


Figure 11. Continuous operational vibration

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 3931 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 31 on page 66](#). 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.

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

Test criteria	$S_{DS}$ (g)	z/h	Horizontal		Vertical	
			$A_{FLX-H}$	$A_{RIG-H}$	$A_{FLX-V}$	$A_{RIG-V}$
<b>ICC-ES AC156</b>	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 3931 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 3931 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.

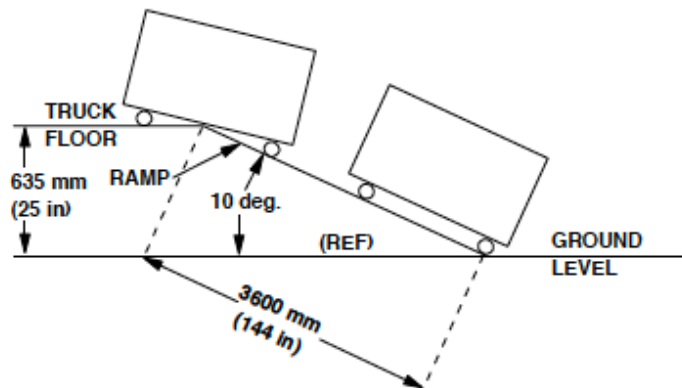
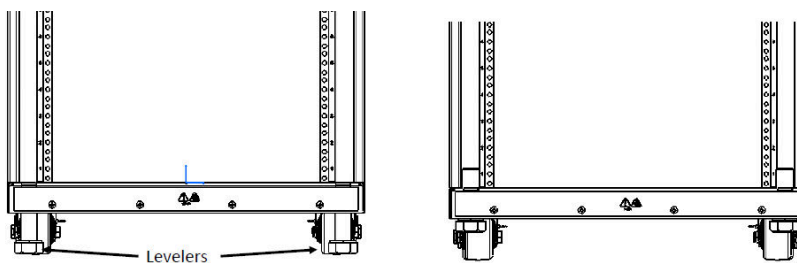
## System mobility

**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 palletized 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 10° incline is recommended for all ramped surfaces.

When positioning systems with 3 or 4 frames, you must disassemble the system in pairs (2 frames) prior to transporting it into your environment.



## 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 3931. 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 12 on page 69 shows the parts for the inner frame stiffener component of the earthquake kit.

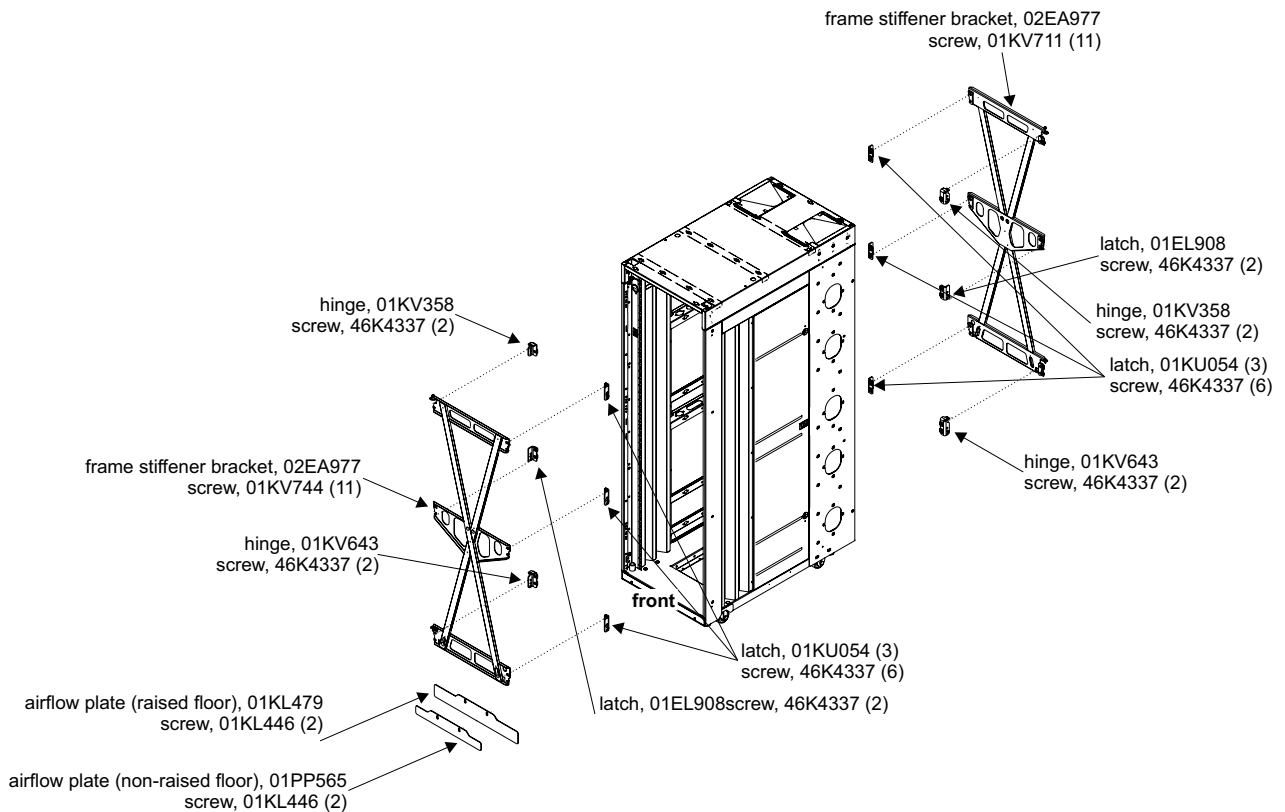


Figure 12. Frame stiffening parts list

## Raised floor Earthquake Kit

The Earthquake Kit for the 3931 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 13](#) on page 70.

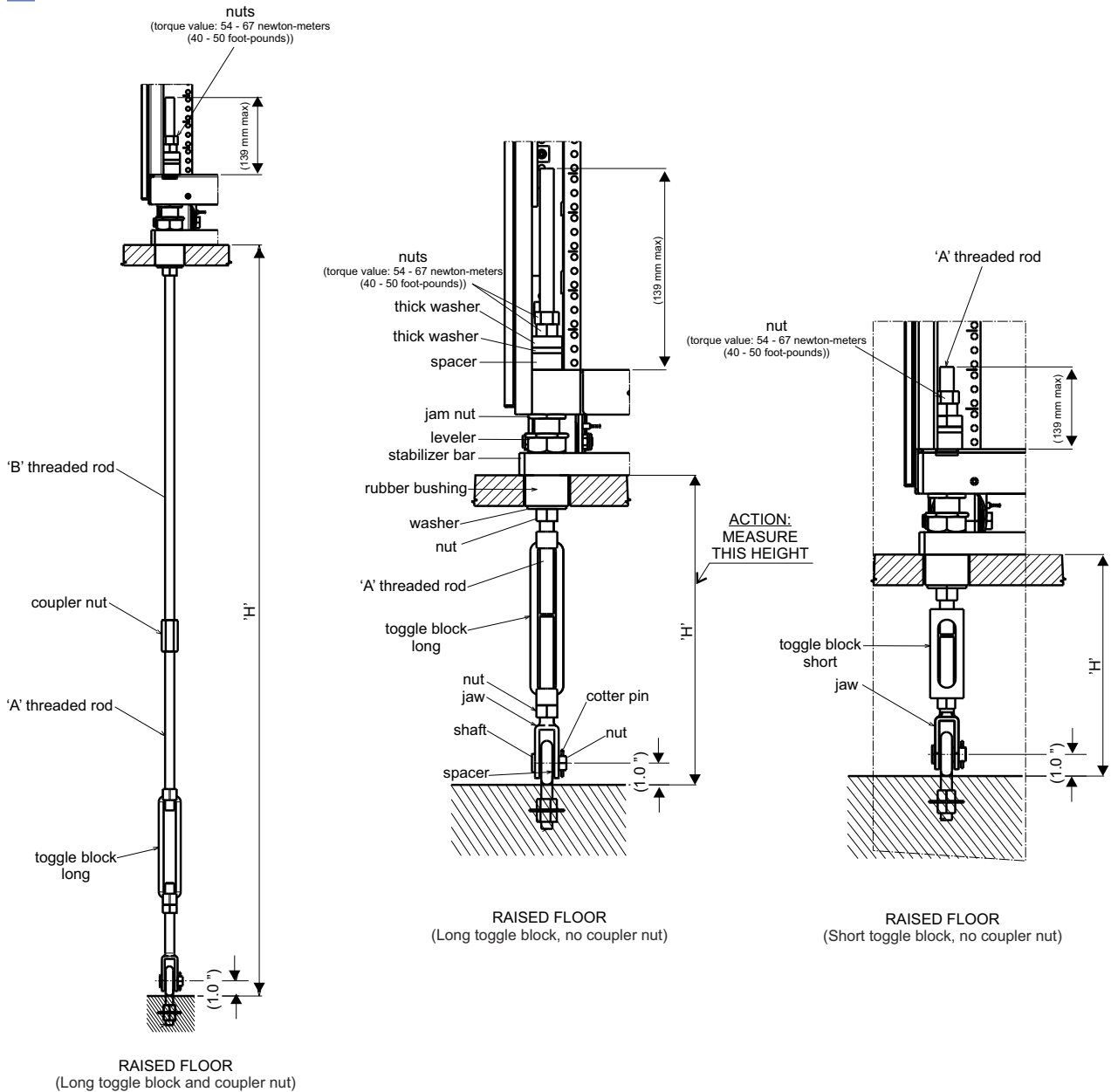


Figure 13. Turnbuckle assembly

Use the raised floor height (specified as 'H') and [Table 32](#) on page 71 to determine the specific hardware that you need to select from the Earthquake Kit.



Table 32. 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"

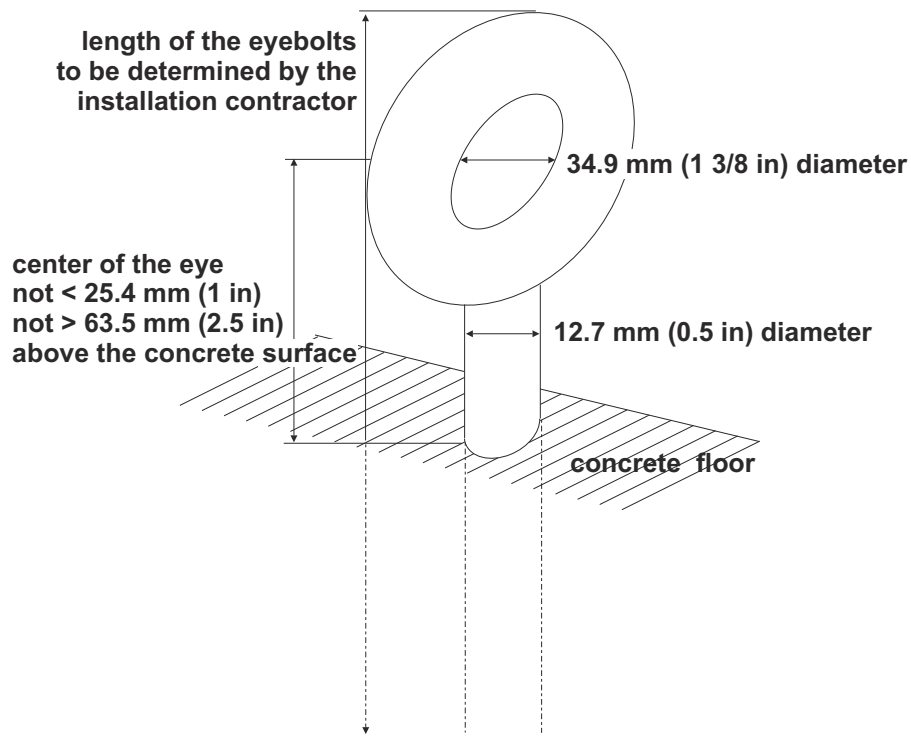
**Important:** Make a note of the measurement information and hardware selection, as it will be needed later in the server installation.

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.

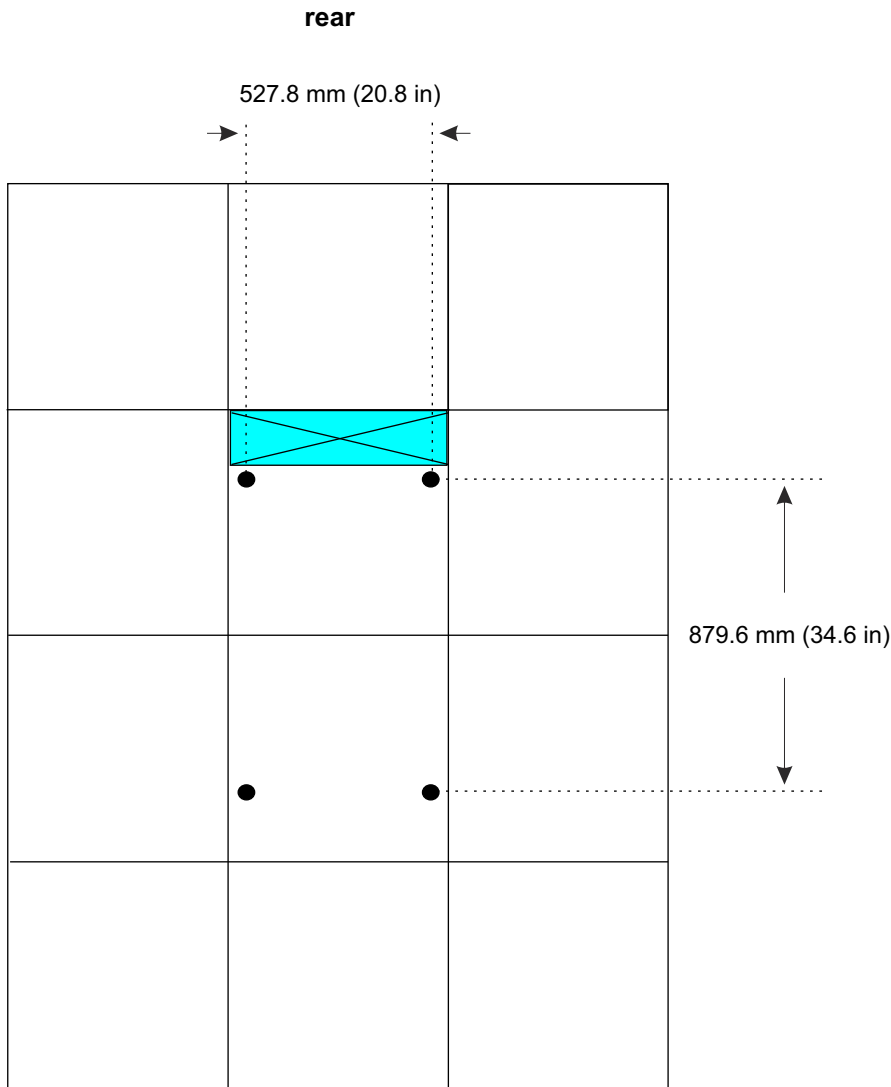
### Installing the eyebolts

You are responsible for obtaining and installing the eyebolts that will anchor the frames of 3931. 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.



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.



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 *3931 Installation Manual*, which is shipped with the server.

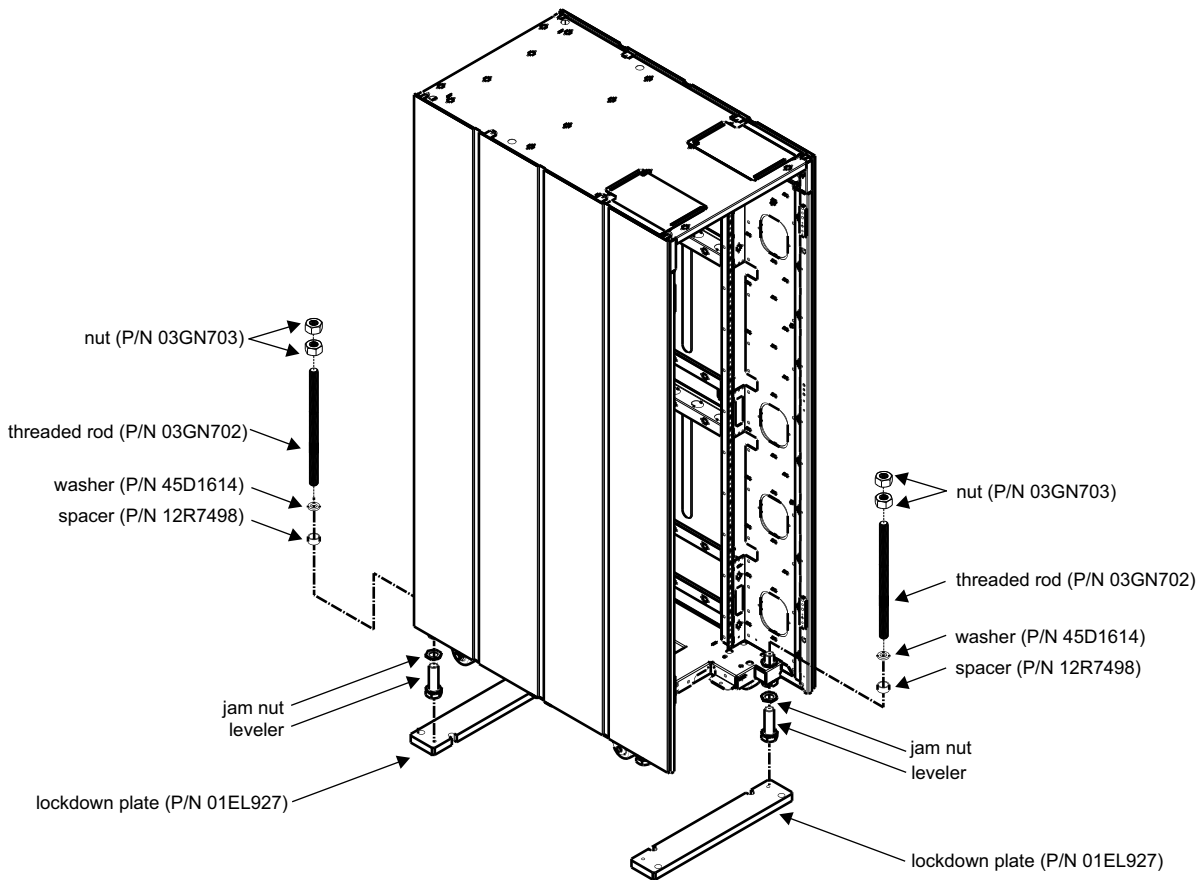
## Non-raised floor Earthquake Kit

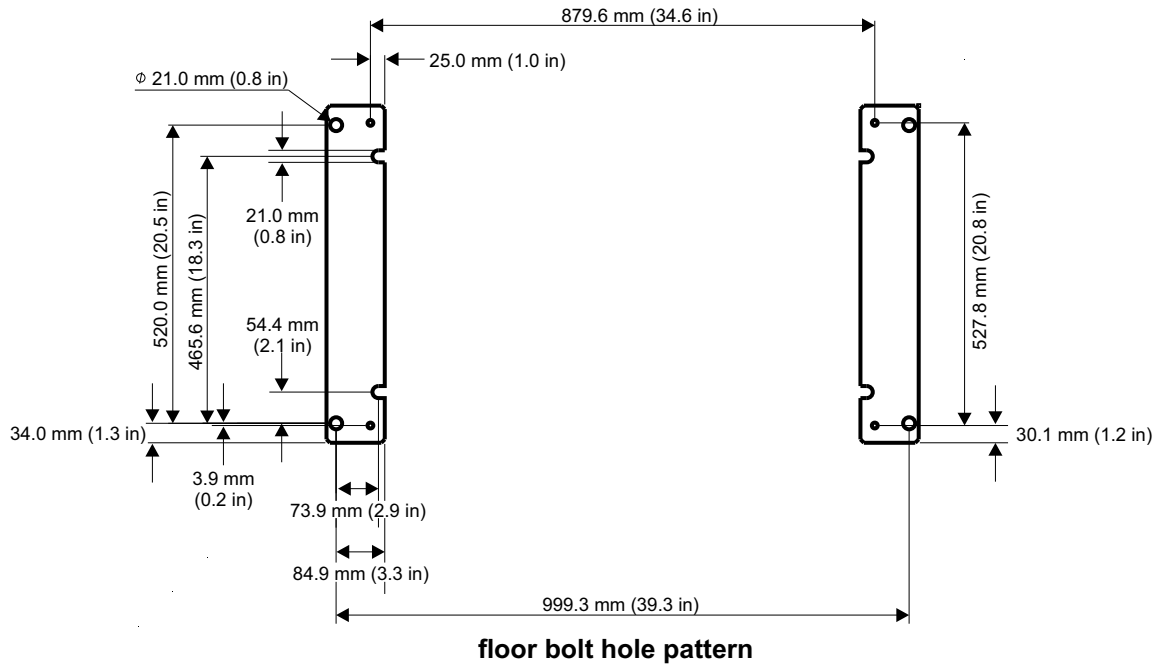
The purpose of this installation instruction is to install an Earthquake kit that will provide hardware for securing the frame to a concrete non-raised floor. This kit (FC 8015) is designed to help secure the frame and its contents from damage when exposed to vibrations and shocks such as those in a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





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.

## Alternate Electronic Locking Latch

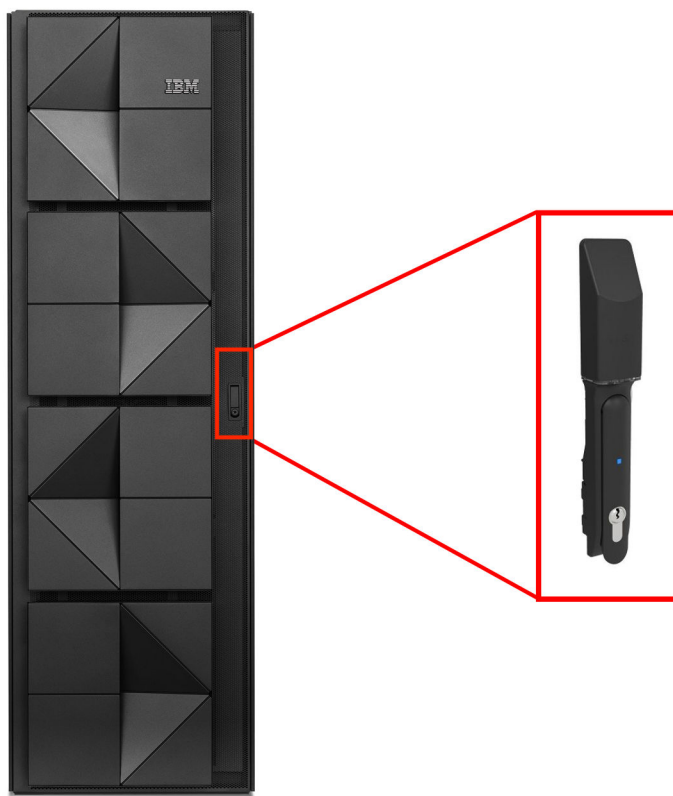
Similar to predecessor offerings, IBM z16 (Model A01) or IBM LinuxONE Emperor 4 (Model LA1) is provided with a key operated locking latch assembly to physically secure each system door. IBM is now enabling the ability to exchange the provided locking latches with electronic versions to satisfy the evolving controlled accessibility, monitoring, and audibility associated with IT equipment.

If desired, IBM Z Electronic Locking Latch may be procured directly from *SouthCo* at <http://www.southco.com/h3-em-99-610>. These retrofit kits are provided on a per system frame basis and may require some additional hardware (for example, electrical wiring) to connect to a facilities security infrastructure. Installation does not require any permanent alteration to the system doors. If installation assistance is desired, please contact IBM Global Technology Services (GTS).



**Attention:** If this alteration is completed, the following restrictions apply:

- The electronic locking latch is customer provided, customer installed *and* customer serviced. The SSR is not responsible for installing the latch, however, can be hired by the customer to do so if requested.
- The supporting TSS team member (SSR) must be notified of this system alteration and the appropriate provisions enabled to ensure any contracted accessibility to the system is provided. Should this not be done, then a delay in system serviceability may occur.
- The electronic locking latches and any additional enabling hardware (junction box, door sensors, associated wire and cabling, etc.) shall be removed and the originally supplied door latches be reinstalled prior to returning the system to IBM as part of a Technology Exchange/Hybrid or a System MES.



## Electronic Locking Latch service considerations

It is the *customer's* responsibility to provide the SSR with access to the system at the time of service. If the customer does not, then the system is not serviceable and the customer bears full responsibility for impeding any needed service activity.

For situations in which there are two or more 3931 frames that sit adjacent to one another, the electronic locking latch will not allow the door of the frame to its left to fully open. If this impedes the ability to service components in the adjacent frame, its door can be removed as follows. If removing the door is not an option, ask the customer to open the lock on the adjacent door (to the right of the door being serviced) and swing the adjacent door open to gain clearance.

1. Open the frame door. The door is hinged on the left side.
2. Lift the door to disengage it from its top and bottom hinges, then pull the door away from the frame. Place the door in a safe, out-of-the-way location during servicing.
3. Once servicing is *complete*, hang the door on the hinges by starting at the bottom hinge first, then setting the top hinge on its pin.
4. Close the door.

## 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.

<i>Table 33. Machine area and service clearance area</i>			
<b>Model</b>	<b>Number of frames</b>	<b>Machine area M<sup>2</sup> (ft<sup>2</sup>)</b>	<b>Service clearance area M<sup>2</sup> (ft<sup>2</sup>)</b>
A01 or LA1	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)
A01 or LA1	2 frames	1.50 (16.15)	front service clearance = 1.57 (16.9) machine area w/o doors and side covers = 1.28 (13.77) rear service clearance = 1.24 (13.3)
A01 or LA1	3 frames	2.25 (24.22)	front service clearance = 2.35 (25.3) machine area w/o doors and side covers = 1.95 (20.73) rear service clearance = 1.85 (19.9)
A01 or LA1	4 frames	3.01 (32.4)	front service clearance = 3.13 (33.7) machine area w/o doors and side covers = 2.57 (27.64) rear service clearance = 2.47 (26.6)
<b>Notes:</b>			
<ol style="list-style-type: none"> <li>1. Machine area includes installed covers.</li> <li>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.</li> </ol>			



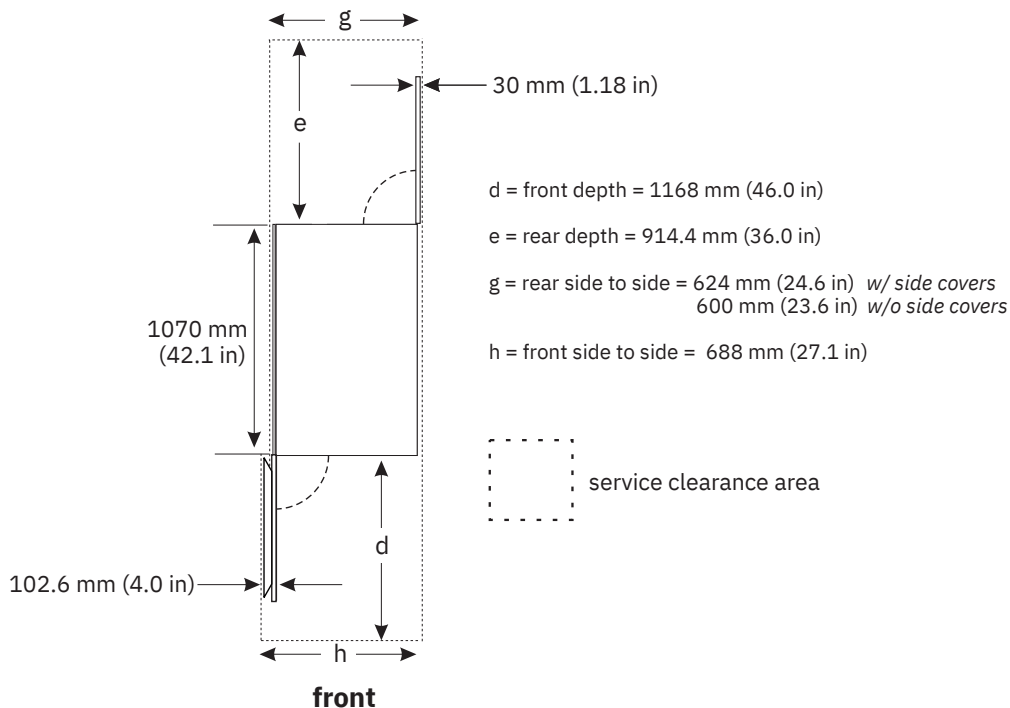


Figure 14. Minimum service clearance area (single frame)

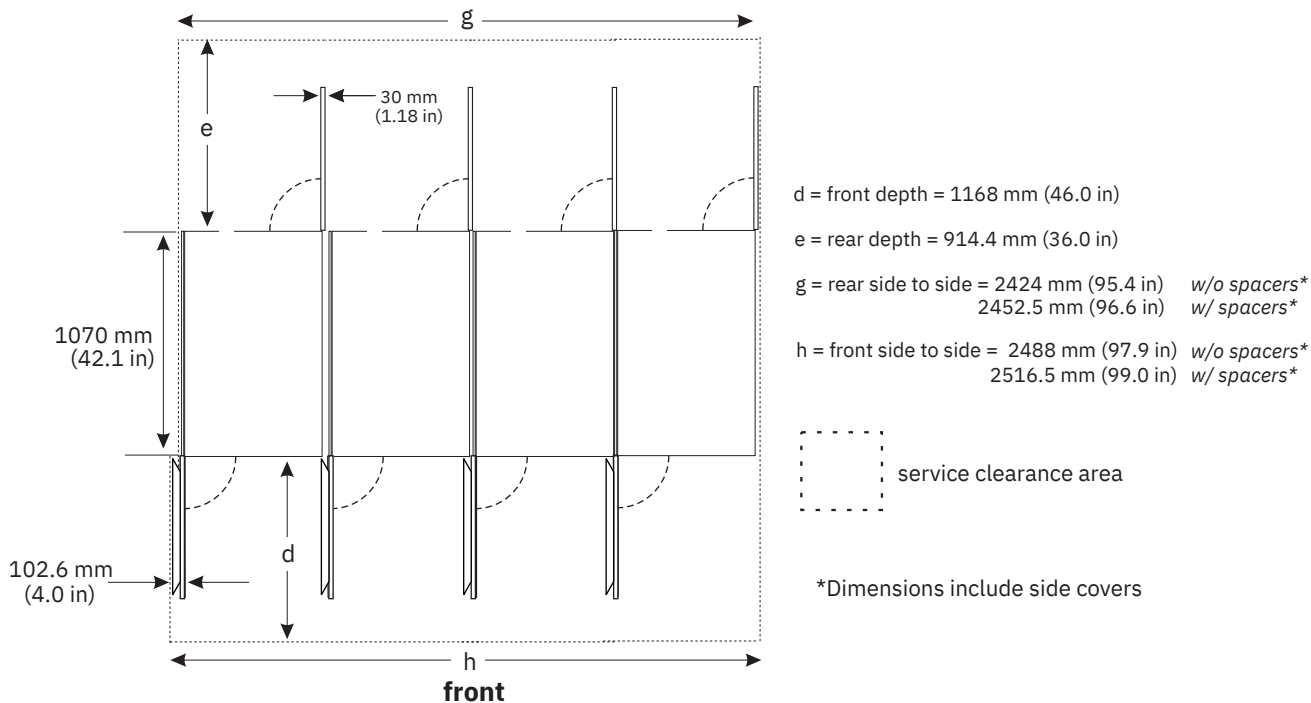


Figure 15. Maximum service clearance area (four frames)

**The front and rear doors access all of the serviceable area in the 3931. 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 16](#) on page 80.)

- 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**).

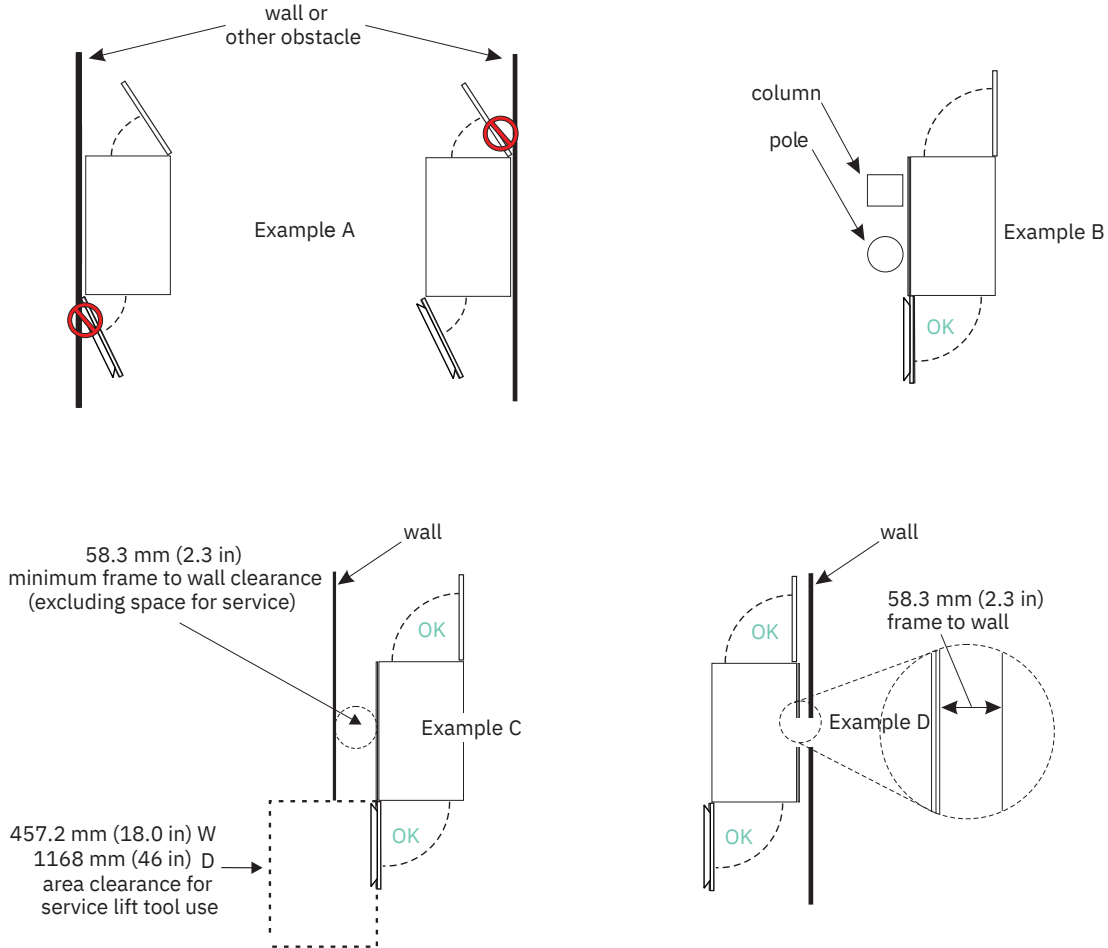


Figure 16. Detailed service clearances

## Cooling recommendations for the room

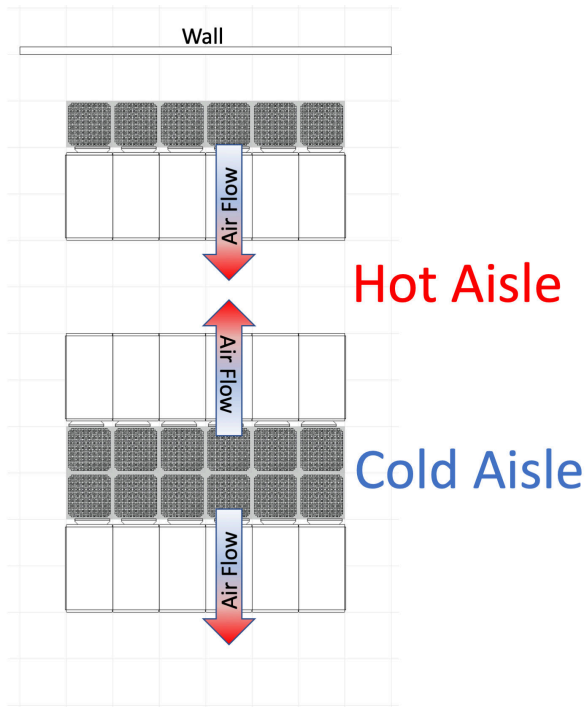
The following illustration does not represent any particular server machine type, and is intended only to show hot and cold airflow and the arrangement of server aisles on the raised floor.

A typical 3931 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 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 provides 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

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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 3931 system can be used within these aisle cooling containment solutions. Below are general guidelines for assessing the installation of a 3931 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 78.)
- Consideration should be given to the airflow requirements of the 3931 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 81.)
- Care should be taken to assure that frames across the aisle will not negatively impact the 3931 operation or conversely the impact of the 3931 on other frame equipment.

If you have questions regarding the installation of the 3931 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

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When integrating a 3931 into an existing multiple-system environment, or when adding additional systems to an installed 3931, consider the following factors:

- **Thermal interactions**

Although computer room floor space is valuable, for optimal cooling, it is recommended that 3931 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 81](#).

- **Floor placement**

The 3931 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.

When positioning systems with 3 or 4 frames, you must disassemble the system in pairs (2 frames) prior to transporting it into your environment.

- **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.



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## 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.

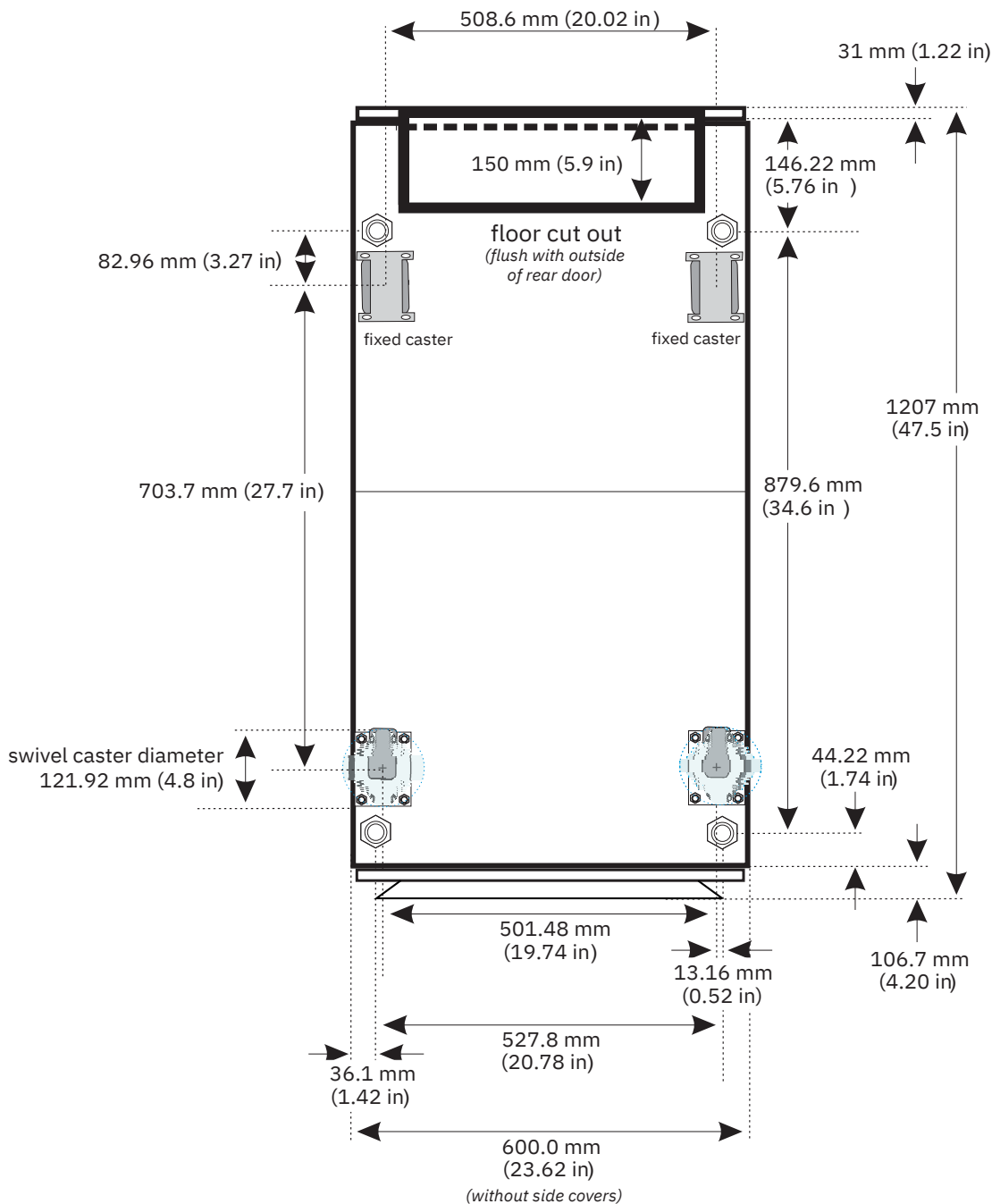
## Casters

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 graphic is an example. See the following sections for more options.



front



## Procedure for cutting and placement of floor panels

**Important:**

3931, fully configured with PDU power, can weigh up to 2813 kg (6203 lbs).

3931, fully configured with BPA power, can weigh up to 3225 kg (7111 lb).

The system weights are distributed over multiple frames.

**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 3931.

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**

**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 must adjust the size of the cut for the thickness of the edge molding you are using. The dimensions shown are finished dimensions.
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



**Attention:** If the Bottom Exit Cabling feature (**FC 7899**) was not ordered, no floor cutout is required.

- **24 in (609 mm) floor panels** - English
  - A cutout depth of 5.9 in (150 mm)
  - A width of 3.0 in (75 mm) of material **must** remain at both ends of the cutout (150 mm x 450 mm cutout)
  - Require the use of frame spacers, which are pre-installed on the system.
- **600 mm (23.5 in) floor panels** - Metric
  - A cutout depth of 150 mm (5.9 in)
  - A width of 75 mm (3.0 in) of material **must** remain at both ends of the cutout (150 mm x 450 mm cutout)
  - Do not require the use of frame spacers, which must be uninstalled from the system before frame placement.

**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.

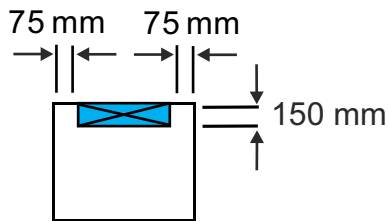


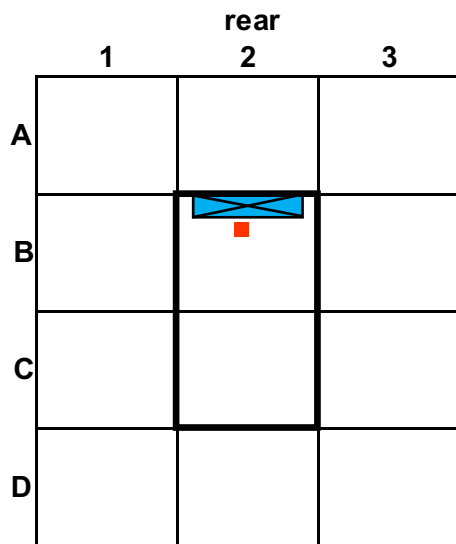
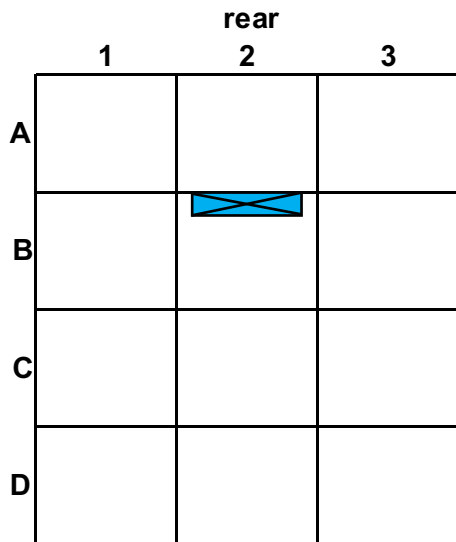
Figure 17. On-grid floor cutout options - 24 in (609 mm) or 23.5 in (600 mm) panels

**Important:**

Extra pedestals can be placed as shown in the following figure.

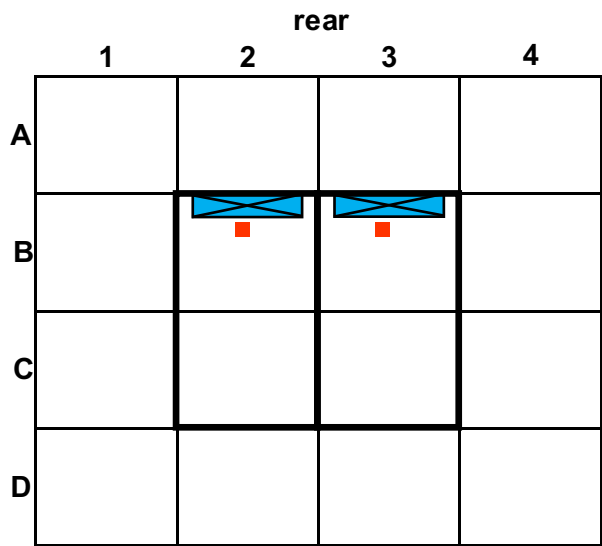
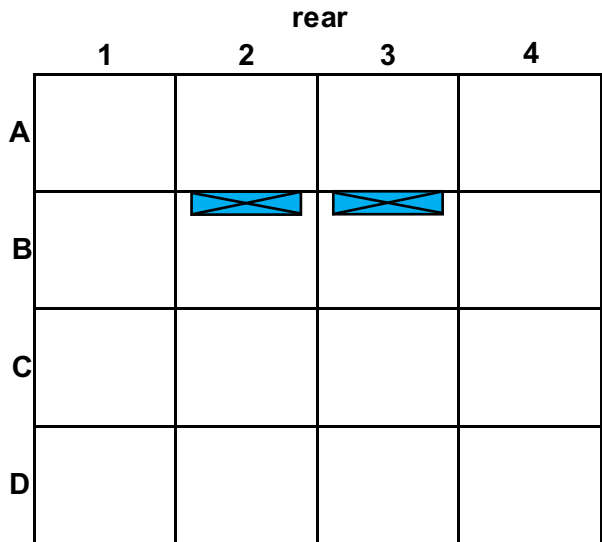
**These extra pedestals are recommendations. You must decide which, if any, of these recommendations to use.**

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.



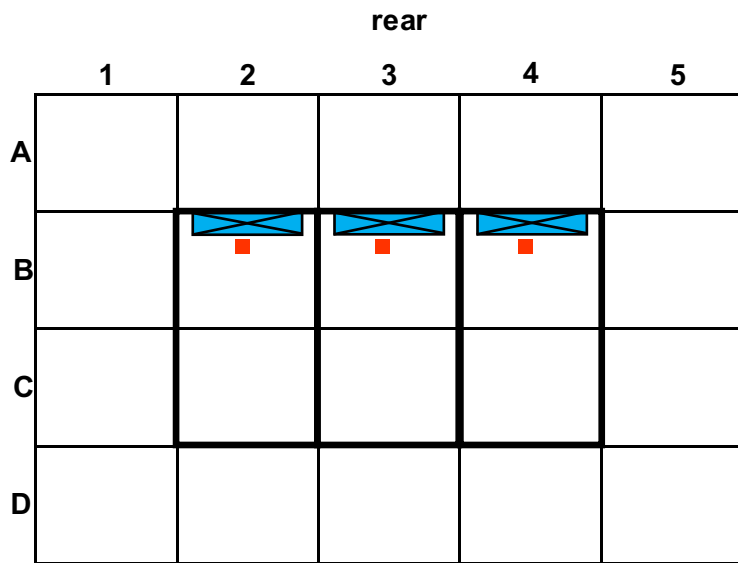
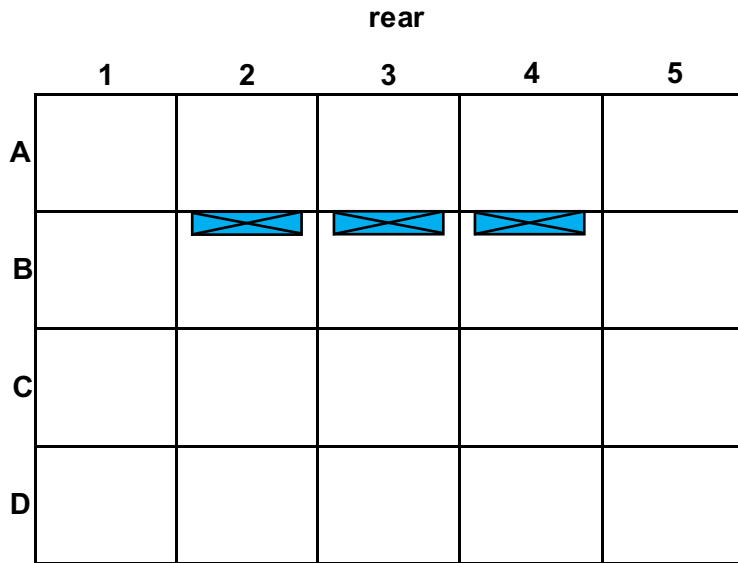
■ = added pedestal

Figure 18. On-grid floor cutouts and minimum number of pedestals - 1 frame



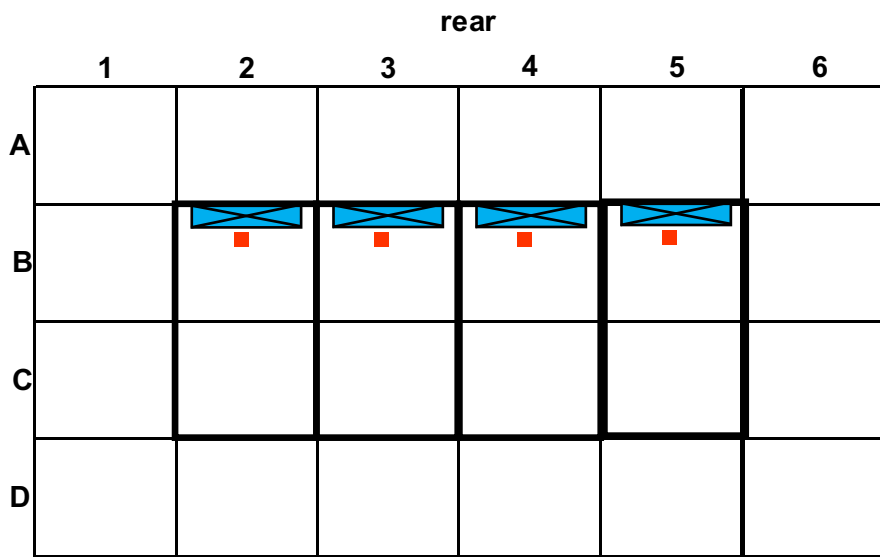
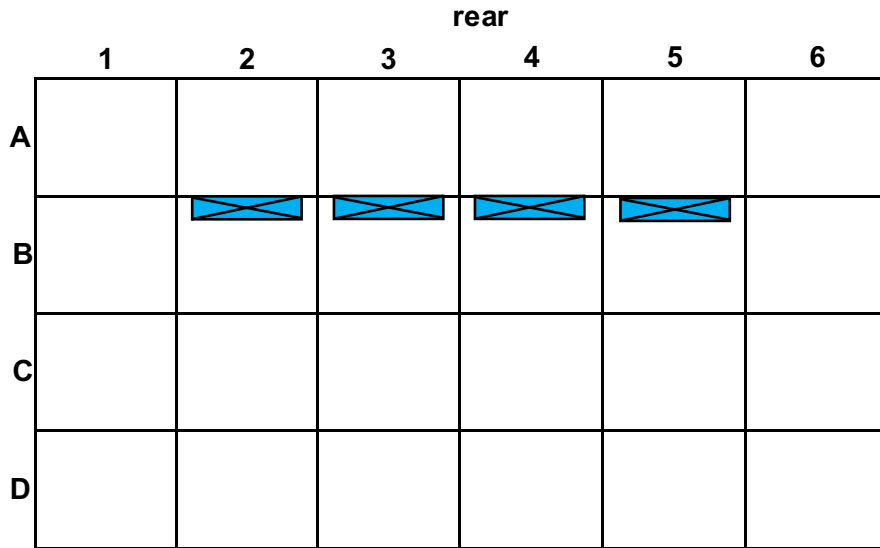
■ = added pedestal

Figure 19. On-grid floor cutouts and minimum number of pedestals - 2 frames



■ = added pedestal

Figure 20. On-grid floor cutouts and minimum number of pedestals - 3 frames



■ = added pedestal

Figure 21. On-grid floor cutouts and minimum number of pedestals - 4 frames

## Chapter 5. Power requirements

The 3931 provides you with two options for powering your system, similar to IBM z15. You must choose one of the following power options:

### Power Distribution Unit (PDU) power

Feature code	Description	Line-Line Voltage
FC 0645	60A 3 Phase PDU (Delta)	200-240V AC (Low Voltage)
FC 0646	32A 3 Phase PDU (WYE)	380-415V AC (High Voltage)

- Supports a maximum of 12 PCIe+ I/O drawers.
- Supports 2, 4, 6, or 8 PDUs, depending on system configuration.
- Requires 2, 4, 6, or 8 line cords, depending on number of PDUs.

### Bulk Power Assembly (BPA) power



**Attention:** The BPA power feature will be available on 4Q 2022. IBM z16 is planned to be the last generation of IBM Z server to support BPA.

Feature code	Description	Comments
FC 0648	Bulk Power Assembly (BPA) pair	Includes 2 Bulk Power Enclosures (BPEs) per BPA feature
FC 3017	Bulk Power Regulator (BPR) pair	Per BPR feature: <ul style="list-style-type: none"> <li>• Minimum quantity of 1, includes 2 BPRs</li> <li>• Maximum quantity of 3, includes 6 BPRs</li> </ul>

- Supports a maximum of 10 PCIe+ I/O drawers.
- Supports 1 or 2 BPA pairs, depending on system configuration.
  - Each BPA pair (**FC 0648**) includes 2 Bulk Power Enclosures (BPEs)
  - Each BPA pair requires a minimum of 2 BPRs (**FC 3017**); up to 3 BPRs per BPA
    - 1 BPA pair feature can support up to 6 BPRs
    - 2 BPA pair features can support up to 12 BPRs
- Requires 2 or 4 line cords; 2 per BPA pair feature.
- 3-phase balanced power is offered as a feature (**FC 3003**) for systems that would otherwise have less than the maximum quantity of BPRs and are desired to have balanced 3-phase currents.

## General electrical power requirements

---

3931 requires the following power requirements:

### **System frame**

#### • **PDU power**

- 2, 4, 6, or 8 PDUs supported
- 2, 4, 6, or 8 line cords required, depending on number of PDUs
- 3-phase line-line voltage ranges:
  - 60A, 200-240V AC
  - 32A, 380-415V AC

**Note:** 480V AC and Higher Voltage DC (HVDC) are not supported.

- Refer to [“Dual "facilities power distribution" installation - PDU power” on page 181](#) for the correct wiring method for your particular power distribution equipment.

#### • **BPA power**

- 2 or 4 BPAs supported
- 2 or 4 line cords required, depending on number of BPAs
- 3-phase line-line nominal voltage ranges:
  - 60A, 200-240V AC
  - 30/32A, 380-415V AC
  - 30A, 480V AC

**Note:** Higher Voltage DC (HVDC) input is not supported.

- For configurations using a total of six or less Bulk Power Regulators (BPRs) - 2 power feeds, of the types previously described, each with the same nominal voltage. Both are connected to the rear of the A frame.
- For all other configurations - 4 power feeds, of the types previously described, each with the same nominal voltage. Two are connected to the rear of the A frame, and two are connected to the rear of the B frame or C frame, depending on system configuration.
- Refer to [“Dual "facilities power distribution" installation - BPA power” on page 189](#) for the correct wiring method for your particular power distribution equipment.

### **Hardware Management Console**

- For HMC **FC 0062**, a single-phase feed from a customer-supplied service outlet. The outlet must provide 90 Vrms to 137 Vrms or 180 Vrms to 265 Vrms 47/63 Hz single-phase AC power.
- For HMC **FC 0063**, the customer must supply a PDU that provides C13 outlets for the three C13/C14 power jumper cables.



## Power and weight estimation tool

---

The power estimator tool for 3931 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 weight estimation**. 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.

**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.

## Power Distribution Unit (PDU) power

### Power installation considerations (PDU)

3931 operates from 2, 4, 6, or 8 power cords, depending on system configuration, 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 C, “Dual “facilities power distribution” installation,” on page 181 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	input voltage	input frequency	input current rating
2, 4, 6, or 8, 3-phase power cords	200-240 V AC	50/60 Hz (47 to 63 Hz with tolerance)	48A
2, 4, 6, or 8, 3-phase power cords	380-415 V AC	50/60 Hz (47 to 63 Hz with tolerance)	24A



#### 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/procnm/WHS-GS-0012?opendocument&login](https://d01db034.pok.ibm.com/q_dir/qmx/ef/qf2pl2.nsf/procnm/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.

# of CPC drawers	# of PCIe+ I/O drawers												
	0	1	2	3	4	5	6	7	8	9	10	11	12
1	2	2	2	2	4	4	4	N/A	N/A	N/A	N/A	N/A	N/A
2	4	4	4	4	4	4	4	4	6	6	6	8	8
3	4	4	4	4	4	4	4	6	6	6	8	8	N/A
4	6	6	6	6	6	6	6	6	6	6	8	8	8

## PDU locations in the frame

The following figure displays all of the eight possible PDU locations in a four frame system. The PDU number assignments (**PDU-A1**) specify the frame, **A**, and the EIA locations of the PDUs within the frame.

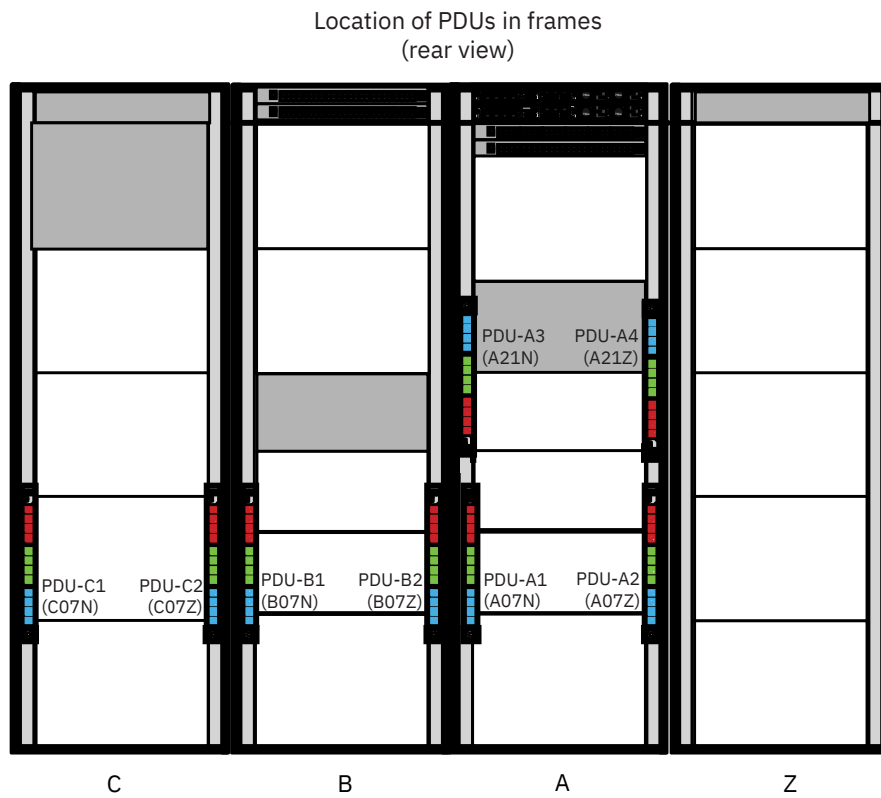


Figure 22. Location of PDUs in the frames

## Power specifications (PDU)

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 Weight Estimation** tool provides a more accurate estimation of the power consumption for your specified configuration. See [“Power and weight estimation tool”](#) on page 95.

FC (# of CPCs)	Number of PCIe+ I/O drawers												
	0	1	2	3	4	5	6	7	8	9	10	11	12
<b>0667 (1)</b>	4.9 kW	5.8 kW	6.8 kW	7.7 kW	8.6 kW	9.5 kW	10.4 kW	-	-	-	-	-	-
<b>0668 (2)</b>	8.7 kW	9.7 kW	10.6 kW	11.6 kW	12.5 kW	13.4 kW	14.3 kW	15.2 kW	16.2 kW	17.1 kW	18.0 kW	18.9 kW	19.8 kW
<b>0669 (3)</b>	12.8 kW	13.8 kW	14.7 kW	15.7 kW	16.6 kW	17.5 kW	18.4 kW	19.4 kW	20.3 kW	21.2 kW	22.1 kW	23.0 kW	-
<b>0670 or 0671 (4)</b>	17.6 kW	18.7 kW	19.6 kW	20.5 kW	21.4 kW	22.4 kW	23.3 kW	24.2 kW	25.1 kW	26.0 kW	26.9 kW	27.8 kW	28.7 kW

### Notes:

- The power used in this table assumes the CPC processor drawer and PCIe+ I/O drawers are maximally configured with highest power features (for example: memory and I/O adapters and fanouts). Also assumed is a maximum system inlet air temperature of 40°C at 945 meters (3100 feet) elevation.
- Typical configurations and data center conditions will result in lower power usage.

## Customer circuit breakers (PDU)

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

Input Voltage Range (V)	System Rated Current (A)	Circuit Breaker
200 - 240V AC	48A	60/63 A
380 - 415V AC	24A	30/32 A

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 3931. By internal design and grounding, 3931 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 power cord input pairs should be reasonably equal in length or at least no one connection should be much shorter than the other.

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 37 on page 100](#) 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)

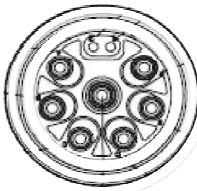




Table 37. Supported PDU power cords					
Feature code Countries Voltage Amperage Phase Length Wall plug	IBM shipped plug (on cord)	View of customer plug	Plug (on cord) customer end (pin contacts)	Receptacle (on wall, female contacts) / Connector (on cord, female contacts) <sup>8</sup>	IBM part number of cord <sup>9</sup>
<p><b>FC 7946</b></p> <p>USA, CNN <sup>2</sup>, Japan ----- 400 V AC ----- 30/32 A ----- three phase (WYE) ----- 4.3 m (14 ft) ----- IEC 60309, 4P-5W</p>	<p>plug: Souriau UTG</p> 		<p>plug type: HBL530P6V02</p>	<p>receptacle type: HBL530R6V02</p>  <p>connector type: HBL530C6V02</p> 	03FM499
<p><b>FC 7947</b></p> <p>World Trade <sup>1</sup> ----- 380-415 V AC ----- 32 A ----- three phase (WYE) ----- 4.3 m (14 ft) ----- Cut End</p>	<p>plug: Souriau UTG</p> 	<p>Cut End<sup>3</sup></p>	<p>Cut End (lead labels) L1 L2 L3 N GND</p>	<p>(not specified)</p>	03GN439

Table 37. Supported PDU power cords (continued)

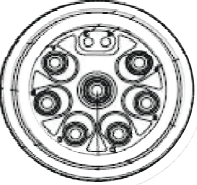
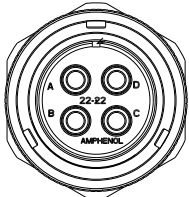



<b>Feature code</b> <b>Countries</b> <b>Voltage</b> <b>Amperage</b> <b>Phase</b> <b>Length</b> <b>Wall plug</b>	<b>IBM shipped plug (on cord)</b>	<b>View of customer plug</b>	<b>Plug (on cord) customer end (pin contacts)</b>	<b>Receptacle (on wall, female contacts) / Connector (on cord, female contacts)<sup>8</sup></b>	<b>IBM part number of cord<sup>9</sup></b>
<p><b>FC 7948</b></p> <p>World Trade <sup>1</sup>                      -----                      380-415 V AC                      -----                      32 A, LSZH                      -----                      three phase (WYE)                      -----                      4.3 m (14 ft)                      -----                      Cut End                      -----                      low smoke, halogen-free</p>	<p>plug: Souriau UTG</p> 	<p>Cut End<sup>3</sup></p>	<p>Cut End (lead labels)                      L1                      L2                      L3                      N                      GND</p>	<p>(not specified)</p>	<p>03FM501</p>
<p><b>FC 7971</b></p> <p>USA, CNN <sup>2</sup>,                      Japan                      -----                      250 V AC                      -----                      60 A                      -----                      three phase (Delta)                      -----                      4.3 m (14 ft)                      -----                      IEC 60309 3P-4W</p>	<p>plug: Amphenol 02WN656</p> 		<p>plug type: HBL460P9V05</p>	<p>receptacle type: HBL460R9W</p>  <p>connector type: HBL460C9W</p> 	<p>02WN658</p>

Table 37. Supported PDU power cords (continued)

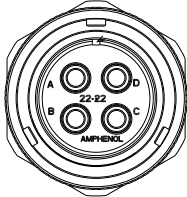
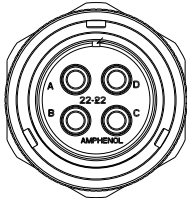
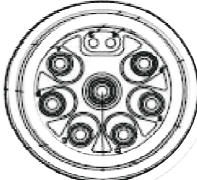



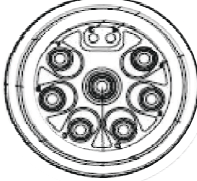



<b>Feature code</b> <b>Countries</b> <b>Voltage</b> <b>Amperage</b> <b>Phase</b> <b>Length</b> <b>Wall plug</b>	<b>IBM shipped plug (on cord)</b>	<b>View of customer plug</b>	<b>Plug (on cord) customer end (pin contacts)</b>	<b>Receptacle (on wall, female contacts) / Connector (on cord, female contacts)<sup>8</sup></b>	<b>IBM part number of cord<sup>9</sup></b>
<p><b>FC 7972</b></p> <p>World Trade <sup>1</sup>                      -----                      250 V AC                      -----                      60 A                      -----                      three phase (Delta)                      -----                      4.3 m (14 ft)                      -----                      Cut End</p>	<p>plug: Amphenol 02WN656</p> 	<p>Cut End<sup>3</sup></p>	<p>Cut End (lead labels) PH-1 PH-2 PH-3 GND</p>	<p>(not specified)</p>	<p>03GN074</p>
<p><b>FC 7973</b></p> <p>World Trade <sup>1</sup>                      -----                      250 V AC                      -----                      60 A, LSZH                      -----                      three phase (Delta)                      -----                      4.3 m (14 ft)                      -----                      low smoke, halogen-free                      -----                      Cut End</p>	<p>plug: Amphenol 02WN656</p> 	<p>Cut End<sup>3</sup></p>	<p>Cut End (lead labels) PH-1 PH-2 PH-3 GND</p>	<p>(not specified)</p>	<p>03GN076</p>



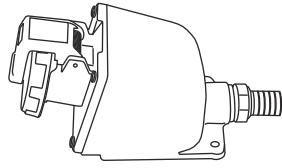
Table 37. Supported PDU power cords (continued)

Feature code Countries Voltage Amperage Phase Length Wall plug	IBM shipped plug (on cord)	View of customer plug	Plug (on cord) customer end (pin contacts)	Receptacle (on wall, female contacts) / Connector (on cord, female contacts) <sup>8</sup>	IBM part number of cord <sup>9</sup>
<p><b>FC 7974</b></p> <p>USA, CAN, Mexico, Japan ----- 240 V AC ----- 30 A ----- single phase ----- 4.3 m (14 ft) ----- IEC 309, 2P-3W</p>	<p>plug: Souriau UTG</p> 		<p>plug type: 330P6W</p>	<p>receptacle type: 330R6W</p>  <p>connector type: 330C6W</p> 	<p>03JJ281</p>
<p><b>FC 7975</b></p> <p>EMEA ----- 380 - 415 V AC ----- 32 A ----- three phase (WYE) ----- 4.3 m (14 ft) ----- IEC 309, 3P+N+G</p>	<p>plug: Souriau UTG</p> 		<p>plug type: 532P6W</p>	<p>receptacle type: 532R6W</p>  <p>connector type: 532C6W</p> 	<p>39M5413</p>

**Notes:**

1. Except US, Japan, Australia, Korea, India, China, and all CNN.
2. CNN includes the following geographies: Bahamas, Turks & Caicos, Barbados, Bermuda, Guyana, Cayman Islands, Canada, Jamaica, Dutch Caribbean, Aruba, Bonaire, 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, 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	#12 AWG HAR/LSZH	No	16.0 (0.63)
USA, CNN, Japan 3-Phase (250 V AC), Delta 14 ft	FC 7971	#6 AWG Type PPE	Yes	28.5 (1.12)
World Trade 3-Phase (250 V AC), Delta 14 ft	FC 7972	#6 AWG Type PPE	No	28.5 (1.12)
World Trade 3-Phase (250 V AC), Delta 14 ft low smoke, halogen-free	FC 7973	#6 AWG Type DP-LS	No	25.9 (1.02)
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)

### 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.

## Lead colors for cut end line cords (PDU)

Feature code (FC)	IBM part number of cord	Lead labels and corresponding color
FC 7947	03GN439	Line 1 ( <b>L-1</b> ) = Brown Line 2 ( <b>L-2</b> ) = Black Line 3 ( <b>L-3</b> ) = Gray Neutral ( <b>N</b> ) = Blue Ground ( <b>GND</b> ) = Green/Yellow
FC 7948	03FM501	Line 1 ( <b>L-1</b> ) = Brown Line 2 ( <b>L-2</b> ) = Black Line 3 ( <b>L-3</b> ) = Gray Neutral ( <b>N</b> ) = Blue Ground ( <b>GND</b> ) = Green/Yellow
FC 7972	03GN074	Phase 1 ( <b>PH-1</b> ) = Red Phase 2 ( <b>PH-2</b> ) = Black Phase 3 ( <b>PH-3</b> ) = Blue Ground ( <b>GND</b> ) = Green/Yellow
FC 7973	03GN076	Phase 1 ( <b>PH-1</b> ) = Brown Phase 2 ( <b>PH-2</b> ) = Black Phase 3 ( <b>PH-3</b> ) = Gray Ground ( <b>GND</b> ) = Green/Yellow

### Notes:

- Leads are individually labeled for identification during system installation.
- IBM part numbers are subject to change.

## Bulk Power Assembly (BPA) power



**Attention:** The BPA power feature will be available on 4Q 2022. IBM z16 is planned to be the last generation of IBM Z server to support BPA.

### Power installation considerations (BPA)

The 3931 can optionally operate from 2 or 4 fully-redundant BPA power supplies. These redundant BPA power supplies each have their own line cords, allowing the system to survive the loss of input power to either line cord. If power is interrupted to one of the BPA power supplies, the other BPA power supply will pick up the entire load and the system will continue to operate without interruption. Therefore, the line cord(s) for each BPA power supply must be wired to support the entire power load of the system.

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

See Appendix C, “Dual “facilities power distribution” installation,” on page 181 for examples of typical redundant wiring facilities.

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.

The utility current distribution across the phase conductors (phase current balance) depends on the system configuration. Each front end power supply is provided with phase switching redundancy. The loss of an input phase is detected and the total input current is switched to the remaining phase pair without any power interruption. Depending on the configuration input power draw, the system can run indefinitely as long as there are no other utility power faults occurring simultaneously. Due to most single phase losses being transients which recover in seconds, this redundancy provides protection against almost all loss of one phase outages.

Supply type	Nominal voltages (V)	Voltage tolerances (V)	Frequency (Hz)
Two or four redundant 3-phase line cords	200, 208-240, 380-415, 480	180-264, 342-456, 432-528	50 / 60

Source type	Frequency	Input voltage range (V)	Rated input current (A)
Three-phase (60A plug) Delta	50/60 Hz	200V <sup>1</sup>	50A
Three-phase (60A plug) Delta	50/60 Hz	208V - 240V <sup>2</sup>	48A
Three-phase (30A plug) WYE	50/60 Hz	380V - 415V <sup>3</sup>	24A
Three-phase (30A plug) WYE	60 Hz	480V <sup>4</sup>	21A

**Notes:**

1. Japan (same physical cord as Note 2)
2. US, Canada (same physical cord as Note 1)
3. US, Canada only
4. US only

## Line cord/Bulk Power Regulator (BPR) specifications

The following tables provide number of line cords and number of BPRs required based on the number of CPC processor drawers and number of PCIe+ I/O drawers in the server configurations.

<i>Table 38. Number of BPRs installed per BPA</i>							
	Number of PCIe+ I/O drawers <sup>3</sup>						
	0	1	2	3	4	5	6
<b>(0 processor drawer)</b>	-	1	1	1	1	2	2
<b>(1 processor drawer)</b>	1 <sup>1</sup>	1 <sup>1</sup>	2 <sup>1</sup>	2 <sup>1</sup>	2	2	2
<b>(2 processor drawers)</b>	2 <sup>1</sup>	2 <sup>1</sup>	2 <sup>1</sup>	2 <sup>1</sup>	2 <sup>1</sup>	3 <sup>2</sup>	3
<b>(3 processor drawers)</b>	2 <sup>1</sup>	2 <sup>1</sup>	3 <sup>2</sup>	3 <sup>2</sup>	3 <sup>2</sup>	3 <sup>2</sup>	-

**Notes:**

1. Single-line power cord pair.
2. Two-line power cord pair.
3. Current balance on the phases is determined by the BPR count in this table. The balance (or imbalance) is defined in [Table 39 on page 108](#).

The following table describes the current balance for BPA pair 1 (A frame) and BPA pair 2 (B or C frame).

<i>Table 39. Current balance per line cord</i>	
	Current balance per cord per BPA pair
1 BPR per BPA	unbalanced <sup>1</sup>
2 BPRs per BPA	unbalanced <sup>2</sup>
3 BPRs per BPA	balanced <sup>3</sup>

**Note:**

1. Unbalanced where two phases carry equal current and the third phase carries zero current.
2. Unbalanced where two phases carry equal current and the third phase carries 1.732 times the current in the other two.
3. Balanced where all three phases carry the same current.

## BPA locations in the frame

The following figure displays the possible BPA locations in a four frame system.

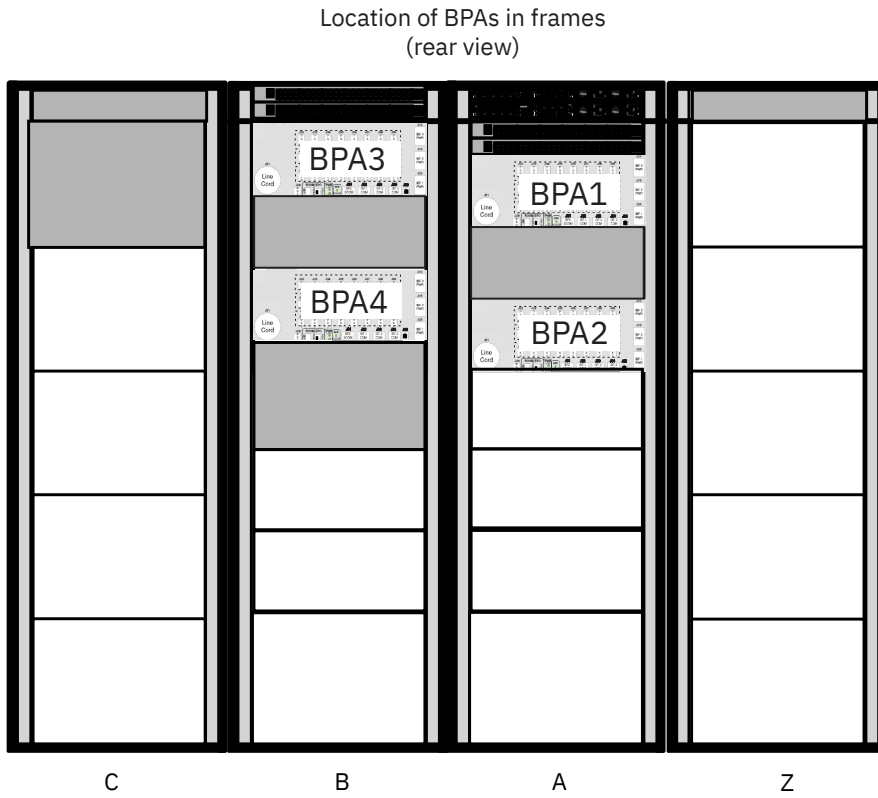


Figure 23. Location of BPAs in the frames

## Power specifications (BPA)

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 Weight Estimation** tool provides a more accurate estimation of the power consumption for your specified configuration. See “Power and weight estimation tool” on page 95.

FC (# of CPCs)	# of PCIe+ I/O drawers										
	0	1	2	3	4	5	6	7	8	9	10
<b>0667</b> (1)	7.0 kW	8.0 kW	9.0 kW	9.9 kW	10.8 kW	11.7 kW	14.0 kW	-	-	-	-
<b>0668</b> (2)	10.7 kW	11.6 kW	12.5 kW	13.4 kW	14.3 kW	16.6 kW	17.9 kW	19.0 kW	20.1 kW	21.1 kW	22.1 kW
<b>0669</b> (3)	14.1 kW	15.1 kW	16.1 kW	17.1 kW	18.0 kW	20.4 kW	21.7 kW	22.8 kW	23.9 kW	24.9 kW	25.9 kW
<b>0670</b> or <b>0671</b> (4)	20.6 kW	21.6 kW	22.6 kW	23.6 kW	24.6 kW	25.5 kW	26.5 kW	27.4 kW	28.3 kW	29.2 kW	30.0 kW

### Notes:

- The power used in this table assumes the CPC processor drawer and PCIe+ I/O drawers are maximally configured with highest power features (for example: memory and I/O adapters and fanouts). Also assumed is a maximum system inlet air temperature of 40°C at 945 meters (3100 feet) elevation.
- Typical configurations and data center conditions will result in lower power.

## Customer circuit breakers (BPA)

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

Input voltage range (V)	System rated current (A)	Circuit Breaker Rating (A)
200-240 V AC	48A (50A Japan)	60A/63A WT
380-415 V AC	24A	30A/32A WT
480 V AC	21A	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 3931. By internal design and grounding, 3931 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 (BPA)

Attached plugs are included with the power line cords in USA and Canada. The line cord length is 4267.2 mm (14 ft) outside the frame. Power plugs in the following table are approved for use with specified models and meet the relevant safety agency 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. *For example:* For WYE sources, you must ensure the neutral is wired to the receptacle!

For countries that require other types of plugs or receptacles, the system is shipped without plugs on the line cords, and you are responsible for supplying and installing both plugs and receptacles.

**Important:**

In a typical three-phase power cord, there are **five** or **six** wires inside the cut cord cable. There are the three phase wires (or the three phase wires *and* a neutral wire if WYE connected), one ground wire, and a small diameter wire that is connected to the cable shield and serves as a drain. This drain wire must connect to the **cable ground** (NOT neutral, if neutral is present).

Table 42. Supported BPA power cords

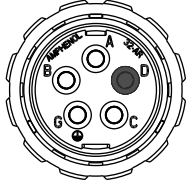



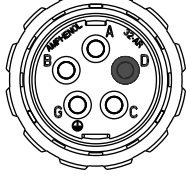
Feature code Countries Voltage Amperage Phase Length Wall plug	IBM shipped plug (on cord)	View of customer plug	Plug (on cord) customer end (pin contacts)	Receptacle (on wall, female contacts) / Connector (on cord, female contacts) <sup>8</sup>	IBM part number of cord <sup>9</sup>
<p><b>FC 7954</b></p> <p>USA, CNN <sup>2</sup>, Japan</p> <p>-----</p> <p>250 V AC</p> <p>-----</p> <p>60 A</p> <p>-----</p> <p>three phase (Delta)</p> <p>-----</p> <p>4.3 m (14 ft)</p>	<p>plug: Amphenol 02WN203</p> 		<p>plug type: HBL460P9V05</p>	<p>receptacle type: HBL460R9W</p>  <p>connector type: HBL460C9W</p> 	03FM139
<p><b>FC 7955</b></p> <p>World Trade <sup>1</sup></p> <p>-----</p> <p>250 V AC</p> <p>-----</p> <p>60 A</p> <p>-----</p> <p>three phase (Delta)</p> <p>-----</p> <p>4.3 m (14 ft)</p> <p>-----</p> <p>Cut End</p>	<p>plug: Amphenol 02WN203</p> 	<p>Cut End<sup>3</sup></p>	<p>Cut End<sup>3</sup> (lead labels) PH-1 PH-2 PH-3 GND</p>	<p>(not specified)</p>	03JJ274

Table 42. Supported BPA power cords (continued)

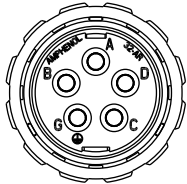



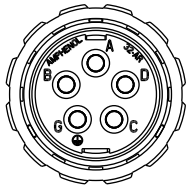
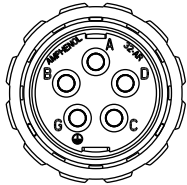
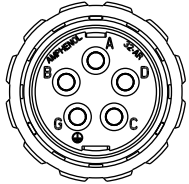



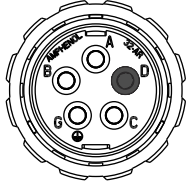
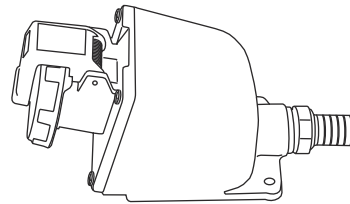
Feature code Countries Voltage Amperage Phase Length Wall plug	IBM shipped plug (on cord)	View of customer plug	Plug (on cord) customer end (pin contacts)	Receptacle (on wall, female contacts) / Connector (on cord, female contacts) <sup>8</sup>	IBM part number of cord <sup>9</sup>
<p><b>FC 7956</b></p> <p>USA, CNN <sup>2</sup>, Japan ----- 400 V AC ----- 30/32 A ----- three phase (WYE) ----- 4.3 m (14 ft)</p>	<p>plug: Amphenol 45W3287</p> 		<p>plug type: HBL530P6V02</p>	<p>receptacle type: HBL530R6V02</p>  <p>connector type: HBL530C6V02</p> 	<p>03FM143</p>
<p><b>FC 7957</b></p> <p>World Trade <sup>1</sup> ----- 380-415 V AC ----- 32 A ----- three phase (WYE) ----- 4.3 m (14 ft) ----- Cut End</p>	<p>plug: Amphenol 45W3287</p> 	<p>Cut End<sup>3</sup></p>	<p>Cut End<sup>3</sup> (lead labels) PH-1 PH-2 PH-3 N GND</p>	<p>(not specified)</p>	<p>03FM144</p>
<p><b>FC 7958</b></p> <p>World Trade <sup>1</sup> ----- 380-415 V AC ----- 32 A, LSZH ----- three phase (WYE) ----- 4.3 m (14 ft) ----- Cut End ----- low smoke, halogen-free</p>	<p>plug: Amphenol 45W3287</p> 	<p>Cut End<sup>3</sup></p>	<p>Cut End<sup>3</sup> (lead labels) PH-1 PH-2 PH-3 N GND</p>	<p>(not specified)</p>	<p>03FM145</p>

Table 42. Supported BPA power cords (continued)

<b>Feature code</b> <b>Countries</b> <b>Voltage</b> <b>Amperage</b> <b>Phase</b> <b>Length</b> <b>Wall plug</b>	<b>IBM shipped plug (on cord)</b>	<b>View of customer plug</b>	<b>Plug (on cord) customer end (pin contacts)</b>	<b>Receptacle (on wall, female contacts) / Connector (on cord, female contacts)<sup>8</sup></b>	<b>IBM part number of cord<sup>9</sup></b>
<p><b>FC 7959</b></p> <p>USA, CNN <sup>2</sup>, Japan ---- 480 V AC ---- 30 A ---- three phase (WYE) ---- 4.3 m (14 ft)</p>	<p>plug: Amphenol 45W3287</p> 		<p>plug type: HBL530P7W</p>	<p>receptacle type: HBL530R7W</p>  <p>connector type: HBL530C7W</p> 	<p>03FM146</p>
<p><b>FC 7965</b></p> <p>World Trade <sup>1</sup> ---- 250 V AC ---- 60 A, LSZH ---- three phase (Delta) ---- 4.3 m (14 ft) ---- low smoke, halogen-free</p>	<p>plug: Amphenol 02WN203</p> 	<p>Cut End<sup>3</sup></p>	<p>Cut End<sup>3</sup> (lead labels) PH-1 PH-2 PH-3 GND</p>	<p>(not specified)</p>	<p>03JJ275</p>

**Notes:**

1. Except US, Japan, Australia, Korea, India, China, and all CNN.
2. CNN includes the following geographies: Bahamas, Turks & Caicos, Barbados, Bermuda, Guyana, Cayman Islands, Canada, Jamaica, Dutch Caribbean, Aruba, Bonaire, 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 backboxes 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 miswired 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.
6. See [“Line cord wire specifications \(BPA\)”](#) on page 116 for descriptions of the power cord feature codes.
7. Only the connector is supported because these cords attach directly to the system.
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 (BPA)

Line cord usage location	Feature code	AWG # / type	Number of shields	Connector supplied	Bulk outside diameter mm (in)
USA, Japan, CNN (250 V AC) 60 A, Delta	FC 7954	#6 AWG Type PPE	1 (overall gross shield)	Yes	28.5 (1.12)
World Trade (250 V AC) 60 A, Delta	FC 7955	#6 AWG Type PPE	1 (overall gross shield)	No	28.5 (1.12)
USA, Japan, CNN (400 V AC) 30/32 A, WYE	FC 7956	#10 AWG Type ST	1 (overall gross shield)	Yes	20.45 (0.81)
World Trade (380-415 V AC) 32 A, WYE	FC 7957	#10 AWG Type ST	1 (overall gross shield)	No	20.45 (0.81)
World Trade, LSZH (380-415 V AC) 32 A, WYE	FC 7958	#10 AWG Type ST/LS	1 (overall gross shield)	No	20.45 (0.81)
USA, Japan, CNN (480 V AC) 30 A, WYE	FC 7959	#10 AWG Type ST	1 (overall gross shield)	Yes	20.45 (0.81)
World Trade (250 V AC) 60 A, Delta	FC 7965	#6 AWG Type DP-LS	1 (overall gross shield)	No	25.9 (1.02)

### Notes:

1. Where power line cords plugs are provided, Hubbell is the plug supplier.
2. If you choose to use a Hubbell receptacle, do NOT use the Hubbell C-Series Light Industrial
3. 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.
4. 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.

## Lead colors for cut end line cords (BPA)

Feature code (FC)	IBM part number of cord	Lead labels and corresponding color
FC 7955	03JJ274	Phase 1 ( <b>PH-1</b> ) = Red Phase 2 ( <b>PH-2</b> ) = Black Phase 3 ( <b>PH-3</b> ) = Blue Ground ( <b>GND</b> ) = Green/Yellow
FC 7957	03FM144	Phase 1 ( <b>PH-1</b> ) = White Phase 2 ( <b>PH-2</b> ) = Black Phase 3 ( <b>PH-3</b> ) = Red Neutral ( <b>N</b> ) = Blue Ground ( <b>GND</b> ) = Green/Yellow
FC 7958	03FM145	Phase 1 ( <b>PH-1</b> ) = White Phase 2 ( <b>PH-2</b> ) = Black Phase 3 ( <b>PH-3</b> ) = Red Neutral ( <b>N</b> ) = Blue Ground ( <b>GND</b> ) = Green/Yellow
FC 7965	03JJ275	Phase 1 ( <b>PH-1</b> ) = Brown Phase 2 ( <b>PH-2</b> ) = Black Phase 3 ( <b>PH-3</b> ) = Gray Ground ( <b>GND</b> ) = Green/Yellow

### Notes:

- Leads are individually labeled for identification during system installation.
- IBM part numbers are subject to change.

## 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**.



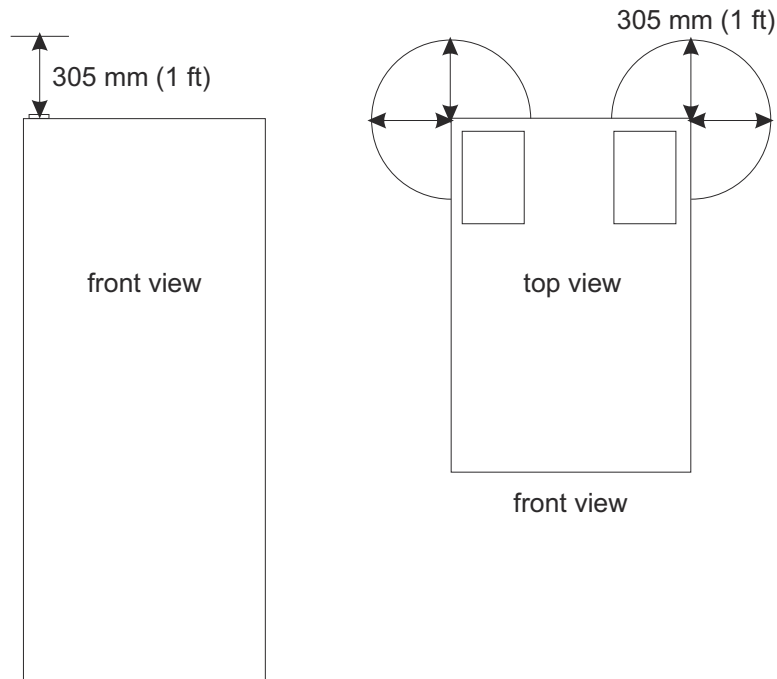
## Power cabling

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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 7816**)
- Through the top of the frame using the Top Exit cabling feature *with* top hat (**FC 7898**)
- Through the bottom of the frame using the Bottom Exit cabling feature (**FC 7899**).

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 B, “Top Exit cabling and Bottom Exit cabling specifications,”](#) on page 175 for information on the top exit cabling feature (FC 7898) and the bottom exit cabling feature (FC 7899).



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## Chapter 6. Hardware Management Console and Support Element communications

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### Support Element

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The 3931 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 3931 power supply, and there are no additional power requirements.

The Support Elements or Hardware Management Appliance on the 3931 connect to the LAN via the customer network switch. Then the Support Elements or Hardware Management Appliance connects to the Ethernet switches in the 3931. The Hardware Management Console also connects to the LAN via the customer network switch.

## Hardware Management Console

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**Attention:** The 2461 Hardware Management Console features (FC 0062, FC 0063, FC 0082, or FC 0083) can only be *carried forward* to the 3931.

The only *new* Hardware Management Console feature offered with the 3931 is with the **Hardware Management Appliance** feature (**FC 0129**).

A single console can support multiple machines and can be located remotely to the physical sites.

The supported *carry forward* Hardware Management Console features are as follows:

- The 2461 Hardware Management Console Tower (*carry forward only*) 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 - *carry forward only*)
  - The console requires a customer-supplied table to hold the KMM.
- The 2461 Hardware Management Console Rack Mount (*carry forward only*) 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 - *carry forward only*)
  - 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.

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### Requirements

The Hardware Management Console Tower requires two 110/120V AC outlets for USA and Canada. The Hardware Management Console Rack Mount 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 3931. You **must** supply your own Ethernet switch to manage the Ethernet connection between the Support Elements and HMCs. It is recommended that the Ethernet switch support a speed of 1 Gbps.

## Ethernet LAN switch support

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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 3931. You must supply your own Ethernet switch unless you are upgrading to a 3931.

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 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 3931, 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 24 on page 124.](#))

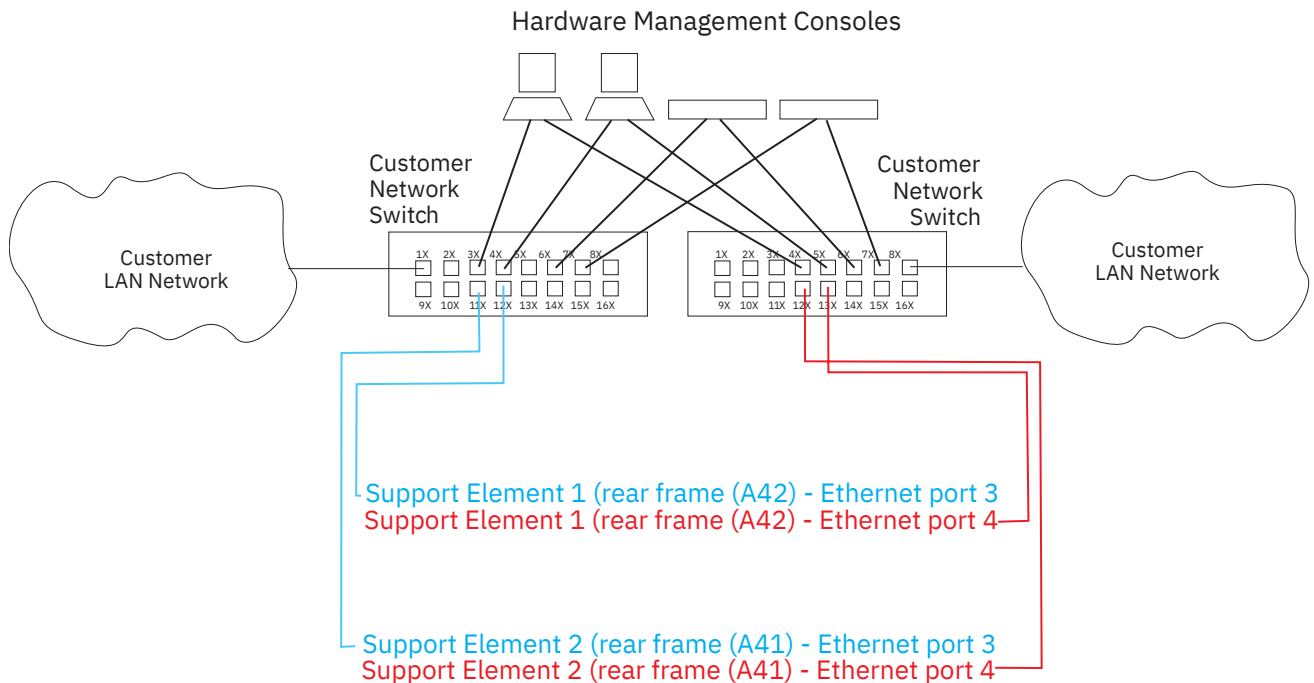


Figure 24. Two-switch configuration

### **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 3931, the dual 1U servers function as a Support Element (SE) and a Hardware Management Console (HMC). See [Figure 25 on page 125](#) for network connection requirements.

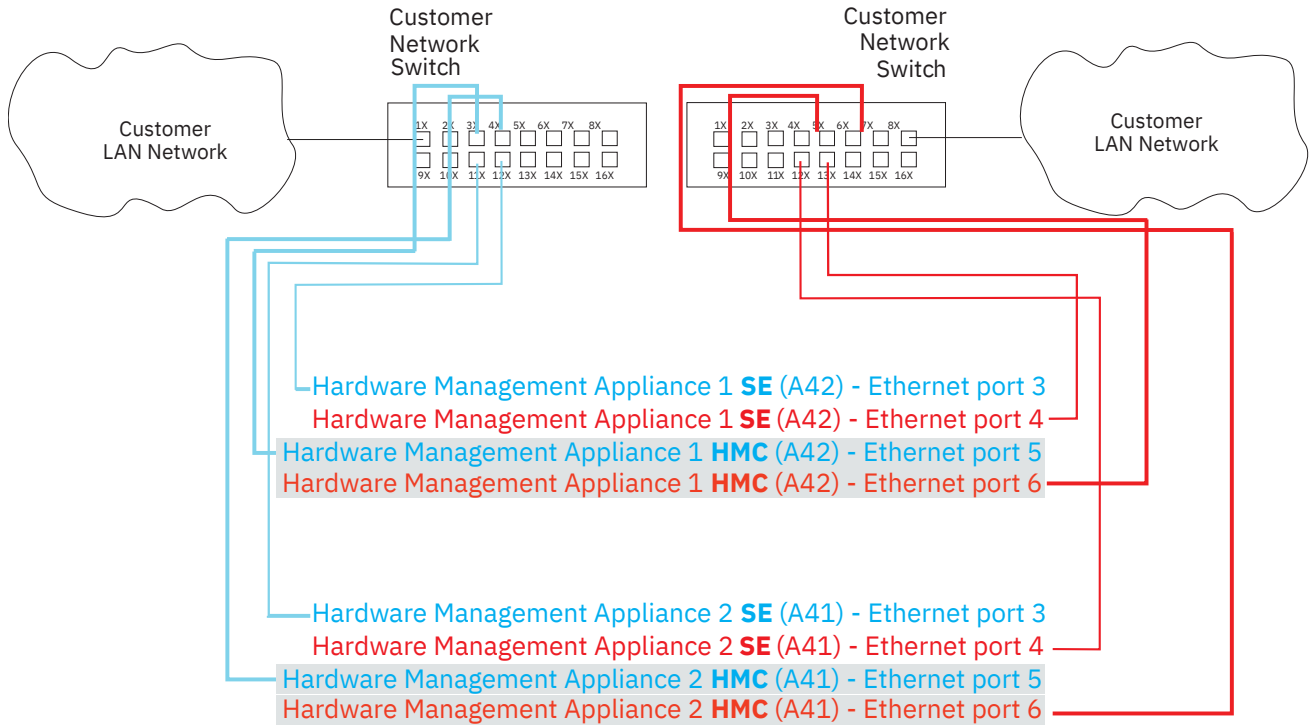


Figure 25. Two-switch configuration with Hardware Management Appliance (FC 0129)

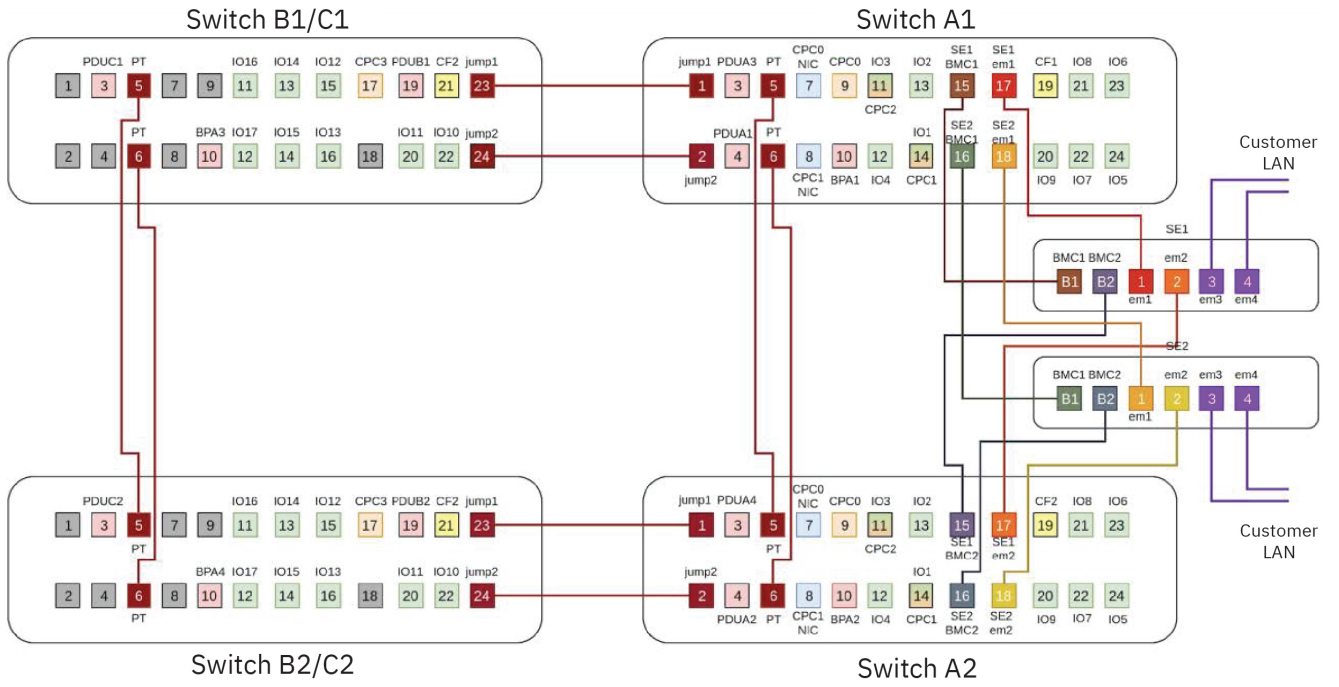


Figure 26. Ethernet Switch assignments



## Hardware Management Console and Support Element wiring options

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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)

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The 3931 may have one or more of the following Crypto Express features for applications where extensive data security is required.

**FC 0908** or **FC 0909**: Crypto Express8S

**FC 0898** or **FC 0899**: Crypto Express7S

**FC 0893**: Crypto Express6S

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.

### Notes:

- TKE 10.0 (**FC 0882**) is required to manage a Crypto Express8S feature.
- TKE 10.0 is required to manage a Crypto Express6S or Crypto Express5S and the additional domains provided on the Crypto feature on the 3931.
- The TKE does not check the IBM Z or LinuxONE processor level. It is the version of the newest HSM on your 3931 that determines what level of TKE you must have. Use this chart to determine the level of TKE you need to manage the HSMs on your 3931:
  - TKE 10.0 is the minimum level of TKE needed to manage a crypto express 8 HSM
  - TKE 9.2 is the minimum level of TKE needed to manage a crypto express 7 HSM
  - TKE 9.0 is the minimum level of TKE needed to manage a crypto express 6 HSM
  - TKE 8.0 is the minimum level of TKE needed to manage a Crypto express 5 HSM

It is *always* best to be at the most current level of TKE because it can manage any level of HSM.

---

The supported Trusted Key Entry (TKE) features are as follows:

- The following **table top or tower** TKE workstations include a system unit, flat panel display, mouse, keyboard, and line cord.
  - FC 0058: TKE 2461-TW4
  - FC 0088: TKE 2461-TW3 (*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 2461-SE4
  - FC 0087: TKE 2461-SE3 (*carry forward only*)
- Optional TKE Tabletop KMM (keyboard, monitor, mouse) - FC 0157
- Optional 1U TKE Rack Mount KMM (keyboard, monitor, mouse) - FC 0156



**Attention:** FC 0087 and FC 0088 can only be carried forward; however, to use with the 3931, they must be converted by replacing the installed Crypto adapter card with a 4770 TKE Crypto adapter card (FC 0851).

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.

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 10.0 as follows:
  - The smart card readers can be used on TKE 10.0 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 10.0 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 Express6S, Crypto Express7S or Crypto Express8S modules.
  - A smart card from FC 0885 or 0886 can be initialized as any one of the 6 types (CA, TKE, EP11, MCA, IA or KPH) of smart cards on TKE 10.0.

To use the TKE function on 3931, the following must be installed:

- FC 0908** or **FC 0909**: Crypto Express8S
- FC 0898** or **FC 0899**: Crypto Express7S
- FC 0893**: Crypto Express6S
- FC 0882**: TKE 10.0 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)

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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 not 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



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## 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

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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 136, 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 136 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:

- *New addresses*
  - 129.42.21.70
  - 129.42.18.70
  - 129.42.19.70
- *Current addresses*
  - 129.42.54.189
  - 129.42.56.189
  - 129.42.60.189

### IPv6 addresses

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

- *New addresses*
  - 2607:f0d0:3901:33:129:42:21:70
  - 2607:f0d0:1f01:9f:129:42:18:70
  - 2607:f0d0:2601:13:129:42:19:70
- *Current addresses*
  - 2620:0:6c0:200:129.42.54.189
  - 2620:0:6c0:200:129.42.56.189
  - 2620:0:6c2:200:129.42.60.189

## Bandwidth requirements

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The 3931 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.

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## 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 3931 channel feature connections.
- A description of the Fiber Quick Connect harness bracket feature offered for customer FICON cables.

### I/O cabling

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You can route I/O cables:

- Through the top of the frame using:
  - Top Exit Cabling feature with top hat (**FC 7898**), with or without Fiber Quick Connect (FQC) harness brackets.
  - Top Exit Cabling feature without top hat (**FC 7816**), routing cables directly through the top of the frame
- Through the bottom of the frame using:
  - Bottom Exit cabling feature (**FC 7899**) *with* Fiber Quick Connect (FQC) harness brackets
  - Bottom Exit cabling feature (**FC 7899**) *without* Fiber Quick Connect (FQC) harness brackets
- Through the bottom or top of the frame using the spine cable management hardware.

See Appendix B, “[Top Exit cabling and Bottom Exit cabling specifications](#),” on page 175 for information on the top exit cabling feature and the bottom exit cabling feature.

## IBM Site and Facilities

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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 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 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

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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 *IBM Z 3931 External Cabling Best Practices* (<https://www.ibm.com/servers/resourcelink/lib03011.nsf/pages/3931ExternalCablingBestPractices?OpenDocument>) available on Resource Link.

2. All purchasing of correct qualified cables.



**Attention:** The IBM Fiber Transport System (FTS) trunking feature is not offered with the 3931. 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 3931.

**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 43 on page 140 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<sup>®</sup> and z/VM<sup>®</sup> environments.

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 <sup>1</sup> (2 ports)	FICON Express16SA SX (Short Wavelength)	multimode 50 and 62.5 micron
FC 0436 <sup>1</sup> (2 ports)	FICON Express16SA LX (Long Wavelength)	single mode 9 micron
FC 0428 <sup>1</sup> (2 ports)	FICON Express16S+ SX (Short Wavelength)	multimode 50 and 62.5 micron
FC 0427 <sup>1</sup> (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 142 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.

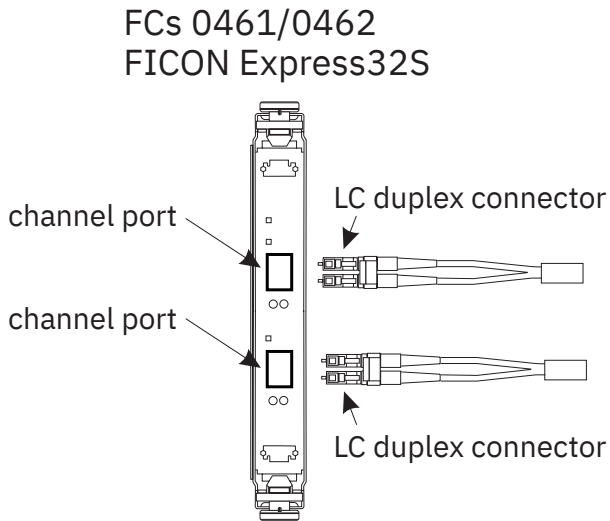


Figure 27. FICON Express32S features

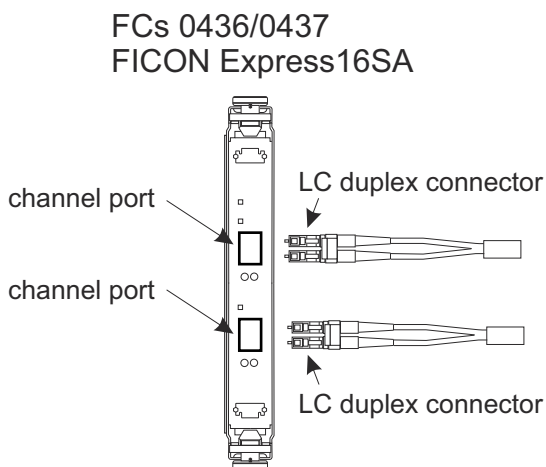


Figure 28. FICON Express16SA features

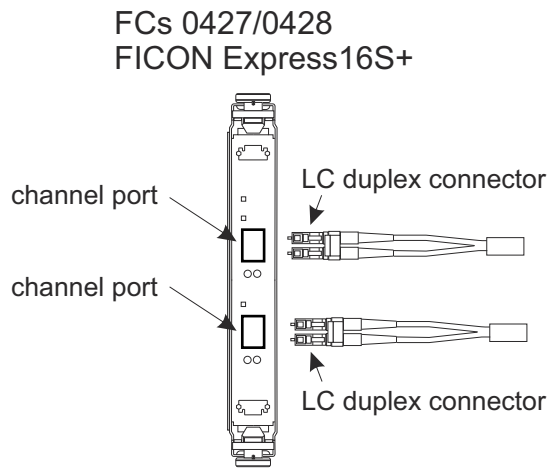


Figure 29. FICON Express16S+ features

## 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 44 on page 143 lists the supported OSA-Express features.

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 <sup>1</sup> (1 port)	OSA-Express7S 25 GbE SR1.1	50 and 62.5 micron multimode	LC Duplex
FC 0446 <sup>1</sup> (2 ports)	OSA-Express7S 1000BASE-T	Category 5 UTP copper wire	RJ-45
FC 0445 <sup>1</sup> (1 port)	OSA-Express7S 10 GbE SR	50 and 62.5 micron multimode	LC Duplex
FC 0444 <sup>1</sup> (1 port)	OSA-Express7S 10 GbE LR	9 micron single mode	LC Duplex
FC 0443 <sup>1</sup> (2 ports)	OSA-Express7S GbE SX	50 and 62.5 micron multimode	LC Duplex
FC 0442 <sup>1</sup> (2 ports)	OSA-Express7S GbE LX	9 micron single mode	LC Duplex
FC 0426 <sup>1</sup> (2 ports)	OSA-Express6S 1000BASE-T	Category 5 UTP copper wire	RJ-45
FC 0425 <sup>1</sup> (1 port)	OSA-Express6S 10 GbE SR	50 and 62.5 micron multimode	LC Duplex
FC 0424 <sup>1</sup> (1 port)	OSA-Express6S 10 GbE LR	9 micron single mode	LC Duplex
FC 0423 <sup>1</sup> (2 ports)	OSA-Express6S GbE SX	50 and 62.5 micron multimode	LC Duplex

Table 44. OSA-Express feature codes (continued)

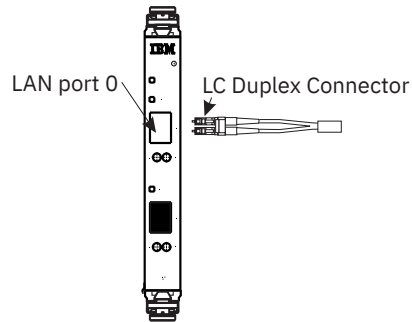
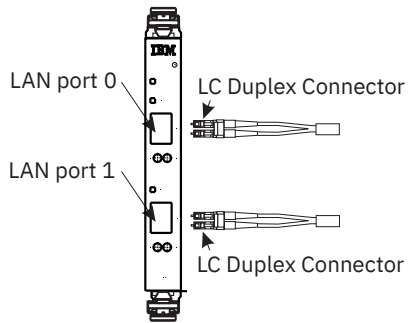
Feature code	Feature description	Cable description	Connector type
FC 0422 <sup>1</sup> (2 ports)	OSA-Express6S GbE LX	9 micron single mode	LC Duplex

**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

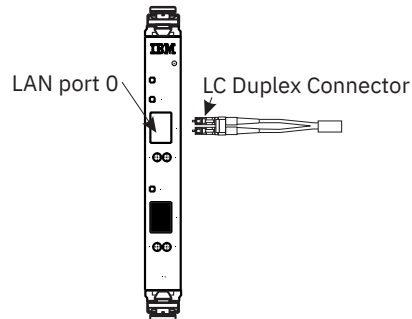
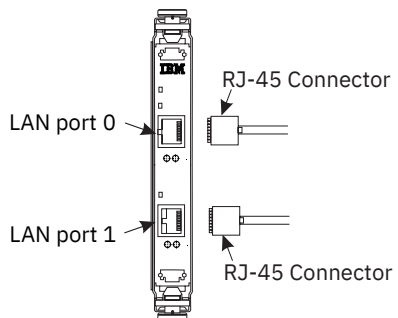


Figure 30. OSA-Express7S 1.2 features

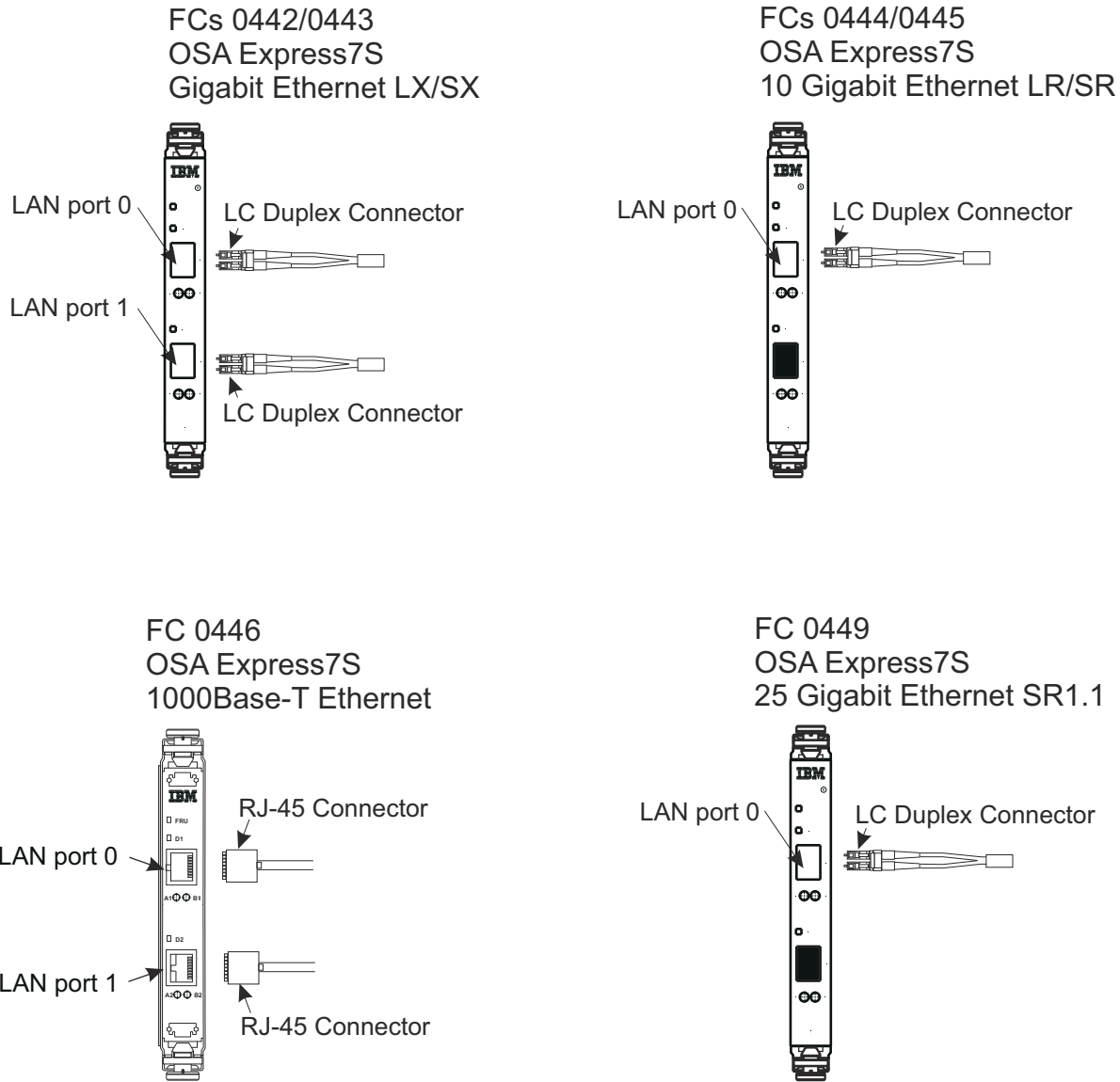


Figure 31. OSA-Express7S features

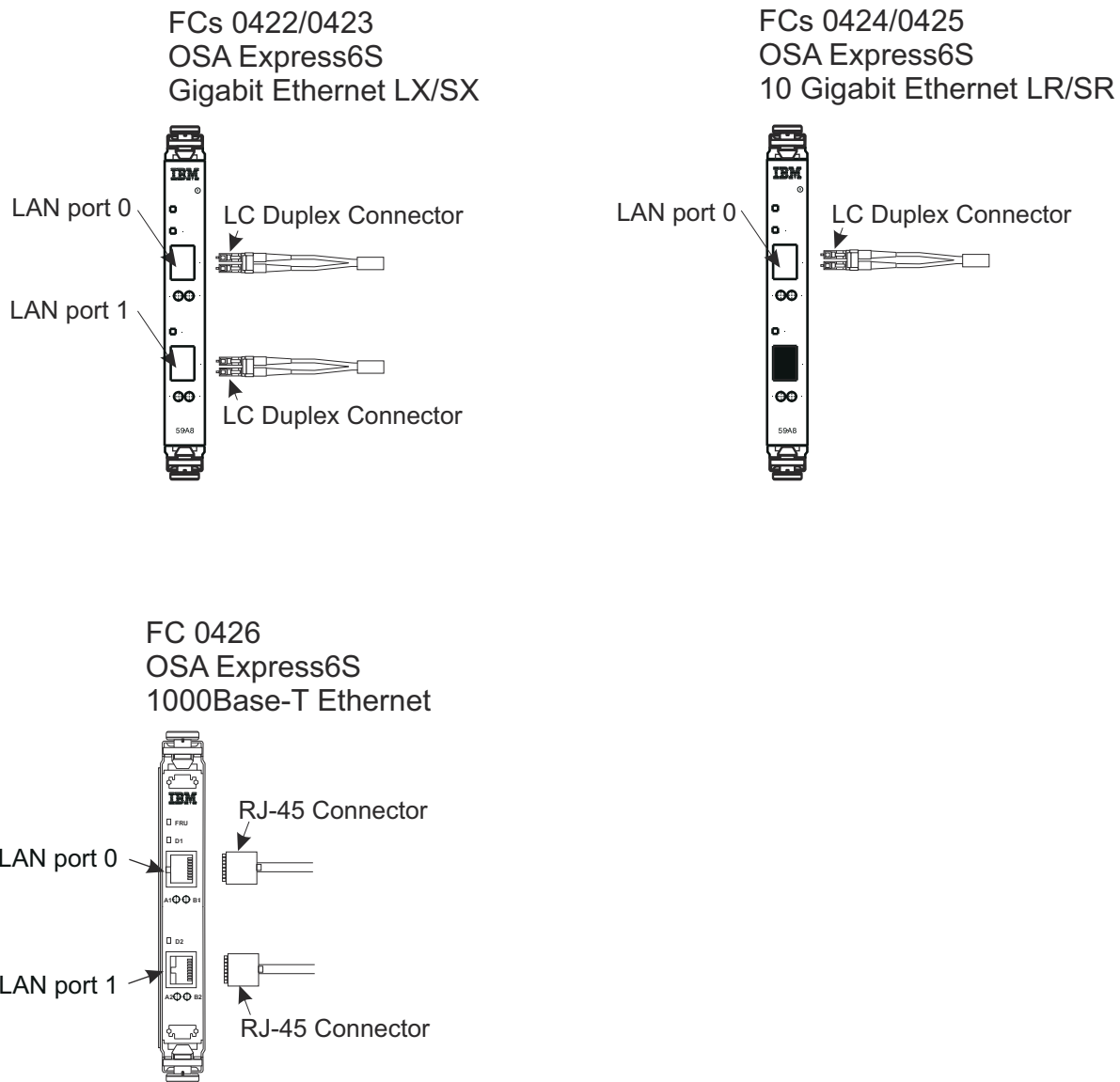


Figure 32. OSA-Express6S features

## **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

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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

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The 3931 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)	48	96 links	1	SX laser 50 micron	MTP
FC 0172 (2 ports)	Integrated Coupling Adapter (ICA SR)	48	96 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

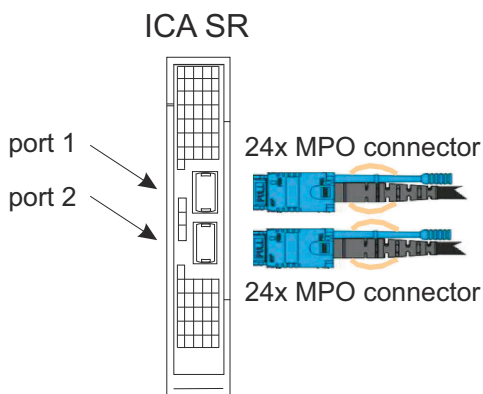
- Integrated Coupling Adapter1.1 (ICA SR1.1) - **FC 0176**
- Integrated Coupling Adapter (ICA SR) - **FC 0172**

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 (Model A01), IBM z15 Model T02 , z15, z14 and z14 ZR1 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.

<b>Part number</b>	<b>Length meters (feet)</b>	<b>Cable type</b>
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.

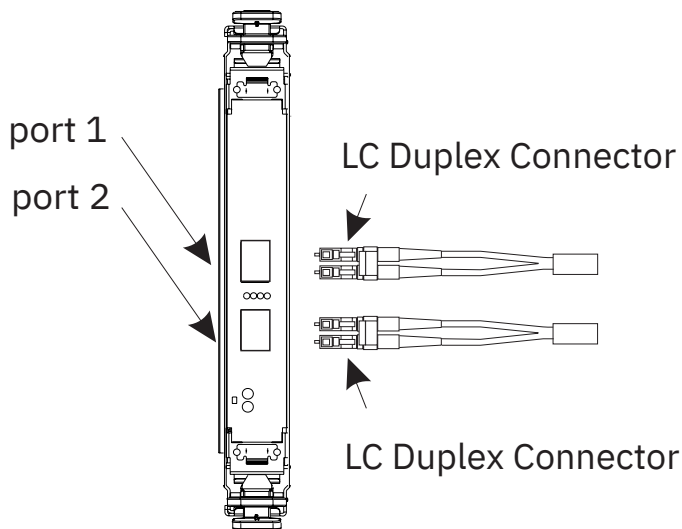
Coupling Express2 LR is a two-port, Ethernet-based coupling card with a data rate of 10.0 Gbps\* and a maximum unrepeated distance of 10 km and a maximum repeated distance of 100 km with a qualified Dense Wavelength Division Multiplexing (DWDM) device. Coupling Express2 LR utilizes a 9 micron single 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



## IBM Virtual Flash Memory (FC 0644)

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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 12 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.

<i>Table 46. Native PCIe adapter feature codes</i>	
<b>Feature code</b>	<b>Description</b>
FC 0451	IBM zHyperLink Express1.1
FC 0431 <sup>1</sup>	IBM zHyperLink Express
FC 0448	IBM Adapter for NVMe1.1 <sup>2</sup>
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 <sup>1</sup>	25GbE RoCE Express2.1
FC 0432 <sup>1</sup>	10GbE RoCE Express2.1
FC 0430 <sup>1</sup>	25GbE RoCE Express2
FC 0412 <sup>1</sup>	10GbE RoCE Express2
<b>Notes:</b>	
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 45 on page 150](#) in “Integrated Coupling Adapter (ICA) SR feature” on page 149.

### zHyperLink Express

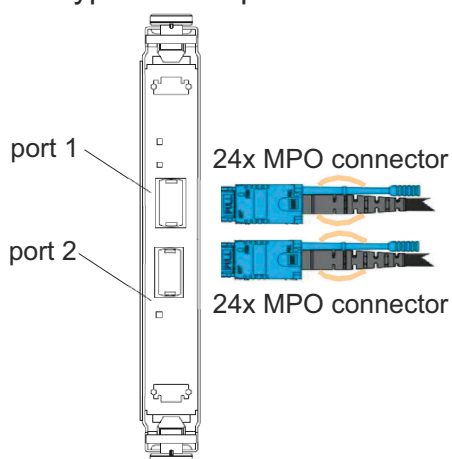


Figure 33. zHyperLink Express feature

## IBM Adapter for NVMe1.1 (FC 0448)

The IBM Adapter for NVMe (Non-Volatile Memory Express) feature utilizes NVMe to provide IBM LinuxONE Emperor 4 (Model LA1) fast access to data stored on Solid State Drives (SSDs). NVMe 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 Emperor 4 (Model LA1)
- 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.

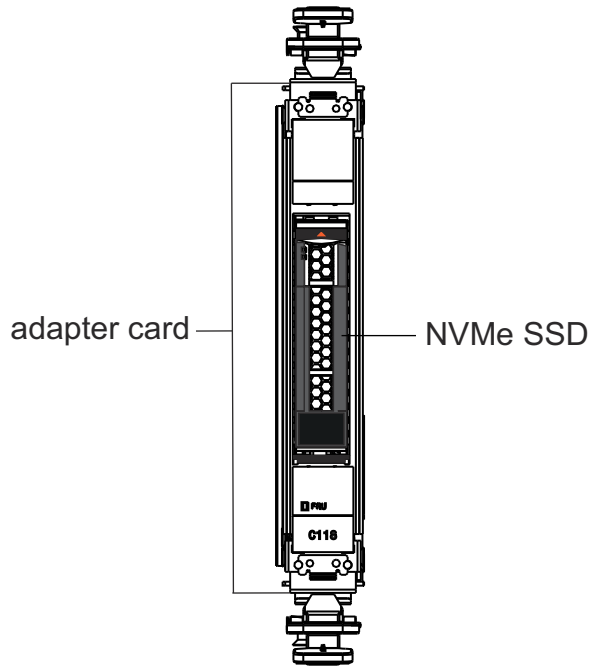


**Attention:** The selection and purchase of the SSDs in this feature is the responsibility of the customer. The *IBM LinuxONE NVMe white paper* (<https://www.ibm.com/downloads/cas/PDGXWWO3>) lists the performance of SSDs that IBM has tested for LinuxONE. IBM can only comment on the functionality of 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

- Hot plug or removal is **not** supported. Use IBM Service support when installing or removing SSDs.
- 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
- Linux on Z:
  - Ubuntu 18.04 LTS with service
  - IBM is working with its Linux distribution partners to include support in future distributions releases
- 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-compatible connector (formerly SFF-8639)
  - 25W max power consumption

### IBM Adapter for NVMe



*Figure 34. 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:

- A CHPID number or CHPID type is not required.
- You can order all IBM RoCE Express adapters in increments of 1 feature (2 ports per feature), up to a maximum of 16 features (32 ports).
- 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

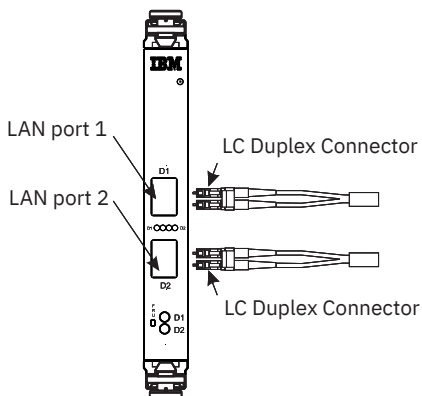
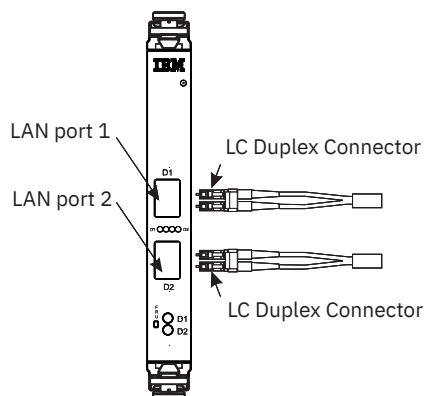


Figure 35. RoCE Express3 features

FC 0441/0440  
10 Gigabit Ethernet RoCE Express3



FC 0430/0450  
25 Gigabit Ethernet RoCE Express2

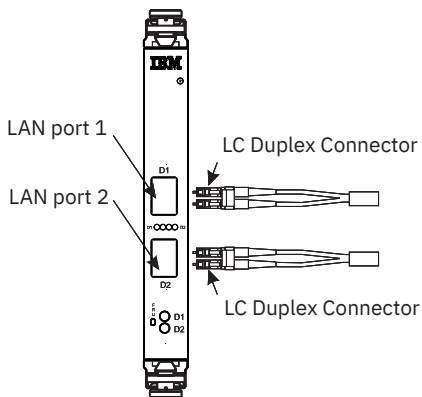
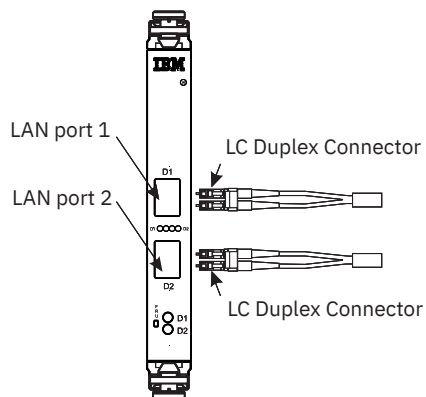


Figure 36. RoCE Express2 features

FC 0412  
10 Gigabit Ethernet RoCE Express2





## Time synchronization

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Synchronized time is possible with a 3931 in a Sysplex environment using Server Time Protocol (STP). STP supports Coordinated Timing Networks (CTNs) where the 3931 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 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.

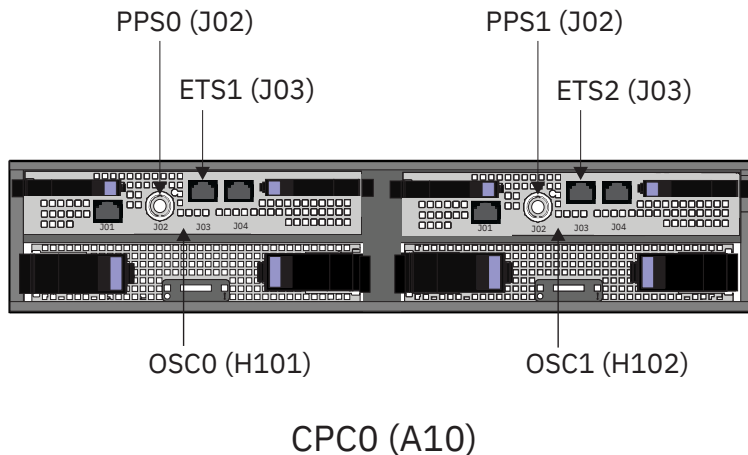
**External Time Source (ETS) IP network considerations:** When planning the Ethernet based External Time Source network, it is recommended that one or two subnets corresponding to ETS1 and ETS2 are routable to the desired NTP/PTP time source(s).

**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 7898) or (FC 7816)* feature:
  - ETS cables should enter the frame through the D hole at the **top, front** of the A frame.
- Installation with *bottom exit (FC 7899)* 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 *IBM Z 3931 External Cabling Best Practices* (<https://www.ibm.com/servers/resourcelink/lib03011.nsf/pages/3931ExternalCablingBestPractices?OpenDocument>) available on Resource Link.

The Ethernet output of the NTP or PTP time server is connected to the input Ethernet connector provided on the oscillator card on the 3931.

- If the 3931 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 37. Single CPC drawer configuration - front view*

- If the 3931 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)

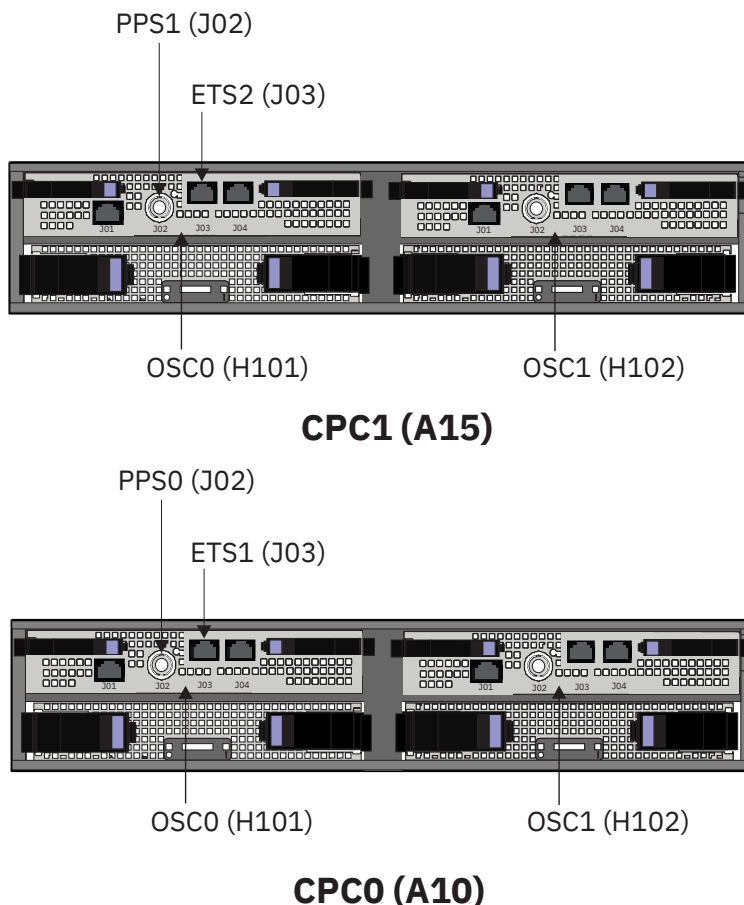


Figure 38. Multiple CPC drawer configuration - front view

The pulse per second (PPS) port on the oscillator cards requires a signal with the characteristics listed in Table 47 on page 162. 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 47. PPS signal characteristics

	Unit of measure	Minimum	Typical	Maximum
<b>Voltage Level LOW</b>	volt	0		0,15
<b>Voltage Level HIGH</b>	volt	3,2		5,2
<b>Rise time</b>	microsecond			50
<b>Fall time</b>	microsecond			50
<b>Pulse width</b>	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 3931 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 3931.

**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)

## Fiber Quick Connect for FICON cabling

Unlike previous IBM Z systems, the 3931 no longer offers the IBM Fiber Transport System (FTS) trunking feature. The customer is responsible to engage third party vendors to purchase a fiber trunking solution, if desired.

You can, however, order the Fiber Quick Connect (FQC) brackets and mounting hardware (**FC 5827**) on the 3931 to connect to customer provided cables in the Top Exit enclosure and/or Bottom Exit tailgate.

**Note:** It is the customer's responsibility to install the FQC brackets and hardware, or to arrange for the System Service Representative (SSR) to install them. Instructions for installing the FQC brackets can be found in the *3931 Installation Manual*, GC28-7017.

Table 48. Fiber Quick Connect feature code	
Feature code	Description
5827	FQC harness bracket and mounting hardware

The Fiber Quick Connect feature enables trunk cables to connect to FICON channels using under-the-cover attachment harnesses.

Figure 39 on page 164 shows the Fiber Quick Connect feature hardware.

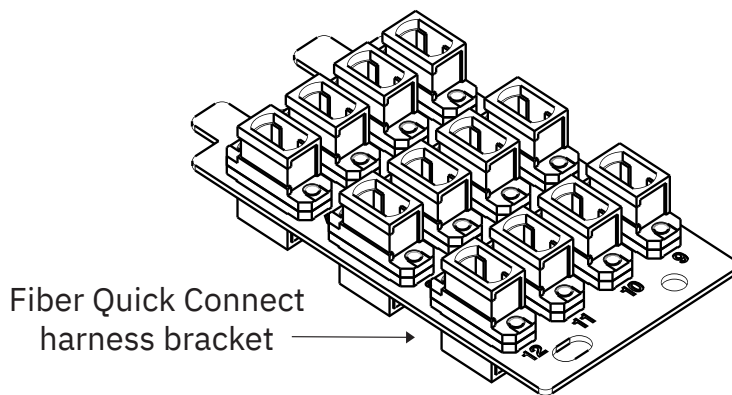


Figure 39. Fiber Quick Connect feature hardware

The harness brackets use an MTP connector, and the FICON connectors are routed to the feature cards the frame.

### Important Notes:

- A **minimum** of two FQC brackets are *required* with any frame that contains a Third Party Fiber Trunking feature. A **maximum** of four FQC brackets are supported in both the Top and Bottom Exit; the maximum per frame is eight.
- The FQC harness bracket and mounting hardware (**FC 5827**) must be ordered in conjunction with either the Top Exit Cabling feature (**FC 7898**) or Bottom Exit Cabling feature (**FC 7899**)
  - The combination of FC 7899 and FC 5827 are factory installed in preparation for system field installation while FC 7898 and FC 5827 are shipped separately and assembled to the system as part of system installation.
- For more information, refer to the *IBM Z Planning for Fiber Optic Links Document* and contact the listed distributors to order any new or additional cabling needed in time for delivery prior to installation.

Figure 40 on page 165 provides the FQC brackets plugging locations along the tailgate for the **Bottom Exit feature (FC 7899)**.

A maximum of 4 FQC brackets are supported along the bottom tailgate. Note the possible bracket locations:

- A01R and A01U = first FQC bracket locations
- A01P and A01W = second FQC bracket locations

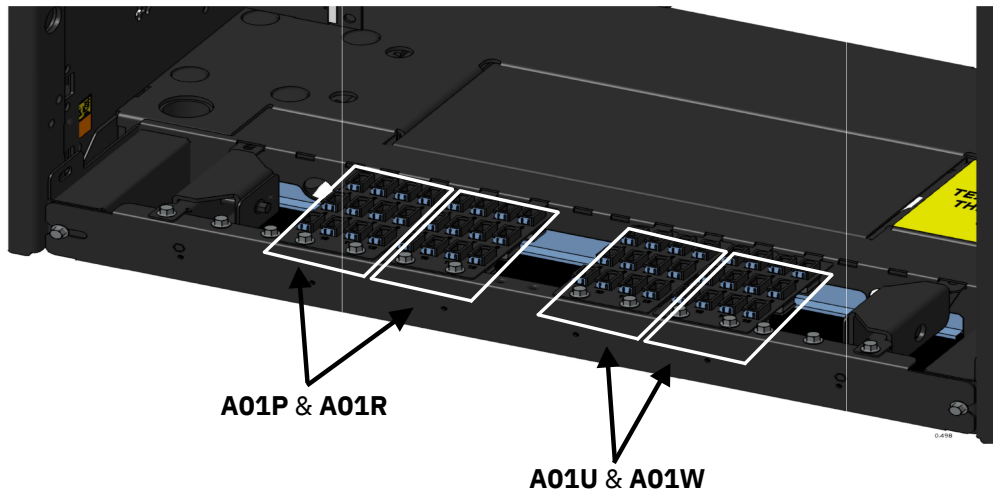


Figure 40. Fiber Quick Connect mounting brackets - Bottom exit feature (FC 7899)

Figure 41 on page 166 provides the FQC brackets plugging locations on the **Top Exit feature (7898)**.

A maximum of 4 FQC brackets are supported in the top hat enclosure. Note the possible bracket locations:

- A43P and A43X = first FQC bracket locations
- A43N and A43Y = second FQC bracket locations

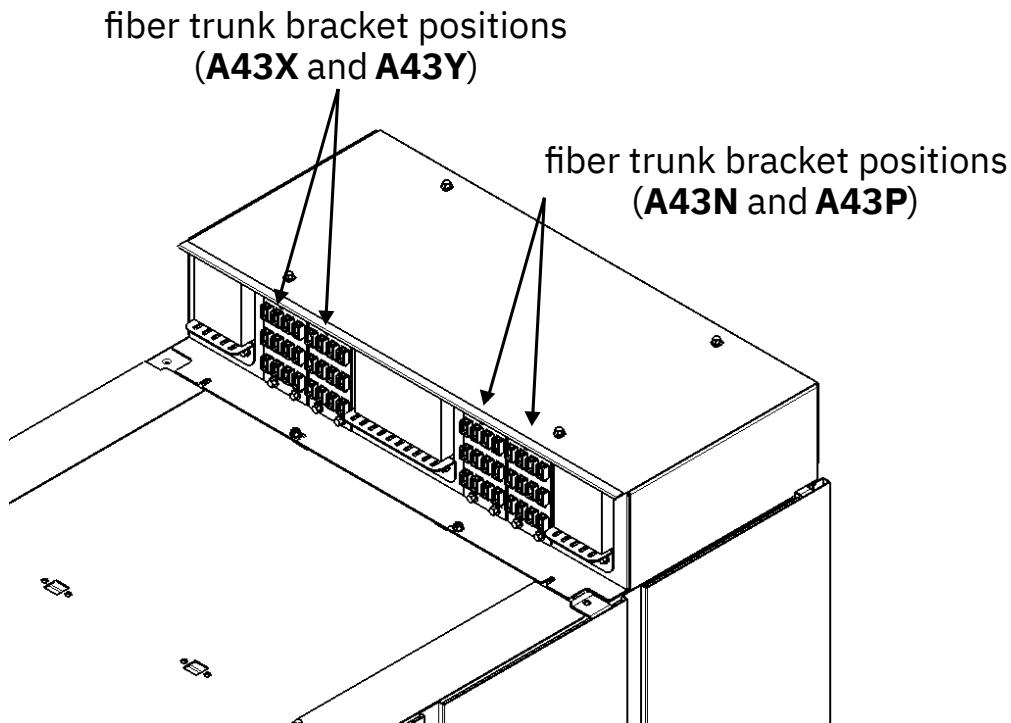


Figure 41. Fiber Quick Connect mounting brackets - Top exit (FC 7898)

**If you are planning to use the Fiber Quick Connect feature for FICON channels,** contact IBM Networking Services for assistance. Networking Services will help you plan for the trunking cabling solution that meets your individual system requirements. Your installation planning representative, product specialist, or service representative will provide you with the information necessary to contact Networking Services.



## Preparing configuration definition

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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 Z cluster IOCDs, 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 Z cluster IOCDs, 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 138. 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.

**Note:**

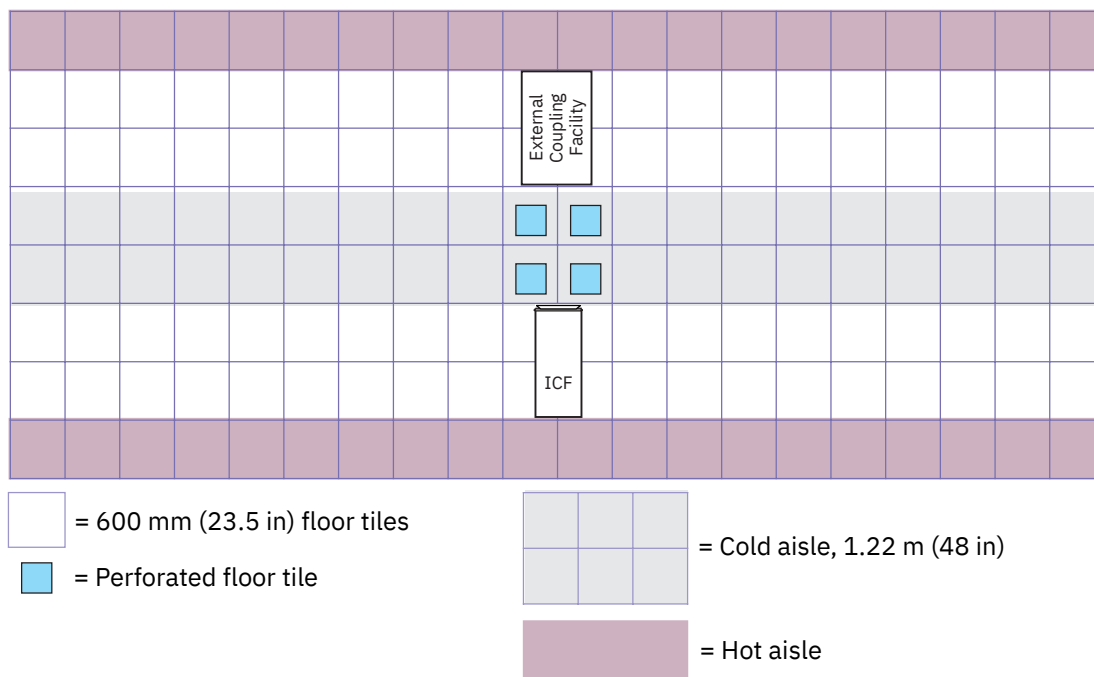
1. IBM z16 (Model A01) can only participate in an STP-only timing network.
2. IBM z16 (Model A01) can only communicate directly with IBM z16 (Model A01), z15 T01, z15 T02, z14, and z14 ZR1 using Coupling Express LR or ICA SR coupling links.

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 A01) system can be configured with 1, 2, 3 or 4 frames.

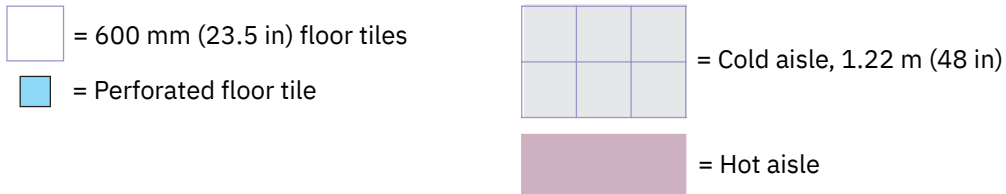
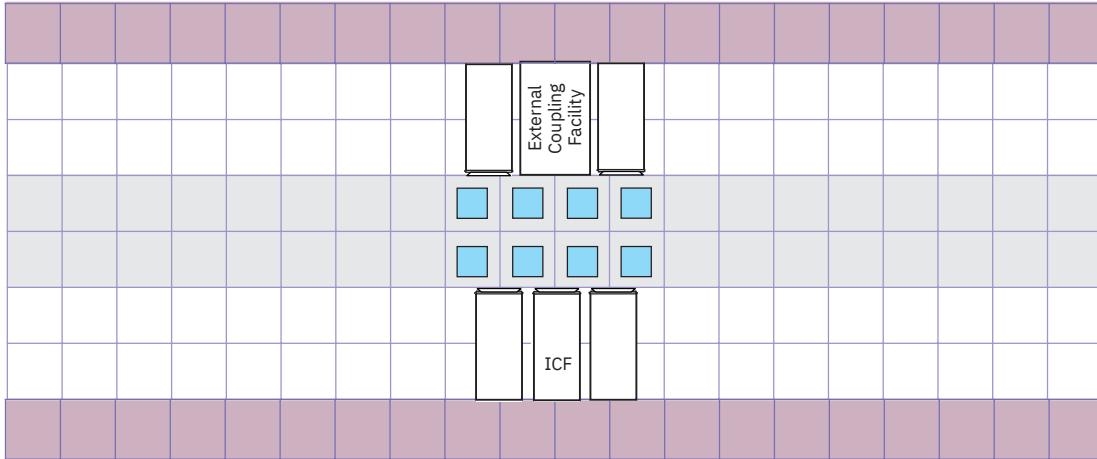
1. Position the coupling facilities (or servers with internal coupling facilities) in the center of an open area of raised floor large enough to accommodate all of the servers and other coupling facilities to which you want to connect.



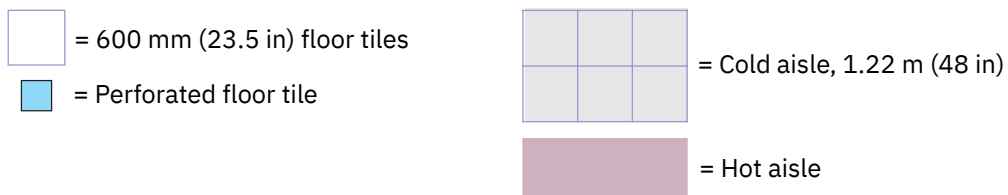
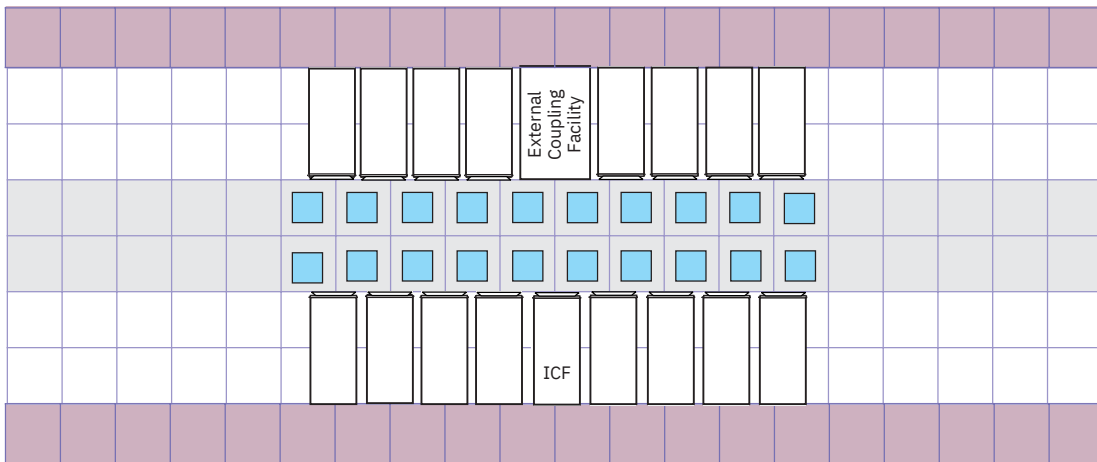
- Use physical planning information for each type of server/coupling facility you intend to add to the Parallel Sysplex to help determine how much floor space you will need.
- Remember to consider weight distribution, service clearances, power, and cooling for each piece of equipment you want to include.

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 60). Allow a 1.22 meter (48 inch) 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 81.)

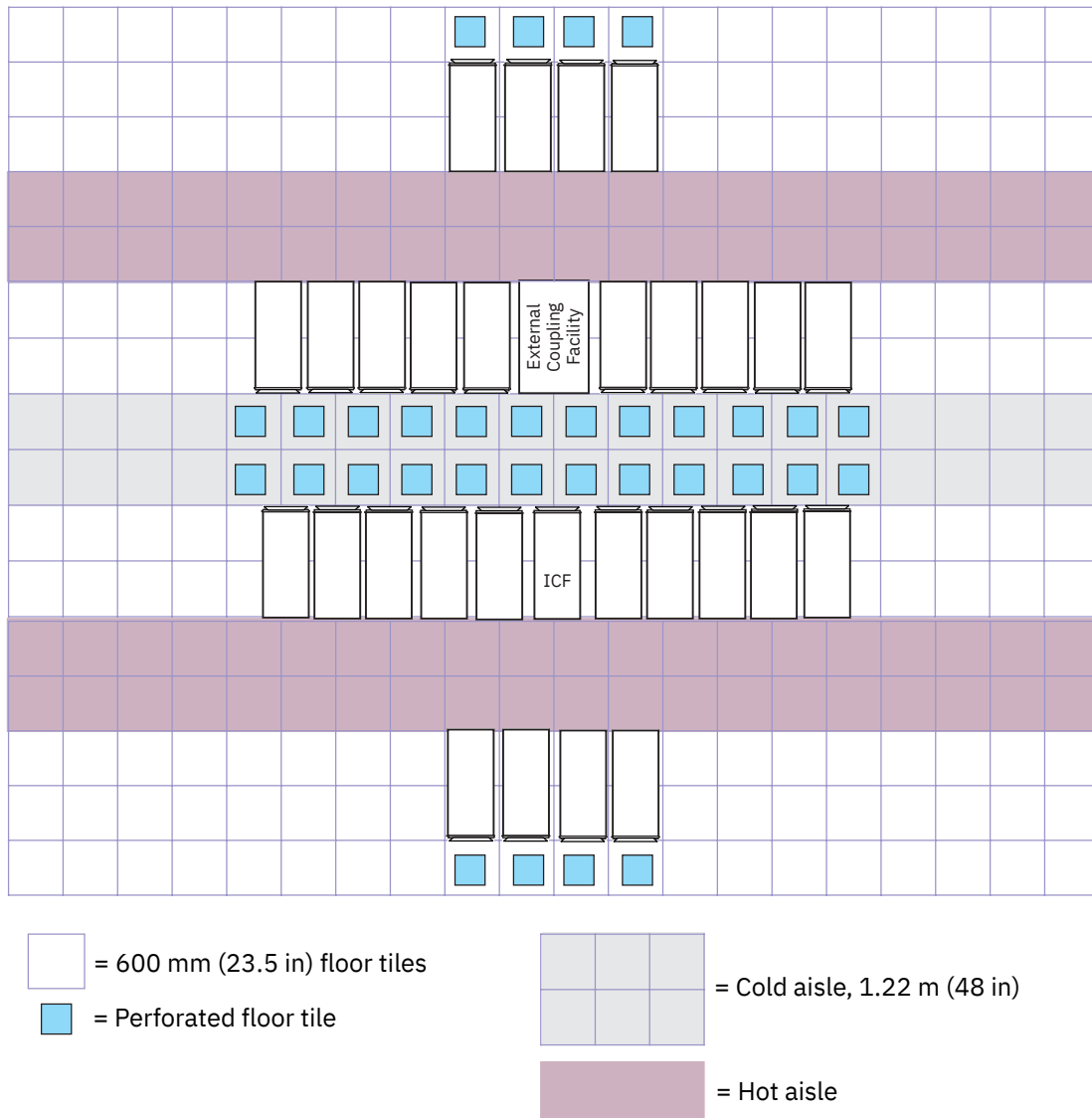
**Note:** The system air flow illustration shows a minimum aisle width of 941 mm (37 in). Although this width is adequate for a congested computer room floor, it is the **minimum** you should use. An aisle 1.22 m (48 in) wide will better serve the cooling and cabling needs of a Parallel Sysplex configuration.



3. Sysplex connections can be made using Coupling Express LR or ICA SR cabling.
4. As the Parallel Sysplex grows, add new servers evenly on either side of the central coupling facilities.



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.



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 A01), z15 T01, z15 T02, z14, and z14 ZR1 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

**In Cabling Schematics:**



Indicates a cable group coming from a machine



Indicates a cable group going to a machine



Service Area Boundary (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



Unit Emergency Switch

**Hinged Covers**



Single



Bifold



Offset Bifold





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## Appendix B. 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” on page 176](#)
- [“Bottom Exit Cabling specifications” on page 179](#)

## Top Exit Cabling specifications

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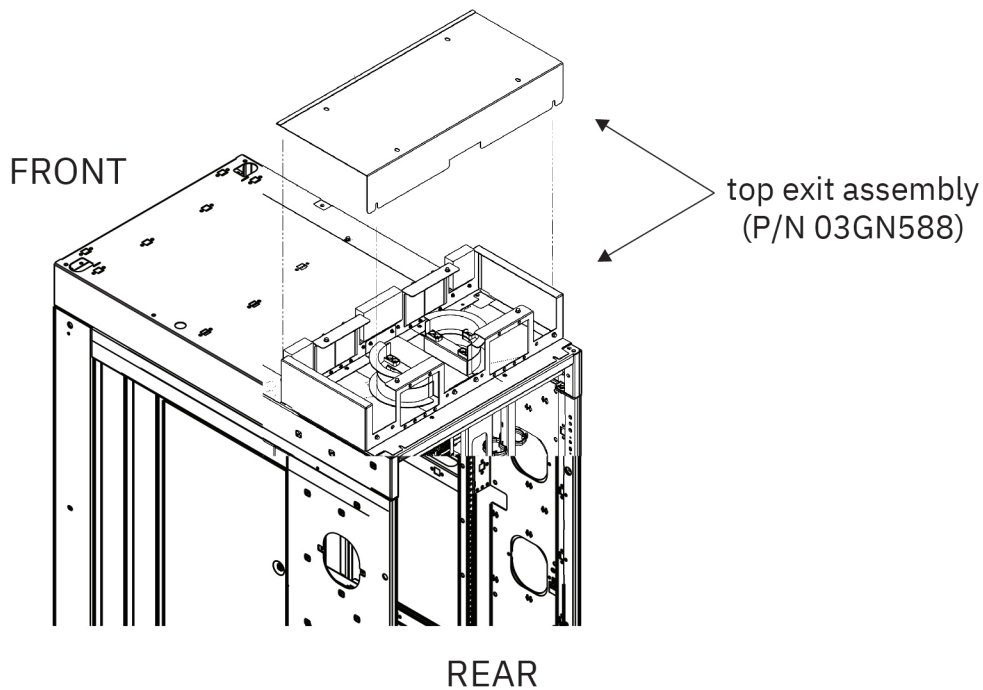
For top exit cabling, you can use one of the following options:

- Top Exit cabling feature *with* top hat (**FC 7898**)
- Top Exit cabling feature *without* top hat (**FC 7816**)

### Top Exit Cabling with top hat (FC 7898):

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 42 on page 176](#) shows the cables exiting toward the front of the frame.



*Figure 42. Top exit cabling feature - cables exiting to the front*

[Figure 43 on page 177](#) shows the cables exiting toward the rear of the frame.

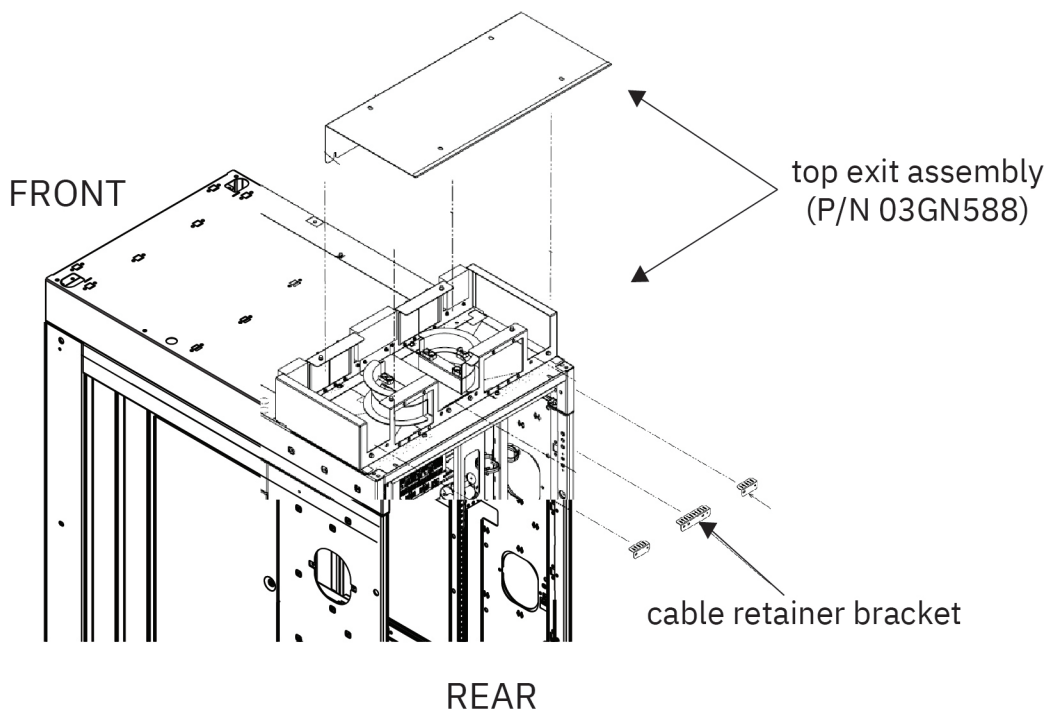
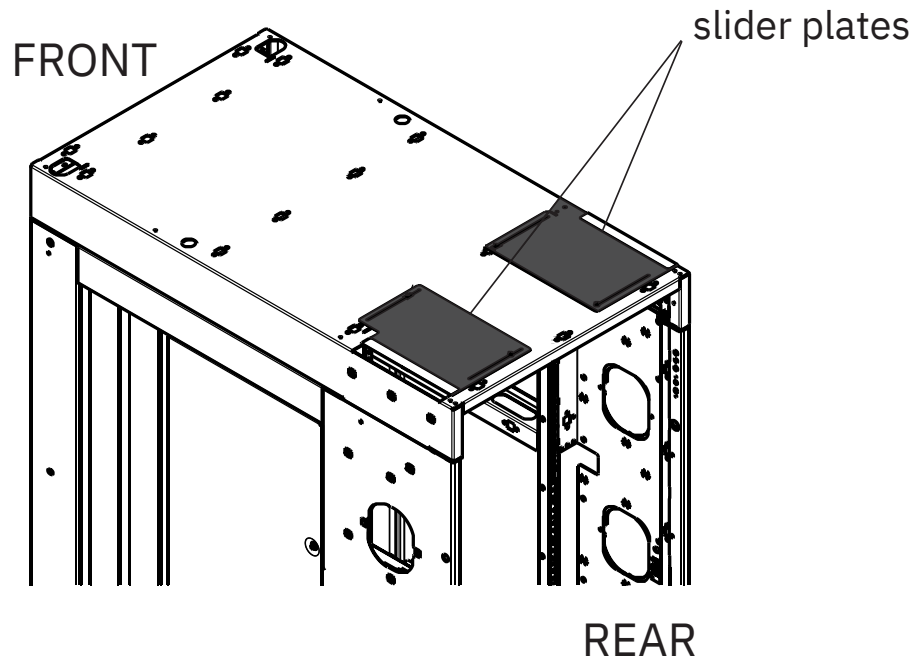


Figure 43. Top exit cabling feature - cables exiting to the rear

**Top Exit Cabling without top hat (FC 7816):**

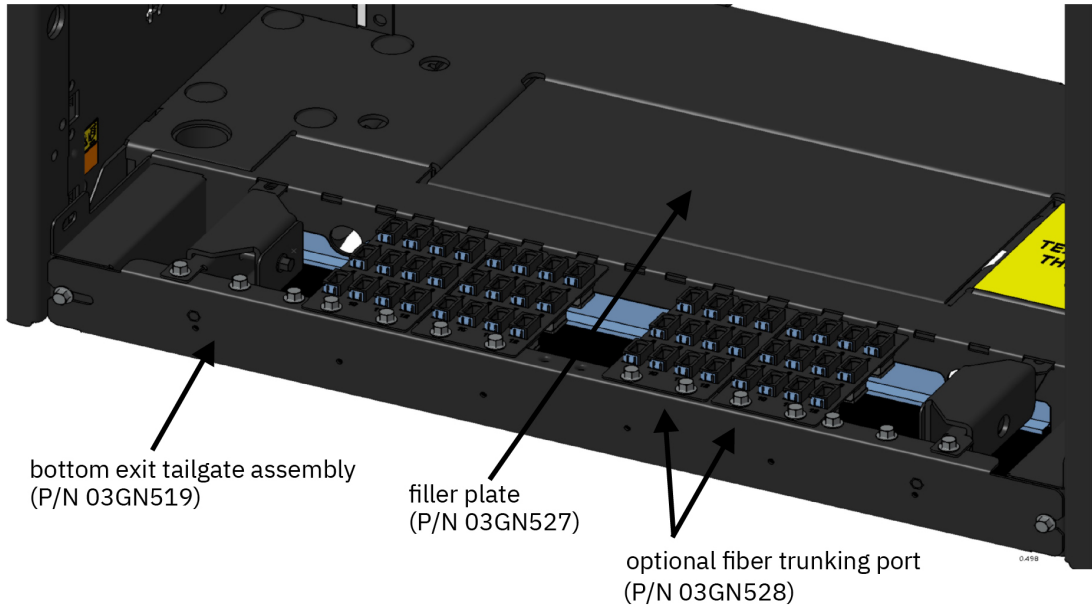
When routing cables directly through the top of the frame, there are two slider plates on the top of the frame (one on each side of the rear of the frame) that can be slid opened partially and any gaps can be eliminated with self-sticking foam. This foam is included in the system ship group.



## Bottom Exit Cabling specifications

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For bottom exit cabling, you must use the Bottom Exit Cabling feature (**FC 7899**).





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## Appendix C. Dual "facilities power distribution" installation

### Dual "facilities power distribution" installation - PDU power

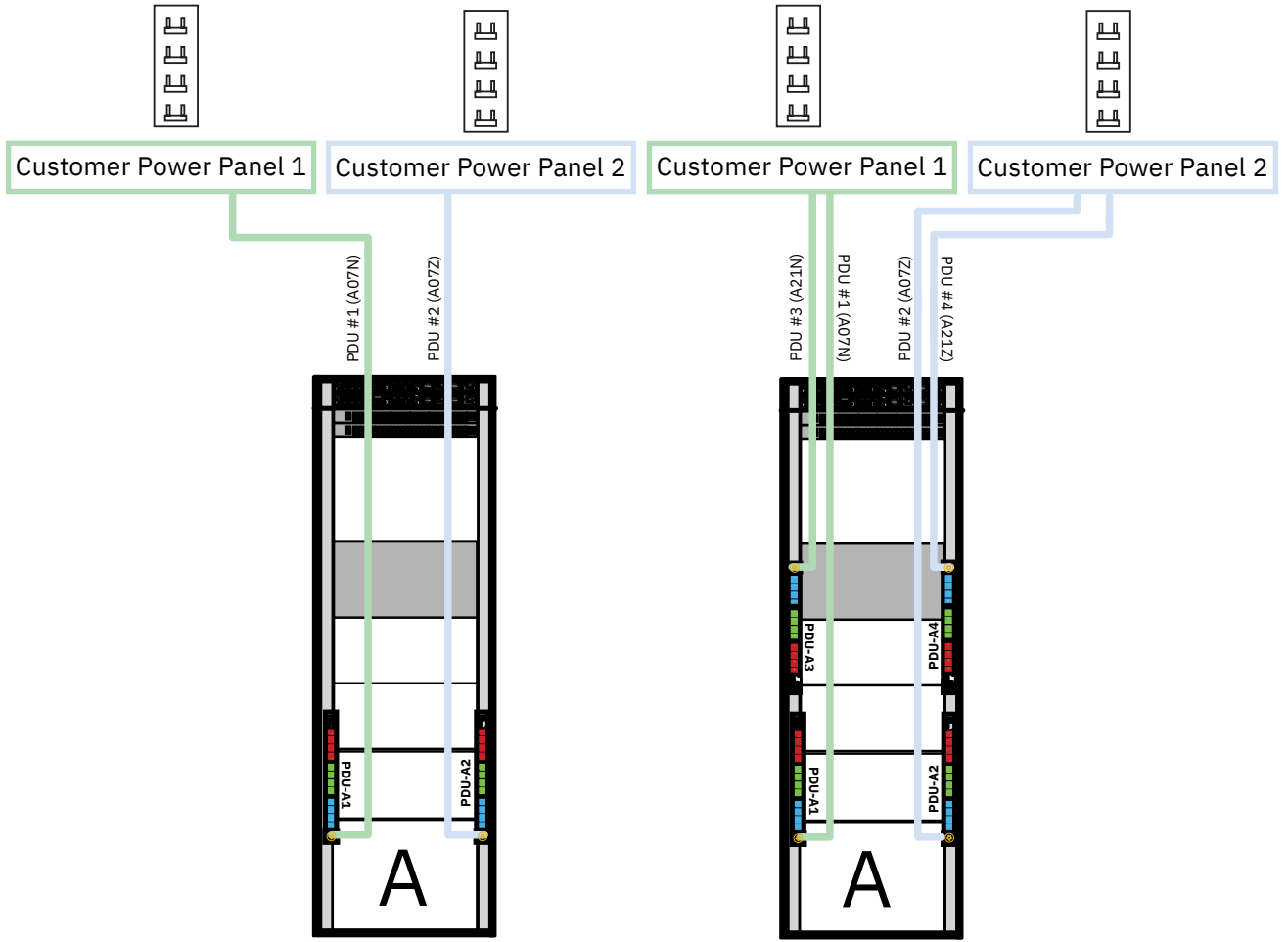
The 3931 is designed with a fully redundant PDU power system. Each computer has 2, 4, 6, or 8 line cords attached to 2, 4, 6, or 8 power input feeds which, in turn, power a fully redundant power sub-system within the computer. The system line cords should be connected to the installation site's distribution panels accordingly, to ensure 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 immunity to power outages.

The following figures show the recommended PDU power connections for 3931.



**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 44. A frame - PDU



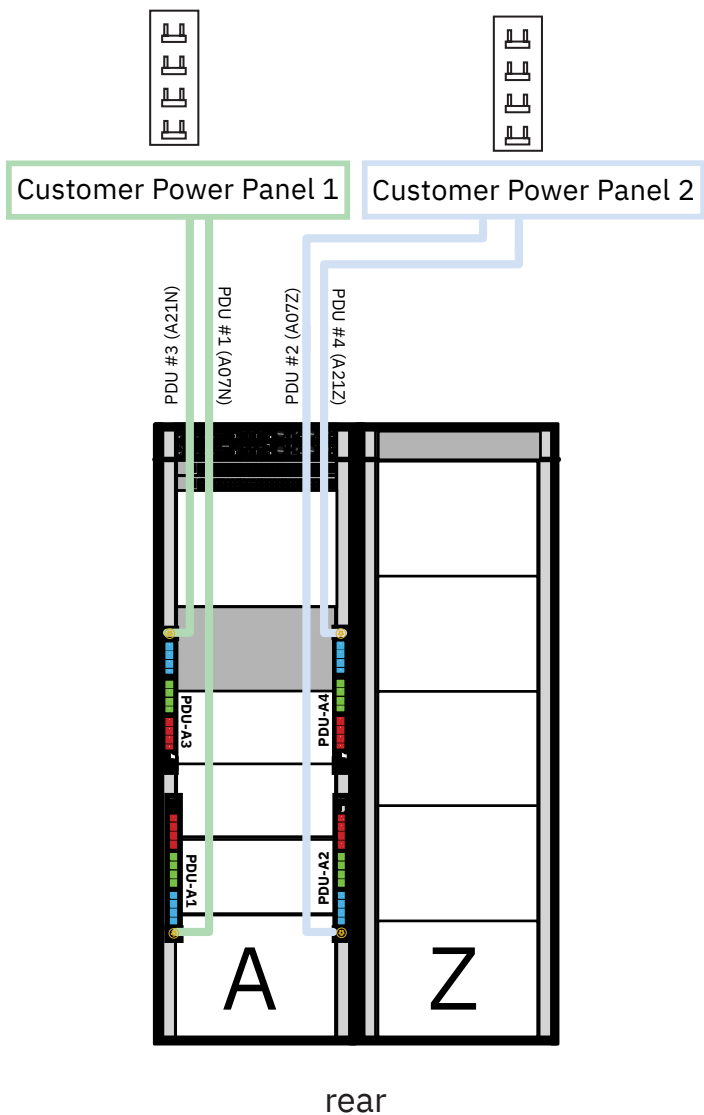


Figure 45. A and Z frames - PDU

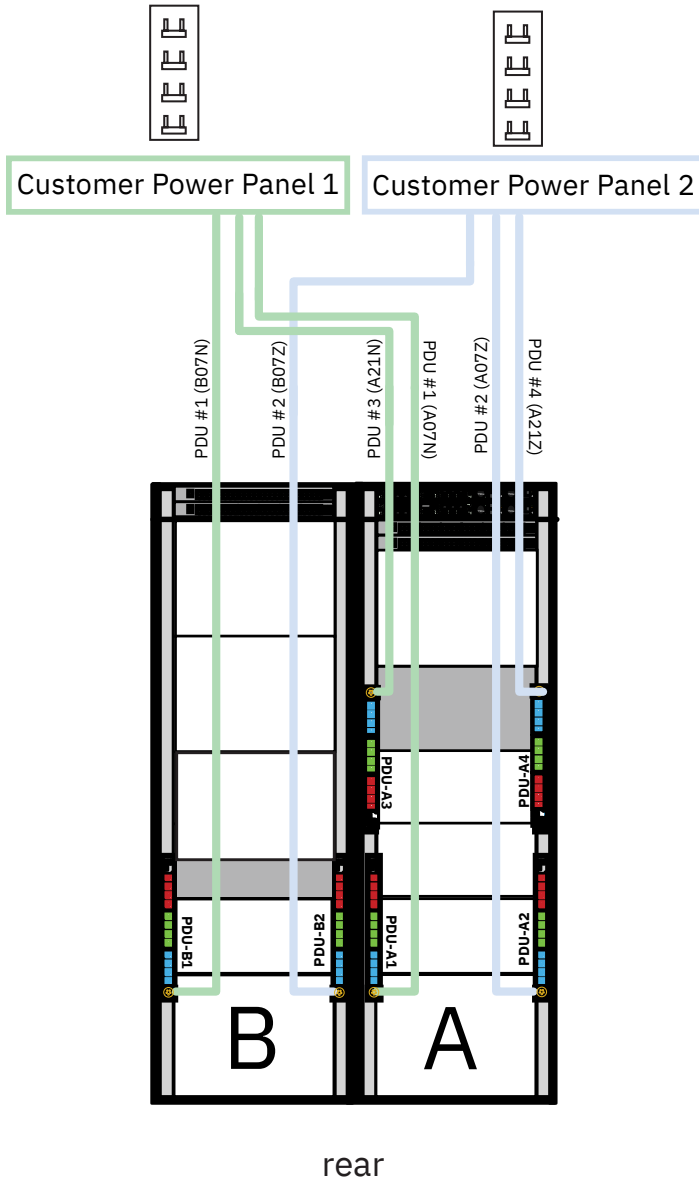


Figure 46. B and A frames - PDU

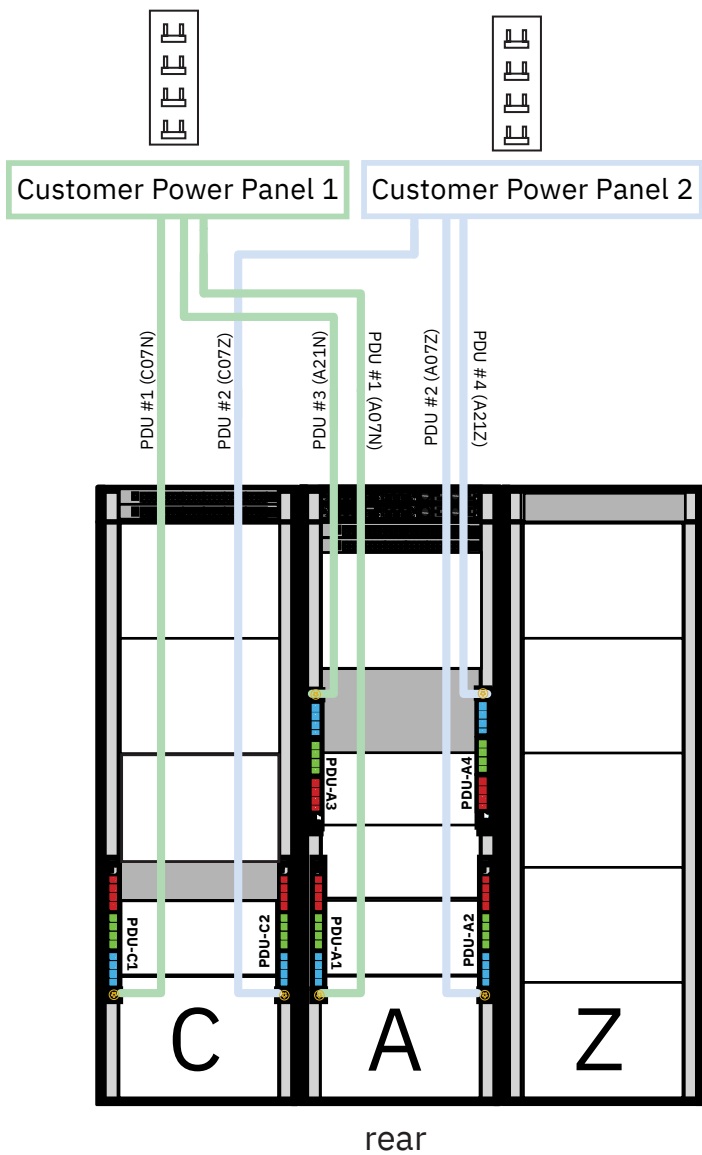


Figure 47. C, A, and Z frames - PDU

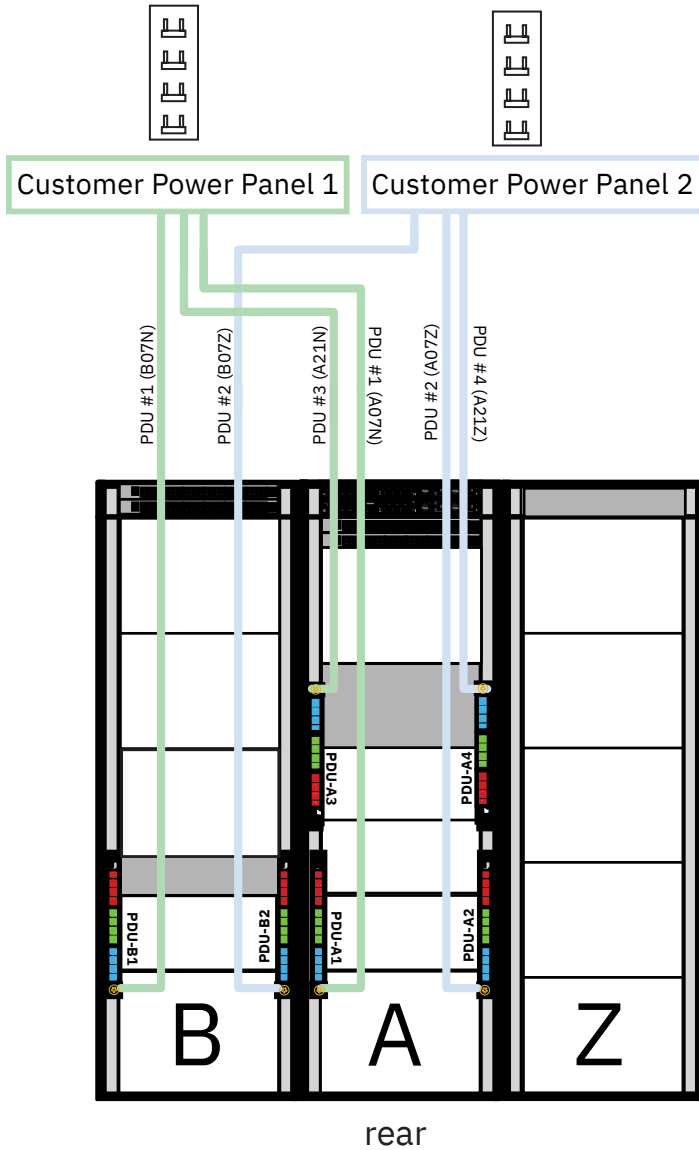


Figure 48. B, A, and Z frames - PDU

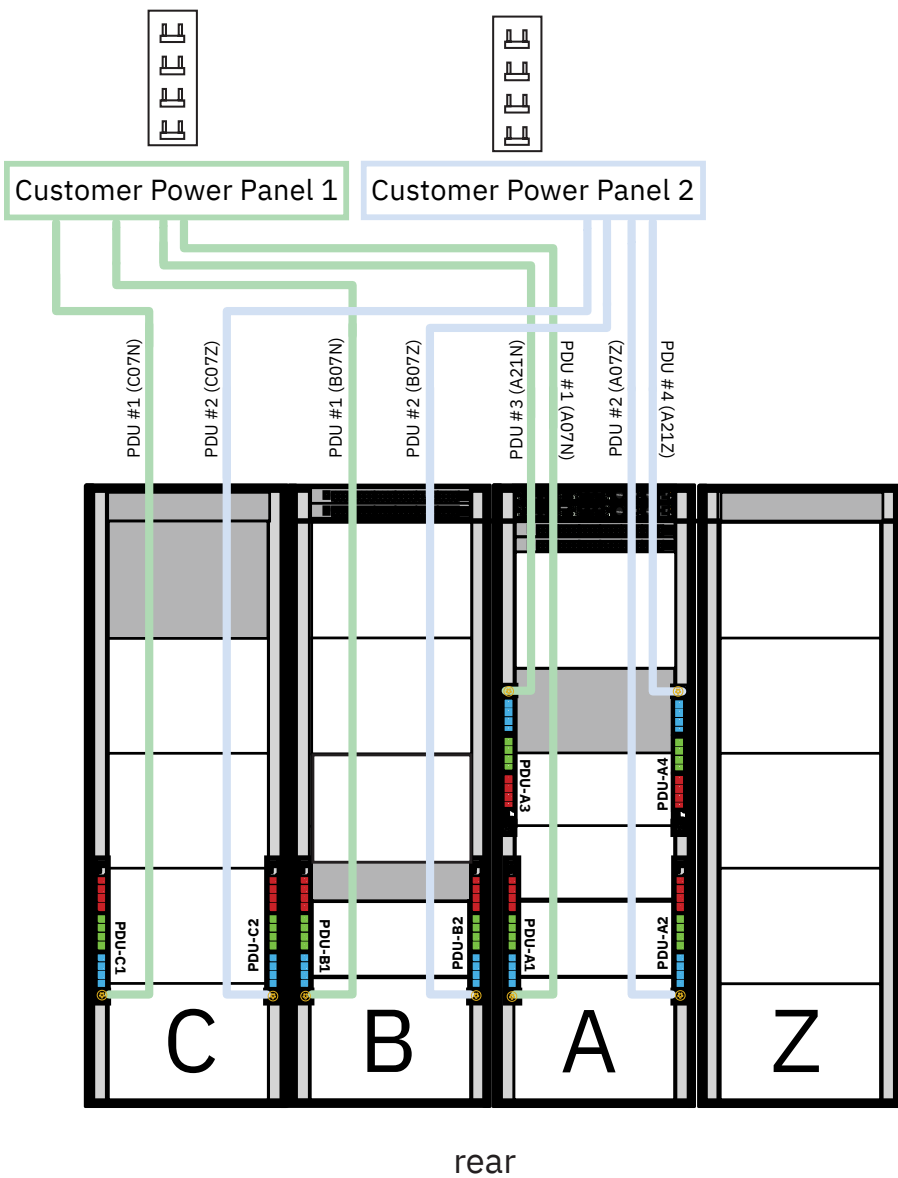
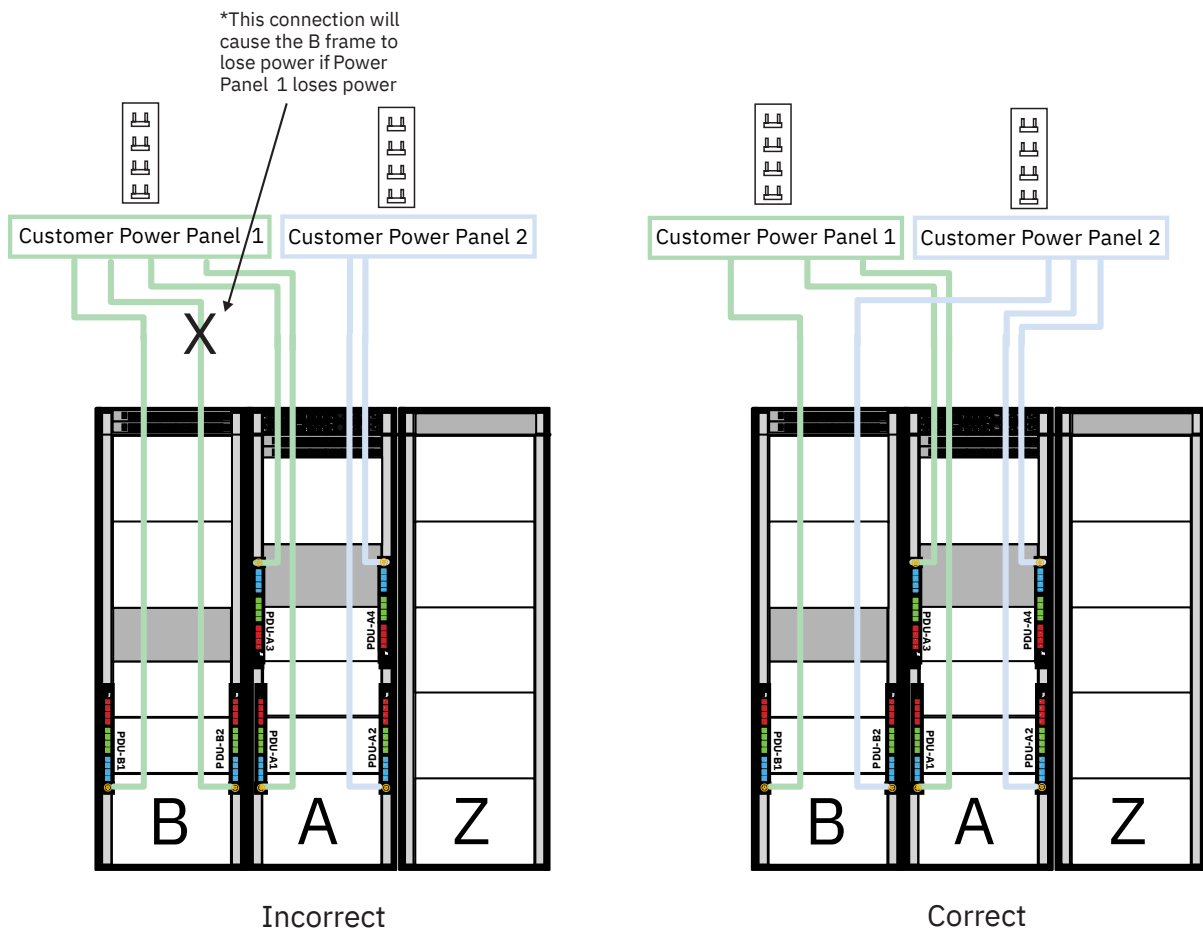


Figure 49. C, B, A, and Z frames - PDU

**Example (incorrect and correct PDU power connections)**




## Dual "facilities power distribution" installation - BPA power

The 3931 is designed to support a fully redundant 2N BPA power system. Each computer has either 2 or 4 line cords attached to 2 or 4 power input feeds which, in turn, power a pair of fully redundant bulk power assemblies within the computer. The system line cords should be connected to the installation site's distribution panels accordingly, to ensure system availability is optimized.

**Note:** The maximum number of power cords that are supported for the BPA feature is 4; two line cords for BPA in A frame, two line cords for BPA in B or C frame.

The minimum recommended redundant connection requires the line cord pair in a given frame to attach to separate power distribution panels. 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 BPA power connections for 3931.

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

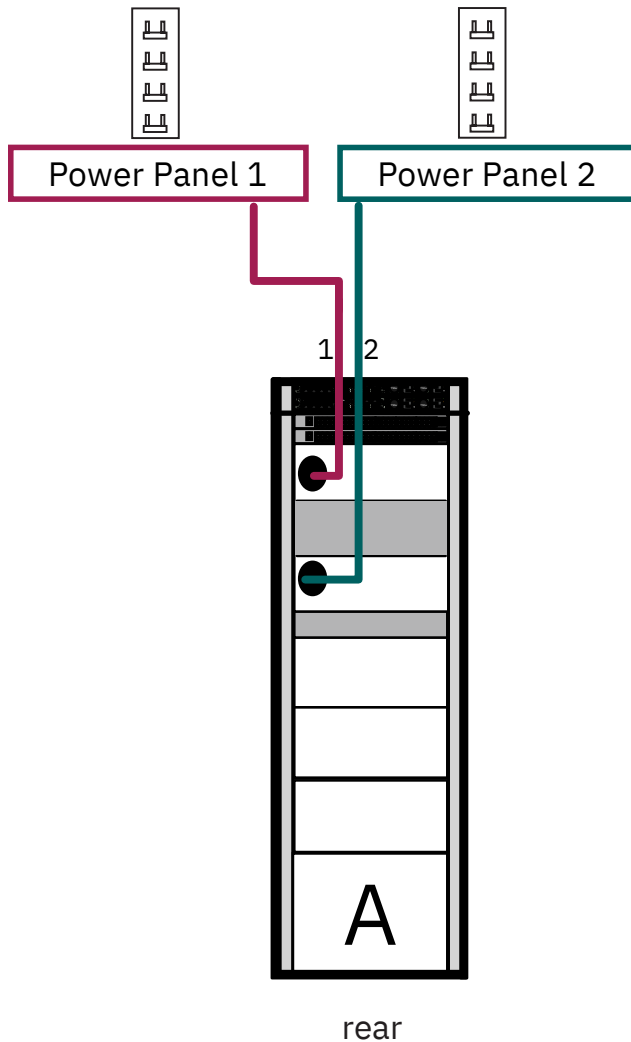


Figure 50. A frame - BPA

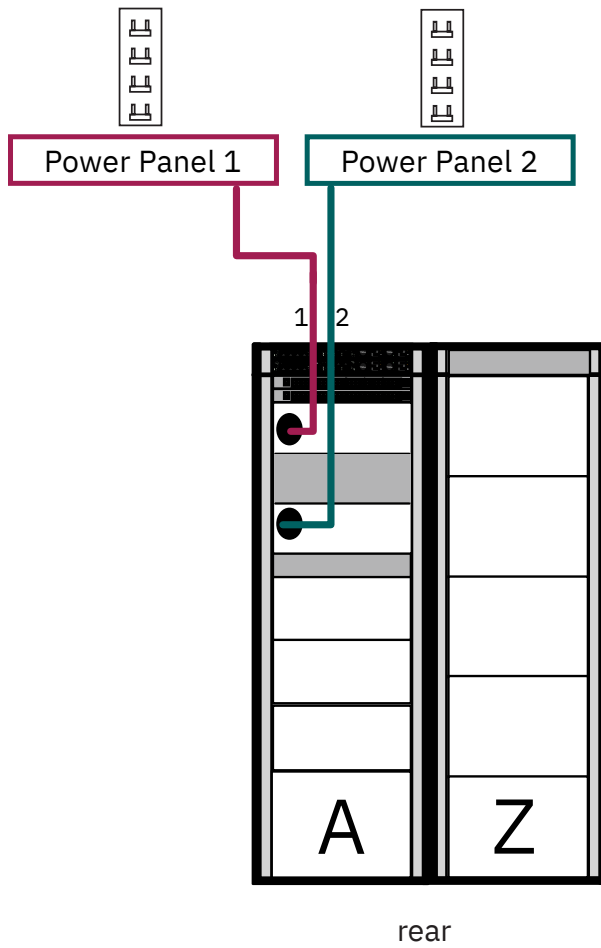


Figure 51. A and Z frames - BPA



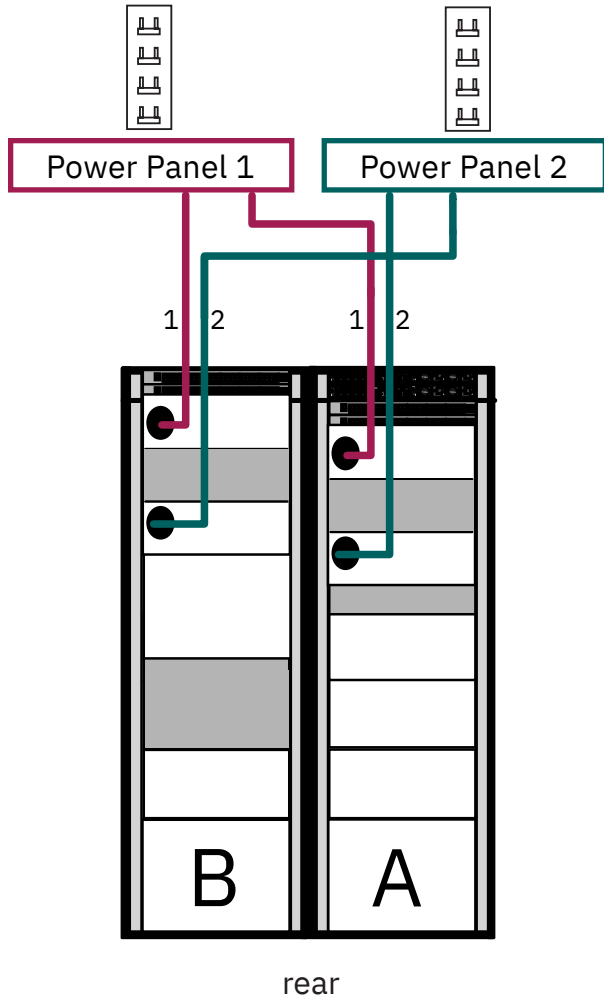


Figure 52. B and A frames - BPA

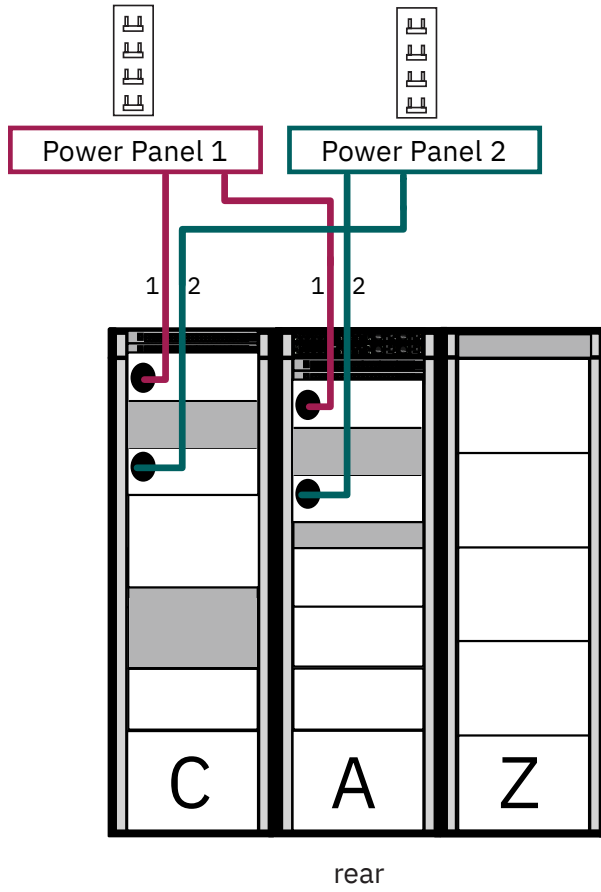


Figure 53. C, A, and Z frames - BPA

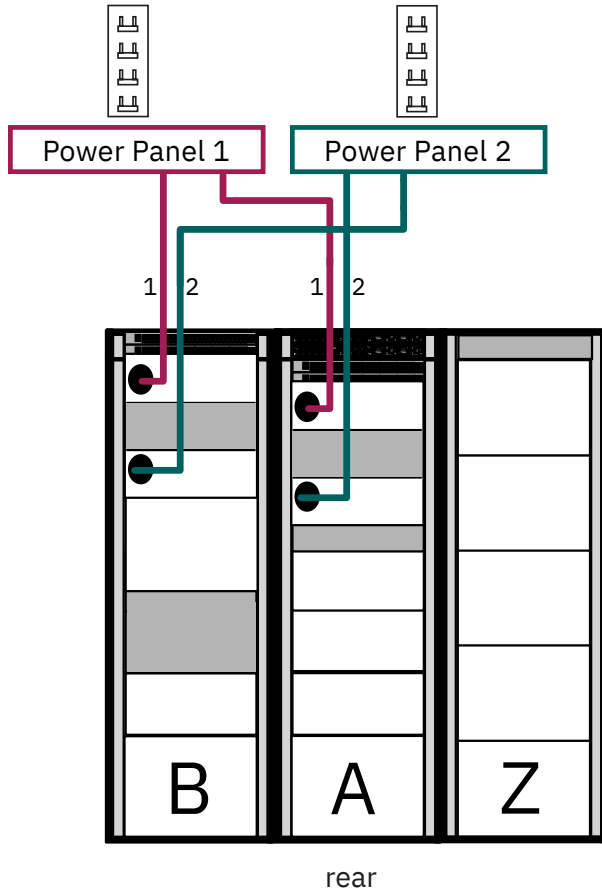


Figure 54. B, A, and Z frames - BPA

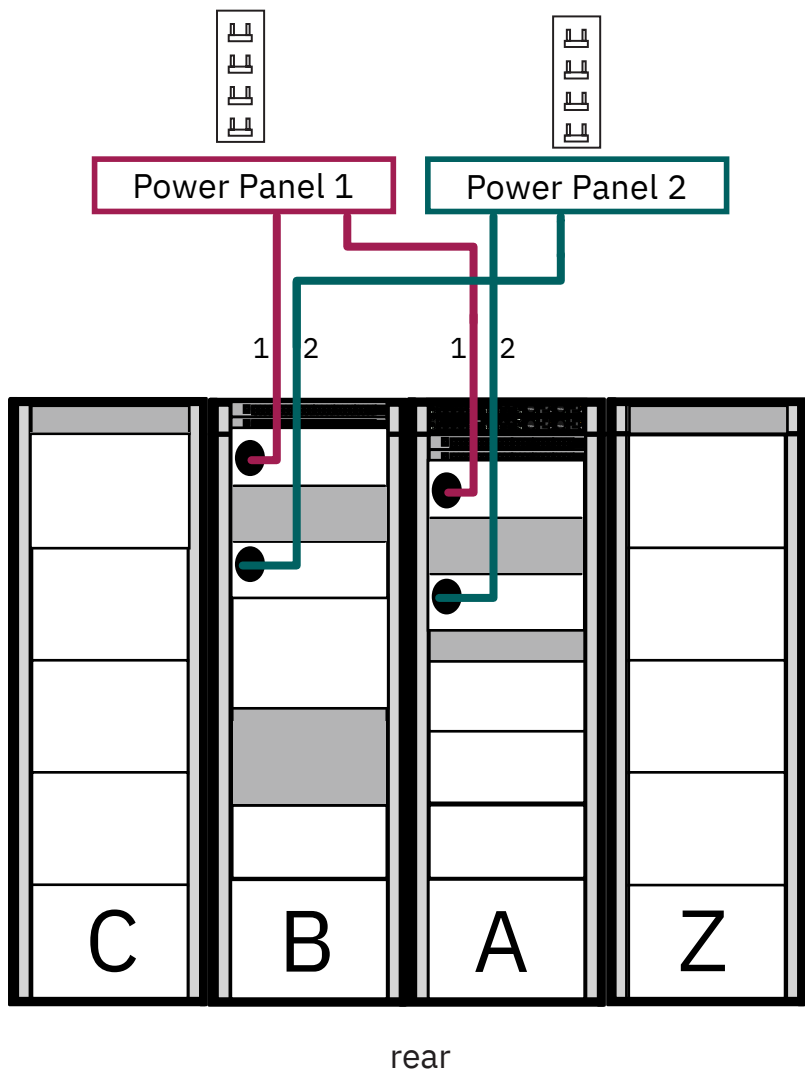
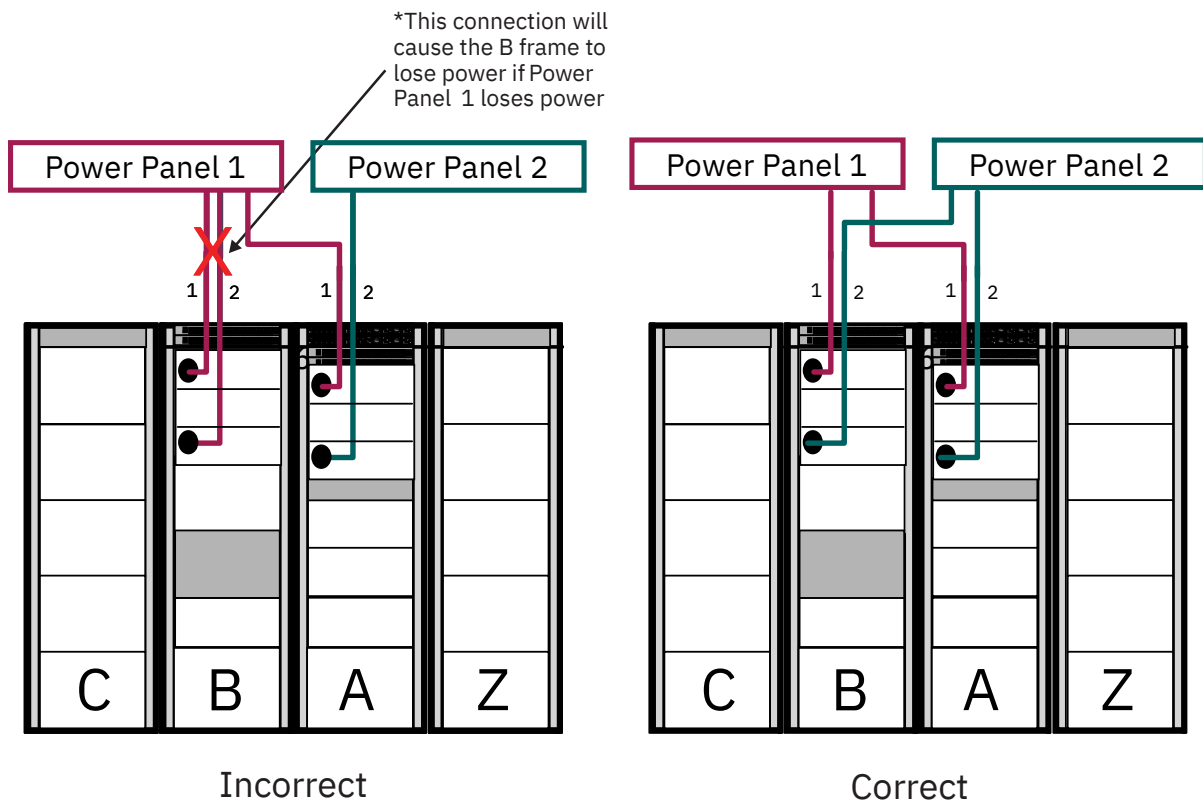


Figure 55. C, B, A, and Z frames - BPA

**Example (incorrect and correct BPA power connections)**





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## Appendix D. HMA, HMC, and TKE physical specifications

This section contains information for the Hardware Management Appliance (HMA), Hardware Management Console (HMC), and Trusted Key Encryption (TKE) components applicable at the time of publication (determined by the edition notice at the front of this document). Specifications may differ from those presented below.

**Note:** All dimensions are considered nominal.

- 2461 Hardware Management Appliance (*FC 0129*), [Table 49 on page 198](#)
- 2461 TKE Rack Mount and Tower (*FC 0057/0058* and *FC 0087/0088*), [Table 50 on page 199](#)
- 2461 HMC Rack Mount (*FC 0063* or *FC 0083*), [Table 51 on page 200](#) - **carry forward only**
- 2461 HMC Tower (*FC 0062* or *FC 0082*), [Table 52 on page 201](#) - **carry forward only**
- 1U KMM (keyboard, monitor, mouse) console unit, [Table 53 on page 203](#)

Table 49. 2461 Hardware Management Appliance (2461-VA3 and 2461-SE4) specifications

CPU:	Environment:	Electrical input:
<ul style="list-style-type: none"> <li>• 3.4 GHz Intel Xeon E-2226GE (2461-SE4)</li> <li>• 3.8 GHz Intel Xeon E3-1275 v6 (HMA - 2461-VA3)</li> </ul> <p><b>Memory:</b></p> <ul style="list-style-type: none"> <li>• RAM: <ul style="list-style-type: none"> <li>– 64 GB</li> </ul> </li> <li>• Type: DDR4, ECC</li> <li>• Slots: 4</li> <li>• Supports: <ul style="list-style-type: none"> <li>– 64 GB</li> </ul> </li> </ul> <p><b>Hard drive:</b></p> <ul style="list-style-type: none"> <li>• 2 TB SATA hard drive</li> </ul> <p><b>Video:</b></p> <ul style="list-style-type: none"> <li>• Display Port</li> </ul> <p><b>Fans:</b></p> <ul style="list-style-type: none"> <li>• Three front-removable hot-swap fans</li> </ul> <p><b>Power supply:</b></p> <ul style="list-style-type: none"> <li>• Two 900-watt AC</li> </ul> <p><b>Integrated functions:</b></p> <ul style="list-style-type: none"> <li>• Six Intel I350 Ethernet ports</li> <li>• Two Intel I210 management Ethernet ports</li> <li>• Eight USB ports (USB 2.0 and USB 3.0)</li> </ul>	<p><b>Operating:</b></p> <ul style="list-style-type: none"> <li>• Temperature: 5°C - 50°C (41°F - 122°F)</li> <li>• Altitude: 3050 m (~10,000 ft)</li> <li>• Humidity: <ul style="list-style-type: none"> <li>– Non-condensing: -12°C (10.4°F) dew point</li> <li>– Relative humidity: 8% - 93%</li> </ul> </li> </ul> <p><b>Storage (non-operating):</b></p> <ul style="list-style-type: none"> <li>• Temperature: -40°C - 60°C (-40°F - 140°F)</li> <li>• Relative humidity: 5% - 100%</li> </ul> <p><b>Air flow:</b></p> <ul style="list-style-type: none"> <li>• 350LFM continuous airflow</li> </ul> <p><b>Size:</b></p> <ul style="list-style-type: none"> <li>• Height: 4.45 cm (1.75 in)</li> <li>• Depth: 71.12 cm (28.00 in)</li> <li>• Width: 48.26 cm (19 in)</li> <li>• Weight: approximately 15.97 kg (35.2 lb)</li> </ul>	<ul style="list-style-type: none"> <li>• Sine-wave input (47-63 Hz) required</li> <li>• Input voltage low range: <ul style="list-style-type: none"> <li>– Minimum: 90 Vrms</li> <li>– Maximum: 137 Vrms</li> </ul> </li> <li>• Input voltage high range: <ul style="list-style-type: none"> <li>– Minimum: 180 Vrms</li> <li>– Maximum: 265 Vrms</li> </ul> </li> <li>• Input kilovolt-amperes (kVA), approximately: <ul style="list-style-type: none"> <li>– Minimum: 0.134 kVA</li> <li>– Maximum: 0.988 kVA</li> </ul> </li> </ul>



Table 50. 2461 TKE Rack Mount and Tower (FC 0057/0058 and 0087/FC 0088) specifications

CPU:	Environment:	Electrical input:
<ul style="list-style-type: none"> <li>• 2461 TKE FC 0057/0058               <ul style="list-style-type: none"> <li>– 3.40 GHz Intel Xeon E-2226GE</li> </ul> </li> <li>• 2461 TKE FC 0087/0088               <ul style="list-style-type: none"> <li>– 3.30 GHz Intel Xeon E3-1225</li> </ul> </li> </ul> <p><b>Memory:</b></p> <ul style="list-style-type: none"> <li>• Minimum: 32 GB</li> <li>• Maximum:               <ul style="list-style-type: none"> <li>– 64 GB (2461 FC 0057/0058)</li> <li>– 32 GB (2461 FC 0087/0088)</li> </ul> </li> <li>• Type: DDR4, ECC</li> <li>• Slots: 4</li> <li>• Supports:               <ul style="list-style-type: none"> <li>– 64 GB (2461 FC 0057/0058)</li> <li>– 32 GB (2461 FC 0087/0088)</li> </ul> </li> </ul> <p><b>Hard drive:</b></p> <ul style="list-style-type: none"> <li>• 2 TB SATA hard drive</li> </ul> <p><b>Video:</b></p> <ul style="list-style-type: none"> <li>• Display Port</li> </ul> <p><b>Fans:</b></p> <ul style="list-style-type: none"> <li>• Two side-removable hot-swap fans (2461 TKE FC 0088/0058)</li> <li>• Five front-removable hot-swap fans (2461 TKE FC 0087/0057)</li> </ul> <p><b>Power supply:</b></p> <ul style="list-style-type: none"> <li>• Two 900-watt AC (on 3931 machines)</li> <li>• C14 inlet</li> </ul> <p><b>Integrated function:</b></p> <ul style="list-style-type: none"> <li>• Six Intel I350 Ethernet ports</li> <li>• Two Intel I210 management Ethernet ports</li> <li>• Eight USB ports (USB 2.0 and USB 3.0)</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Operating:</b> <ul style="list-style-type: none"> <li>– Temperature: 0°C - 40°C (32°F - 104°F)</li> <li>– Altitude: 3050 m (~10,000 ft)</li> <li>– Relative humidity: 5% - 90% @ -12°C (10.4°F) dew point, non-condensing</li> </ul> </li> <li>• <b>Storage (non-operating):</b> <ul style="list-style-type: none"> <li>– Temperature: -40°C - 70°C (-40°F - 158°F)</li> <li>– Relative humidity: 5% - 100%</li> </ul> </li> </ul> <p><b>Air flow:</b></p> <ul style="list-style-type: none"> <li>• 350LFM continuous airflow</li> </ul> <p><b>Heat output:</b></p> <ul style="list-style-type: none"> <li>• 757 BTU/hr (222 watts)</li> </ul> <p><b>Size:</b></p> <ul style="list-style-type: none"> <li>• 2461 TKE FC 0087/0057               <ul style="list-style-type: none"> <li>– Height: 4.45 cm (1.75 in)</li> <li>– Depth: 71.12 cm (28.00 in)</li> <li>– Width: 48.26 cm (19 in)</li> <li>– Weight: approximately 15.97 kg (35.2 lb)</li> </ul> </li> <li>• 2461 TKE FC 0088/0058               <ul style="list-style-type: none"> <li>– Height: 439.2 mm (17.29 in)</li> <li>– Depth: 492.25 mm (19.38 in)</li> <li>– Width: 215.9 mm (8.5 in)</li> <li>– Weight: approximately 18.59 kg (41.0 lb)</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Sine-wave input (47-63 Hz) required</li> <li>• Input voltage low range:               <ul style="list-style-type: none"> <li>– Minimum: 90 Vrms</li> <li>– Maximum: 137 Vrms</li> </ul> </li> <li>• Input voltage high range:               <ul style="list-style-type: none"> <li>– Minimum: 180 Vrms</li> <li>– Maximum: 265 Vrms</li> </ul> </li> <li>• Input kilovolt-amperes (kVA), approximately:               <ul style="list-style-type: none"> <li>– Minimum: 0.134 kVA</li> <li>– Maximum: 0.988 kVA</li> </ul> </li> </ul>

<i>Table 51. 2461 HMC Rack Mount (FC 0063 or FC 0083) specifications - carry forward only</i>	
<b>2461 Rack Mount Hardware Management Console system unit specifications FC 0063 or FC 0083</b>	
<b>Dimensions</b>	
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)
<b>Video</b>	
2461 HMC Rack Mount - FC 0083	VGA
2461 HMC Rack Mount - FC 0063	Display Port
<b>Power consumption</b>	
Maximum power supply rating	up to 900W
Working level	200W
<b>Input Power<sup>1</sup></b>	
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
<b>Environmental</b>	
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.	

Table 52. 2461 HMC Tower (FC 0062 or FC 0082) specifications - carry forward only		
CPU:	Environment:	Electrical input:
<ul style="list-style-type: none"> <li>• 3.3 GHz Intel Xeon E3-1225 v5</li> </ul> <p><b>Memory:</b></p> <ul style="list-style-type: none"> <li>• Minimum: 32 GB (HMC)</li> <li>• Maximum: 32 GB (HMC)</li> <li>• Type: DDR4, ECC</li> <li>• Slots: 4</li> <li>• Supports: 32 GB (HMC)</li> </ul> <p><b>Hard drive:</b></p> <ul style="list-style-type: none"> <li>• 2 TB SATA hard drive</li> </ul> <p><b>Video:</b></p> <ul style="list-style-type: none"> <li>• VGA (2461 FC 0082)</li> <li>• Display Port (2461 FC 0062)</li> </ul> <p><b>Fans:</b></p> <ul style="list-style-type: none"> <li>• Two side-removable hot-swap fans</li> </ul> <p><b>Power supply:</b></p> <ul style="list-style-type: none"> <li>• One 900-watt AC</li> </ul> <p><b>Integrated function:</b></p> <ul style="list-style-type: none"> <li>• Six Intel I350 Ethernet ports</li> <li>• Two Intel I210 management Ethernet port</li> <li>• Eight USB ports (USB 2.0 and USB 3.0)</li> </ul>	<p><b>Operating:</b></p> <ul style="list-style-type: none"> <li>• Temperature: 0°C - 40°C (32°F - 104°F)</li> <li>• Altitude: 3050 m (~10,000 ft)</li> <li>• Relative humidity: 5% - 90% @ -12°C (10.4°F) dew point, non-condensing</li> </ul> <p><b>Storage (non-operating):</b></p> <ul style="list-style-type: none"> <li>• Temperature: -40°C - 70°C (-40°F - 158°F)</li> <li>• Relative humidity: 5% - 100%</li> </ul> <p><b>Air flow:</b></p> <ul style="list-style-type: none"> <li>• 350LFM continuous airflow</li> </ul> <p><b>Size:</b></p> <ul style="list-style-type: none"> <li>• Height: 439.2 mm (17.29 in)</li> <li>• Depth: 492.25 mm (19.38 in)</li> <li>• Width: 215.9 mm (8.5 in)</li> <li>• Weight: approximately 18.59 kg (41.0 lb)</li> </ul>	<ul style="list-style-type: none"> <li>• Sine-wave input (47-63 Hz) required</li> <li>• Input voltage low range:             <ul style="list-style-type: none"> <li>– 90 Vrms - 137 Vrms (tolerance range)</li> <li>– 100 V AC - 127 V AC (nominal range)</li> </ul> </li> <li>• Input voltage high range:             <ul style="list-style-type: none"> <li>– 180 Vrms - 265 Vrms (tolerance range)</li> <li>– 200 V AC - 240 V AC (nominal range)</li> </ul> </li> <li>• Input kilovolt-amperes (kVA), approximately:             <ul style="list-style-type: none"> <li>– Minimum: 0.134 kVA</li> <li>– Maximum: 0.988 kVA</li> </ul> </li> </ul>

**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 EIA locations 21, 22, or 23.
  - If you are sitting when using the KMM unit, place the unit in EIA 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 (T<sub>ma</sub>) 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 53. 1U KMM (keyboard, monitor, mouse) console unit specifications

<b>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)</b>	
<b>Dimensions</b>	
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
<b>LCD panel</b>	
Size	18.5 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
<b>Video</b>	
Type	Display Port
<b>Input Power</b>	
Input voltage	AC - 100-240 VAC - 1 A (nominal range)
Input frequency range	50-60 Hz
<b>Power Consumption</b>	
Standard usage	9 watts
Maximum	11 watts
Power supply maximum	36 watts
Power saving	< 1 watt (at 100 VAC and 240 VAC)
<b>Environmental - Temperature</b>	
Operating	0° to 50° C (32° to 122° F)
Storage	-20° to 60° C (-4° to 140° F)
<b>Environmental - Humidity</b>	
Operating	20% to 90%
Storage	10% to 90%
<b>Environmental - Altitude</b>	
Operating	Maximum 5000 meters
Storage	Maximum 5000 meters



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## Appendix E. Notices

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## Class A Notices

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The following Class A statements apply to this IBM product. The statement for other IBM products intended for use with this product will appear in their accompanying manuals.

### Federal Communications Commission (FCC) Statement

**Note:** This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

Properly shielded and grounded cables and connectors must be used in order to meet FCC emission limits. IBM is not responsible for any radio or television interference caused by using other than recommended cables and connectors or by unauthorized changes or modifications to this equipment. Unauthorized changes or modifications could void the user's authority to operate the equipment.

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

### Industry Canada Compliance Statement

This Class A digital apparatus complies with Canadian ICES-003.

### United Kingdom Notice

This product may cause interference if used in residential areas. Such use must be avoided unless the user takes special measures to reduce electromagnetic emissions to prevent interference to the reception of radio and television broadcasts.

### Avis de conformité à la réglementation d'Industrie Canada

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

### European Community Compliance Statement

This product is in conformity with the protection requirements of EU Council Directive 2014/30/EU on the approximation of the laws of the Member States relating to electromagnetic compatibility. IBM cannot accept responsibility for any failure to satisfy the protection requirements resulting from a non-recommended modification of the product, including the fitting of non-IBM option cards.

This product 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:  
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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。

V C C I - A

The following is a summary of the Japanese VCCI statement above:

This is a Class A product based on the standard of the VCCI Council. If this equipment is used in a domestic environment, radio interference may occur, in which case the user may be required to take corrective actions.

## Japan Electronics and Information Technology Industries Association (JEITA) Notice

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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

本装置は、「高圧又は特別高圧で受電する需要家の高調波抑制対策ガイドライン」対象機器（高調波発生機器）です。

回路分類：6（単相、PFC回路付）

換算係数：0

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

高調波電流規格 JIS C 61000-3-2 準用品

本装置は、「高圧又は特別高圧で受電する需要家の高調波抑制対策ガイドライン」対象機器（高調波発生機器）です。

回路分類：5（3相、PFC回路付）

換算係数：0

## People's Republic of China Notice

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**Declaration:** This is a Class A product. In a domestic environment, this product may cause radio interference, in which case the user may need to perform practical action.

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於居住環境中使用時，  
可能會造成射頻擾動，在此種情況下，  
使用者會被要求採取某些適當的對策。

#### CNS 15936:

警告：為避免電磁干擾，本產品不應安裝或使用於住宅環境。

#### IBM Taiwan Contact Information:

台灣IBM 產品服務聯絡方式：  
台灣國際商業機器股份有限公司  
台北市松仁路7號3樓  
電話：0800-016-888

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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.

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Verantwortlich für die Einhaltung der EMV Vorschriften ist der Hersteller:

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Tel: 914-499-1900

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Generelle Informationen:

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

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GC28-7015-00

