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GE
Intelligent Platforms

Hardware Manual

PCI-to-PCI 13-Slot Rack-Mount Expansion Unit

Model 2123ARC (RoHS)

Second Edition

Part No. 85466106-800

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1 • Introduction

This manual describes the PCI-to-PCI 13-Slot Rack-Mount Expansion Unit (Model 2123ARC), which provides 13 additional PCI slots to PCI systems. This manual includes information about the PCI-to-PCI 13-Slot Rack-Mount Expansion Unit operation, installation, and configuration.

The PCI-to-PCI 13-Slot Rack Mount Expansion Unit complies with the Restriction of Hazardous Substance (RoHS) directive. GE Intelligent Platforms product initiative encourages the design of electronic products with RoHS environmentally safe recycling and recover in mind as well as Waste Electrical and Electronic Equipment (WEEE) reduction in the amount of hazardous chemicals used in electronic manufacturers. For more information on GE Intelligent Platforms RoHS and WEEE implementation, please refer to the ***http://www.ge-ip.com*** website.

1.1 Manual Organization

This manual contains the following chapters:

Chapter 1 "***Introduction,***" is this chapter, which includes warranty information and product specifications.

Chapter 2 "***Expansion Unit Description,***" contains an overview of the Expansion Unit components and functions.

Chapter 3 "***Getting Started***," provides instructions for unpacking and rack-mounting the system.

Chapter 4 "***Installation***," contains instructions for installing and powering up the system.

This manual also contains a glossary and an index.

1.2 Referenced Documentation

The following specifications are referenced in this manual:

Industry Standards

- *PCI® Local Bus Specificatio*n 2.3, PCI Special Interest Group (PICMG®).
- *PCI to PCI Bridge Architecture 1.2 Specification*, PICMG.

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1.3 Notation Conventions

This manual contains the following notation conventions:

- Italics emphasize words in text, and documentation or chapter titles.
- Notes, Warnings, and Cautions call attention to essential information.

NOTE

A note calls attention to important information, such as advice and tips.

CAUTION

A Caution alerts you to conditions that can damage a device, system, or data.

WARNING

A Warning calls attention to actions that can cause risk or personal injury.

- Specific term definitions as applied in this manual include the following:
  - "Should" means that the user has the flexibility but is strongly recommended to perform the specific action to achieve an optimal outcome or result.
  - "Must" means that there is no flexibility and the user is required to perform the specific action to achieve an optimal outcome or result.

1.4 Warranty and Repair

GE Intelligent Platforms Embedded Systems provides a comprehensive site on the World Wide Web at ***http://www.ge-ip.com***. This web site contains up-to-date information including descriptions of current and new products, such as the Telum family of AdvancedMC modules or ATCA Carrier Blades. The web site also contains sales office locations, copyright trademarks, press releases, warranty, and technical support information.

1.4.1 Warranty

Warranty information is described on the GE Intelligent Platforms' web site ***http://www.ge-ip.com/support/embeddedsupport/warranty/***. This site provides current product warranty and repair services as well as information on out-of-warranty services.

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1.4.2 Customer Technical Support

GE Intelligent Platforms' dedicated team of Customer Technical Support Engineers is committed to providing quality support to all GE Intelligent Platforms' customers. Customer Technical Support Engineers are trained to assist GE Intelligent Platforms' customers in the development, integration and use of GE Intelligent Platforms' products in customer applications, systems, and products to facilitate timely product development. The Customer Technical Support Service Center is staffed weekdays (except holidays) between the hours of 8:00 AM and 5:00 PM Central Time (CT).

Use one of the following methods to contact technical support:

Address:	GE Intelligent Platforms, Inc. 12090 South Memorial Parkway Huntsville, AL 35803-3308 USA
Phone:	1-800-433-2682
Email:	support.embeddedsystems.ip@ge.com
Hours:	8:00 AM to 5:00 PM Central Time

Please have the following items and information available when calling technical support:

- Model number and revision level of the PCI Host card.
- Model number and revision level of the Expansion Enclosure.
- Model number and revision level of the Backplane Controller card.
- Host computer maker and model.
- BIOS manufacturer and revision.

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2 • Expansion Unit Description

The rack-mount PCI-to-PCI 13-Slot Expansion Unit Model 2123ARC (hereafter referred to as the Expansion Unit) provides a cost-effective way to increase the number of high-performance PCI devices available to systems. The Expansion Unit provides a low-latency, high-throughput path to 13 32-bit PCI slots within a 19-inch rack-mount chassis. Each slot in the rack-mount expansion chassis supports a short or long form factor +5Volt (V) PCI card. Each slot is master capable, allowing peer-to-peer communication within the chassis.

The Expansion Unit consists of the following:

- Expansion Enclosure with:
  - Integrated Backplane Controller
  - 13-slot backplane
  - 420Watt (W) power supply with provision for +5V and 3.3V
- PCI Host card
- Expansion Unit interconnecting cable

The Expansion Unit PCI Host Card installs in a Host system chassis. The Host system chassis connects to the Backplane Controller in the Expansion Enclosure creating an Expansion Unit that allows data exchange between the two systems.

The 13-slot backplane is divided into four independent PCI buses. Operation of the Host bus and the Expansion buses are independent to provide maximum performance and to allow multimedia and other devices to communicate with each other without slowing down the Host system.

A set of default configuration parameters is loaded automatically by BIOS or system boot software at boot time. The Expansion Unit requires no additional software for use on DOS® or Windows® based systems.

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2.1 Host System Requirements

One +5V or +3.3V PCI slot must be available on the Host system PCI bus for installation of the PCI Host Card. This slot can be either a 32-bit or 64-bit slot, and must have master capability.

The Expansion Unit is designed to work on static-clock frequency PCI buses running between 25 to 33 MHz.

In addition, the Host PCI system BIOS or system boot software must support PCI-to-PCI bridges to at least three levels.

2.2 Product Architecture

The Expansion Unit uses a multi-level PCI-to-PCI bridge architecture. From the Host point of view, all Expansion Enclosure slots reside behind PCI-to-PCI bridges. In addition, the expansion slots are arranged on four separate PCI buses that are separated by PCI-to-PCI bridges.

- Expansion Slot 1 is two bridges downstream from the Host bus.
- Expansion Slots 2-13 are three bridges downstream from the Host bus.

Therefore, for transfers to the Host, Expansion Slot 1 is capable of higher performance than Expansion Slots 2-13.

The Expansion Unit allows the Host system to access the entire 32-bit PCI memory and PCI I/O address space of any add-in cards installed in the Expansion Enclosure; the Expansion Unit requires no memory or I/O space.

In pre-fetchable address space, zero wait state memory burst operations are supported within the expansion enclosure and across the Expansion Unit cable with 72-byte pre-fetch read and 88-byte posted write buffers. Further performance improvements are achieved via the Expansion Unit's implementation of delayed transactions. Delayed transactions were added to the *PCI Local Bus Specification* 2.1 with bridging in mind.

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2.2.1 Performance

The Expansion Unit supports up to 132 MegaBytes per second (MB/s) aggregate throughput. Actual performance depends on the following:

- Type of cards in use
- Slots in use
- Host system

2.2.2 Latency

Added round-trip latency is determined by the number of PCI-to-PCI bridges between the expansion slot and the Host bus. Expansion Enclosure slots are either two or three bridges downstream from the Host bus.

Added round trip latency for configuration and I/O writes:

- 540 nsec (two bridges)
- 810 nsec (three bridges)

All other writes are posted.

Added round trip latency for I/O reads:

- 540 nsec (two bridges)
- 810 nsec (three bridges)

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2.2.3 Arbitration

Each PCI bus in the Expansion Enclosure has an Arbitration Controller. Round-Robin Scheduling (RRS) arbitration is provided for each of the four PCI buses in the Expansion Enclosure.

Alternately, Host system bus masters can access targets in the Expansion Enclosure, and Expansion Enclosure masters can access targets on the Host system. When requesting the Expansion Unit cable, masters installed in expansion Slots 2 - 13 have a lower priority than the one installed in expansion Slot 1; all have equal priority among masters in expansion Slots 2 – 13.

2.2.4 Interrupts

All PCI bus interrupts asserted by add-in cards in the Expansion Enclosure are passed across the Expansion Unit cable to the Host system. All interrupt handling must be performed by the Host system. The Expansion Unit does not have a hardware mechanism to guarantee data synchronization for posted write transactions. Therefore, a device driver interrupt service routine should first perform a read from the device's registers and ensure all write posted data in the bridge is flushed.

Within the Expansion Enclosure, the four PCI bus interrupt lines are shared in the manner specified by the *PCI-to-PCI Bridge Architecture Specification*.

2.2.5 Reset Behavior

Resets on the Host system are transmitted across the Expansion Unit cable to the Expansion Enclosure. After a reset, the Expansion Unit is disabled, except for configuration cycles, and must be reconfigured.

2.2.6 Error Detection

Parity checks on address and data lines are maintained by the integrity of the Expansion Enclosure PCI buses and of the cable interface.

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2.3 Specification

Table 2-1 lists the specifications for the Expansion Unit.

Table 2-1 Expansion Unit Specification

Descriptions	
Chassis	17 x 6.5 x 18 inches (in) or 43.2 x 16.5 x 45.7 centimeters (cm)
Faceplate	19 x 7 in or 48.26 x 17.78 cm
Power Requirements	
Backplane	1.5A @ 5V maximum
Host card	0.5A @ 5V maximum
Power Supply	
AC input	-115V or 230V
Input Frequency	47 - 264 Hz
Input Current	10A/115VAC 5A/230VAC
Maximum DC Loads for installed cards	40.0A @ +5V 05A @-5V 15.0A @ +12V 1.0A @ -12V 30.0A @ +3.3V 2.0A @ +5Vsb 220W maximum of +5V and +3.3V combined
Host Card Environmental	
Temperature	0º to +60º C operating -40º to +85º C storage
Humidity	0% to 90% non-condensing
Enclosure Environmental	
Temperature	0º to +35º C operating -40º to +85º C storage
Humidity	0% to 90% non-condensing
Compliance	- PCI-to-PCI Bridge Architecture Specification Rev. 1.2. - PCI Local Bus Specification Rev. 2.3. - Recognized under the component program of Underwriters Laboratories, Inc. (UL)

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3 • Getting Started

This chapter contains information for setting up and starting the Expansion Unit.

3.1 Unpacking

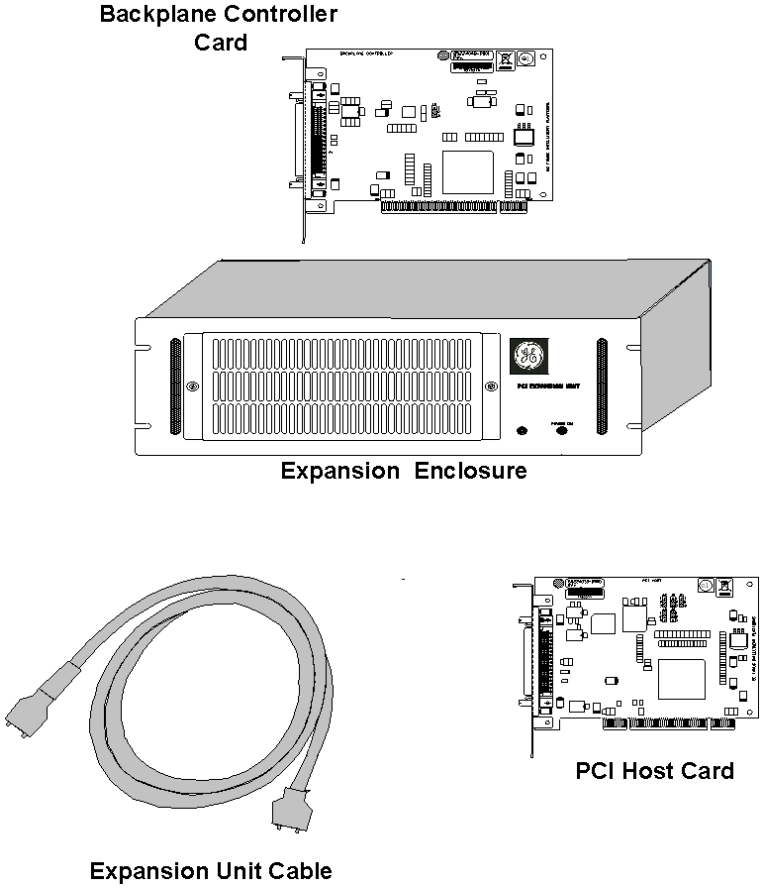
The Expansion Unit package contains the following components:

Component	Part Number
One 13-slot rack-mount Expansions Enclosure	85466106-R000
One Backplane Controller card	85224048-R000
One universal PCI Host card	85224038-R000
One Expansion Unit cable	82004133-04

NOTE
Twelve-digit part numbers with card revision level are printed on white labels affixed to the circuit cards. The serial number of the Expansion Enclosure is located on a white bar code label attached to the exterior of the chassis.

Please identify each item and notify Customer Technical Support if a part is missing.

Figure 3-1 Expansion Unit Components



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3.2 Expansion Enclosure

The Expansion Enclosure contains a 14-slot backplane with 13 available expansion slots, and a power supply. One end of the Expansion Unit cable plugs into the Backplane Controller card that is installed in the specified backplane controller slot on the 14-slot PCI backplane as shown in Figure 3-3 and Figure 3-4.

Figure 3-2 Expansion Enclosure (Front View)

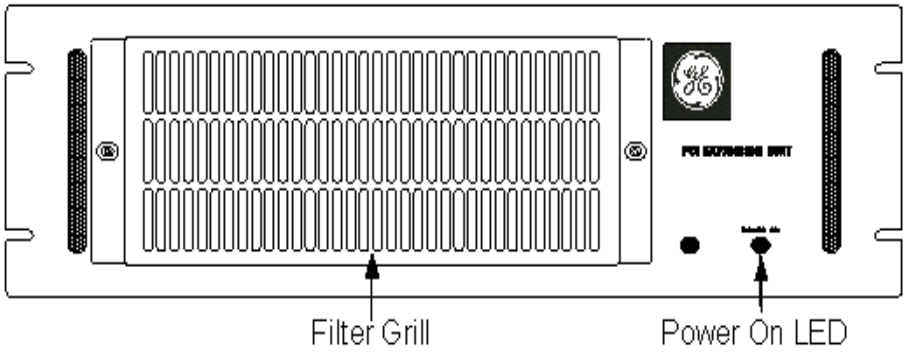

Figure 3-3 Expansion Enclosure (Rear View)

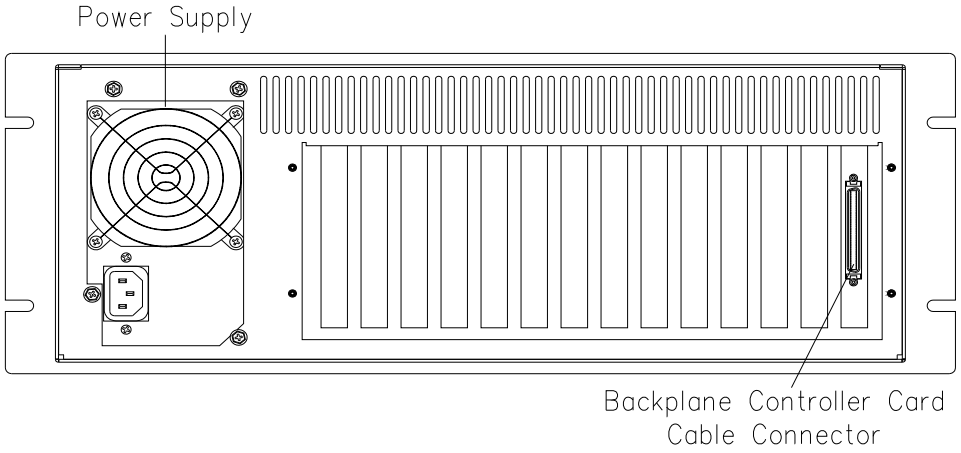

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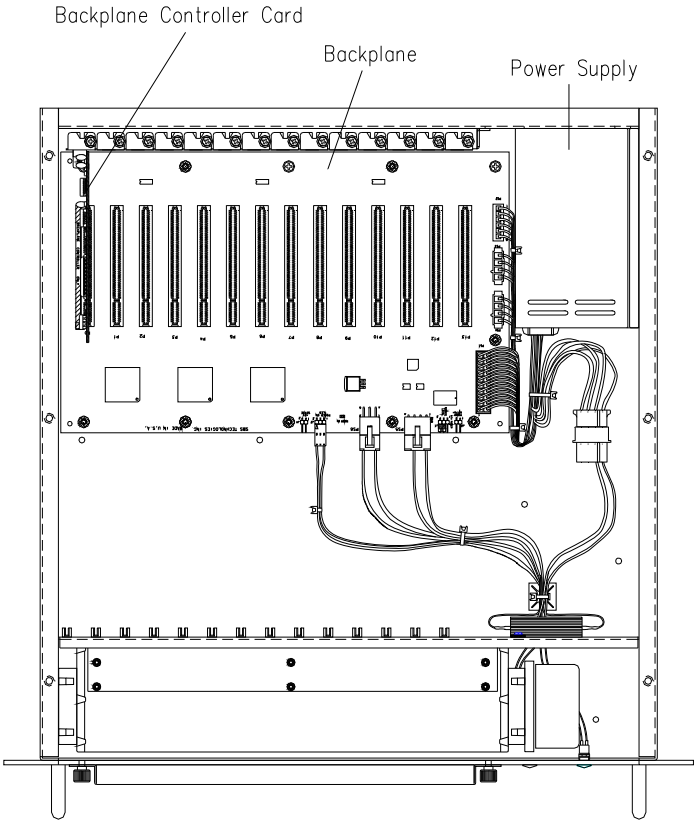
Figure 3-4 Expansion Enclosure (Internal View from Top)



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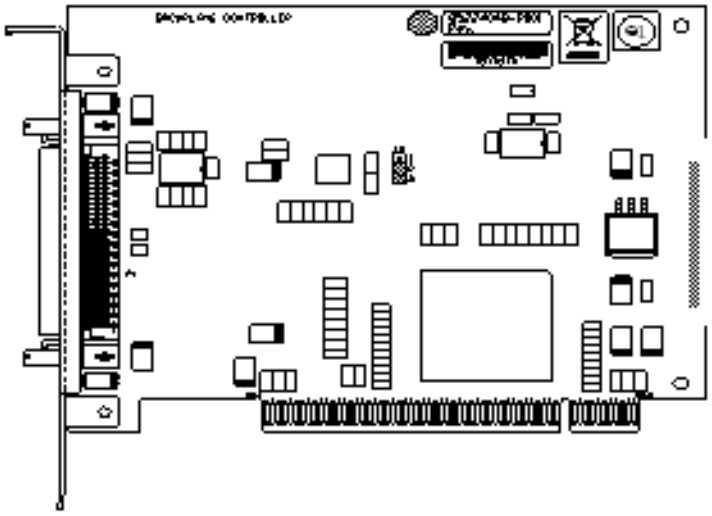
3.3 Backplane Controller Card

The Backplane Controller Card installs into Slot 0 of the Expansion Chassis. This slot is labeled **BACKPLANE CONTROLLER SLOT ONLY**. This slot provides connectivity between the Expansion Chassis and the Host System.

NOTE

The Backplane Controller card ***must*** be installed in the backplane slot labeled **BACKPLANE CONTROLLER SLOT ONLY**.

Figure 3-5 Backplane Controller Card



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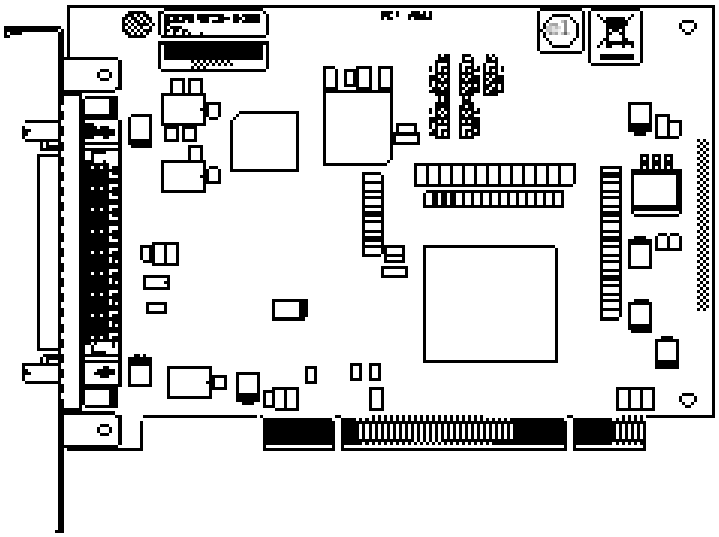
3.4 PCI Host Card

The PCI Host Card installs in the Host system chassis. One end of the Expansion Unit Cable plugs into the PCI Host Card.

CAUTION

Do not change the manufacturing default jumper settings on the PCI Host card.

Figure 3-6 PCI Host Card



3.5 Expansion Unit Cable

One four-foot (1.2192 meter) EMI-shielded cable connects the PCI Host Card to the Expansion Chassis and is included with the Expansion Unit package.

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4 • Installation

Before working with any GE Intelligent Platforms' component, take the necessary precautions to prevent electrostatic discharge (ESD), which can damage the Expansion Unit.

4.1 Installation Precautions

Read the following warnings to preventing ESD and possible harm to the system.

WARNINGS

1. Static Electricity can damage integrated circuit components and cards. Make sure you use proper ESD handling procedures (refer to EIA-625, ESD Association Handbook or MIL-HDBK-263) when working with cards and components.

2. Make sure power is *OFF* and power cords are disconnected before installing cards in the PCI Host system and Expansion Enclosure.

3. Avoid touching the gold-plated card edge connectors.

4. The Expansion Enclosure must be plugged into a grounded outlet (preferably the same outlet used by the host system).

5. When removing or replacing the rack-mount enclosure's cover, first lift the front edge of the cover. Then, slide the cover onto or off of the chassis's back lip.

4.2 Required Tools

The installation procedure requires the following tools:

- A small Phillips screwdriver to secure the mounting screws for the cards.

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4.3 Expansion Unit Installation Procedure

This section contains information for installing the Enclosure Unit and contains instructions for changing the filter, if necessary.

The Expansion Unit installation procedure consists of the following steps:

1. Mounting the Chassis in a Rack Assembly.
2. Installing the Expansion Enclosure.
3. Installing the PCI Host Card.
4. Installing the Expansion Cable.

After the 2123ARC system installation is completed, install additional user cards if necessary.

The Expansion Unit has a remote power-up PCI Host Card, and the Backplane Controller Card supports remote power up. This means that the Expansion Enclosure powers up and down with the Host system that has the Host Card installed in it. It is not required to power on the Expansion Enclosure manually prior to powering on the Host system. Likewise, powering down the Host system also powers down the Expansion Enclosure.

1. Make sure the installation site meets the power and environmental requirements.

Power and environmental requirements are listed in Table 2-1.

2. Mount the Chassis in a Rack Assembly.

Read the following information before mounting the chassis in a rack assembly.

Make sure the amount of airflow required for safe operation is not compromised. There must be at least 2 inches of free space for air circulation both in front of and behind the chassis.

If the Enclosure chassis is installed in a closed or multi-unit rack assembly, the operating ambient temperature of the rack environment may be greater than the room ambient temperature. Consequently, you should consider installing the equipment in an environment compatible with the maximum rated ambient operating temperature (35° C).

Make sure the chassis is mounted in the rack such that the mechanical loading is even. Uneven mechanical loading can cause hazardous conditions.

Consider the connection of the chassis to the supply circuit and the effect that overloading of circuits might have on overcurrent protection and supply wiring. Use appropriate consideration of equipment nameplate ratings when addressing this concern.

Maintain reliable earthing of the rack-mounted equipment. Give particular attention to supply connections other than direct connections to the branch circuit (for example, use of power strips).

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2. Install the Expansion Enclosure.

The Expansion Enclosure requires a Backplane Controller Card as well as a User Card. To install the Expansion Enclosure, perform the following steps

1 If the power is on, power **off** the Expansion Enclosure and disconnect all power cords if already attached.

2 Remove the Expansion Enclosure cover. (*See* Figure 4-1)

3 Install the Backplane Controller Card in the slot labeled ***Backplane Controller Slot Only***. (*See* Figure 4-1)

4 Install PCI user card(s) in the Expansion Enclosure.

Use Expansion Slots 1 – 13.

Slot 1 provides higher performance than Slots 2-13.

5 Replace the Expansion Enclosure cover.

6 Reconnect the power cord.

3. Install the PCI Host Card.

The PCI Host Card must be installed in a PCI Host system chassis.

To install the PCI Host Card in a PCI Host system, perform the following steps:

1. Power OFF the PCI Host system and disconnect the power cord.
2. Remove the Host system's cover to reveal the card slots.
   Refer to the host computer's manual instructions for removing the cover.
3. Locate an unoccupied PCI card slot in the Host System chassis in which you wish to install the PCI Host Card.
   The slot you select must support bus mastering.
4. Remove the cover of the slot you select.
5. Remove the metal plate that covers the cable exit at the rear of the chassis.
   Set aside the mounting screw that secures the metal plate.
   This screw is used again in Step 7.
6. Insert the PCI Host card into the selected slot's connector.
   Make sure the PCI Host card is seated properly in the slot connector.
7. Fasten the PCI Host card in place with the screw removed in Step 5.
8. Replace the Host system cover and secure it in place.
9. Reconnect the Host system's power cord.

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4. Install the Expansion Unit Cable.

The Expansion Cable connects to the PCI Host Card and to the Backplane Controller Card. To install the Expansion Unit Cable, perform the following steps:

CAUTION

Avoid sharp bends or fold in the Expansion Unit cable.

1. Power **OFF** the Host system and the Expansion Enclosure. Then, disconnect the power cords if connected.
2. Connect one end of the Expansion Unit cable onto the Host Card's cable connector.
3. Secure the Expansions Unit cable to the PCI Host Card by tightening the two screws on the cable connector body.
4. Connect the other end of the Expansion Unit cable to the Backplane Controller Card's cable connector.
5. Secure the Expansion Unit cable to the Backplane Controller Card by tightening the two screws on the cable connector body.
6. Replace the Expansion Enclosure cover and tighten down the securing screws.
7. Reconnect the power cords.
8. Power on the Host system, which power on the Expansion Enclosure automatically.

Your 2123ARC system is ready for use.

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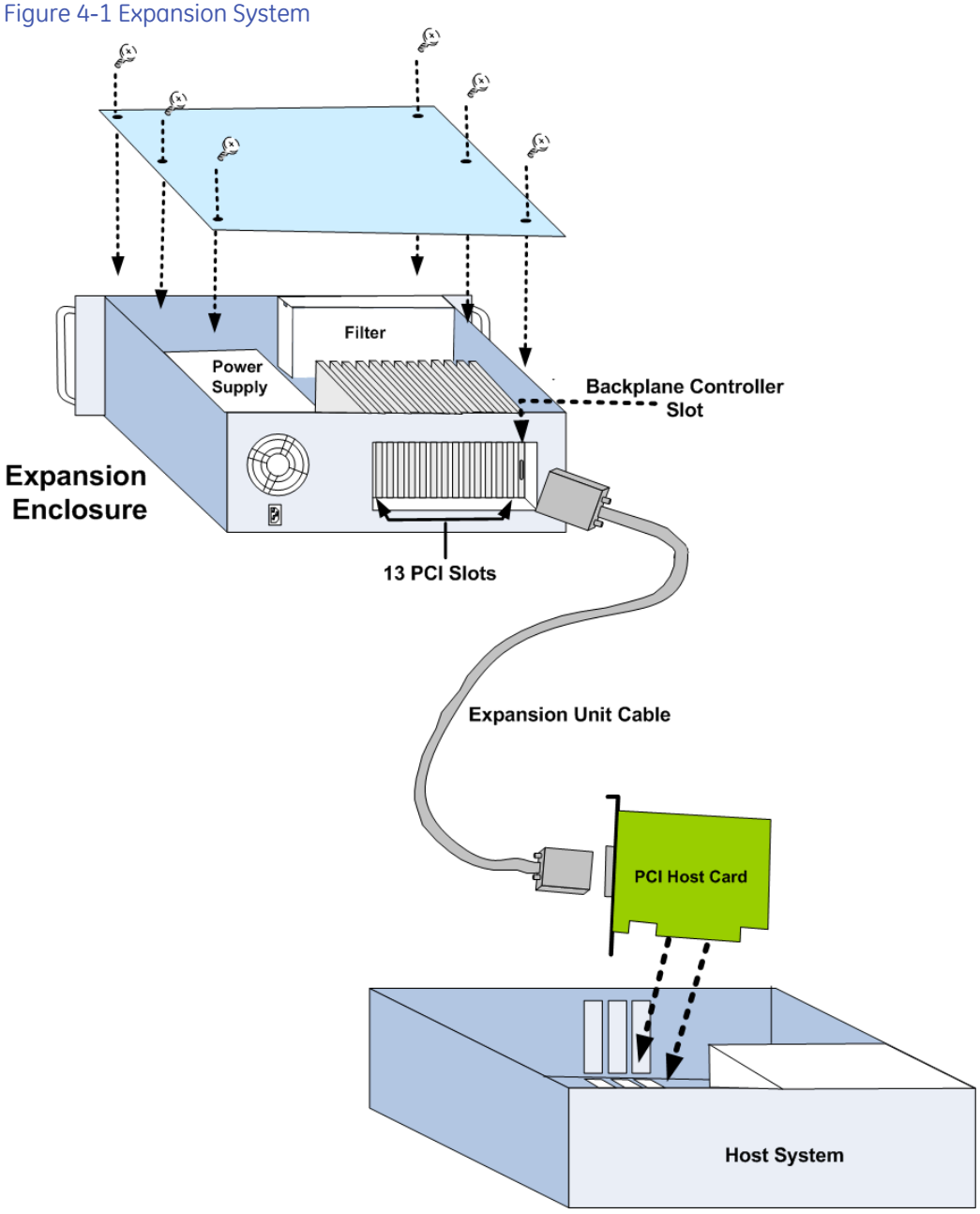
Figure 4-1 Expansion System



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4.4 User Cards Installation

To install additional user cards in the Expansion Enclosure:

- Use expansion Slots 1-13.
- Slot 1 provides higher performance than Slots 2-13.

WARNING

Do not use the slot labeled BACKPLANE CONTROLLER SLOT ONLY as this slot is reserved for the GE Backplane Controller Card that comes with Expansion Unit.

To install a user card in the Expansion Enclosure, perform the following steps:

1. Power down the Host system and disconnect the Expansion Enclosure power cords.
2. Remove the six screws that secure the chassis cover. Set the screws aside for use when replacing the cover. Do not remove any other screws.
3. Carefully remove the Expansion Enclosure cover.
4. Locate an unoccupied expansion slot. Make sure you ***do not*** use the slot labeled BACKPLANE CONTROLLER SLOT ONLY.
5. Remove the cover of the slot you select.
6. Remove the screw at the top of the slot and set aside. This screw will be used in Step 8.
7. Set the user card firmly into the slot.
8. Secure the card to the rear panel with the screw set aside in Step 6.
9. Attach any cables according to the card's instructions.
10. If you are installing more than one card, repeat Steps 4-9 for each additional card.
11. Replace the Expansion Enclosure cover and secure with six screws removed in Step 2.
12. Reconnect the Expansion Enclosure power cord.
13. Power on the Host system, which powers on the Expansion Enclosure automatically.

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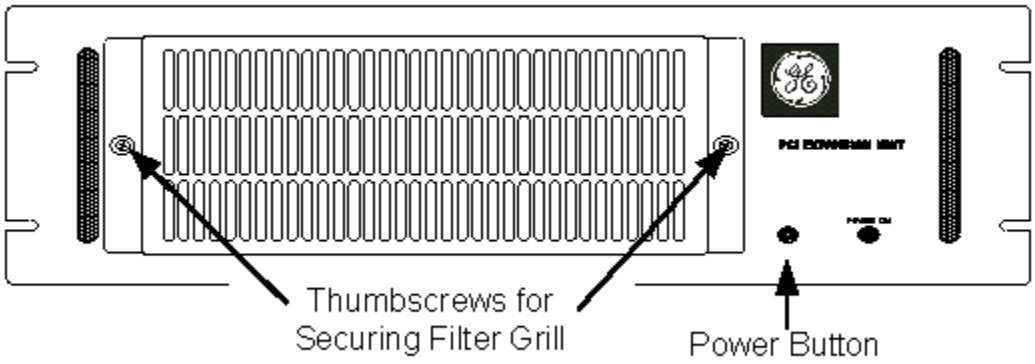
4.5 Changing the Filter

The filter on the Expansion Enclosure can be changed at any time. On the Expansion Enclosure, the filter is located behind the grill on the enclosure's front panel.

To change the filter, perform the following steps:

1. Manually, power off the Expansion Enclosure by pressing the Power Button. The Power LED turns off.
2. Disconnect the power cord and any cables.
3. Remove the two thumbscrews.
4. Remove the grill from the Expansion Enclosure.
5. Replace the old filter with a new filter.
6. Replace the grill and tighten the thumbscrews.
7. Replace the power cord and cables.
8. Manually, power on the Expansion Enclosure by pressing the Power button. The Power LED turns on.

Figure 4-2 Securing the Filter Grill



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Glossary

Downstream transaction: A data transfer in which the initiator is on a PCI bus closer to the host system than the target is. See also Upstream transaction.

EMI: ElectroMagnetic Interference.

Expansion enclosure: The expansion chassis with installed backplane and power supply.

Expansion Unit: Includes the host card, expansion enclosure and its components, and the interface cables. See expansion enclosure.

Expansion Unit Cable: Connects the SBS host card and the backplane controller card installed in the expansion enclosure.

G byte: Gigabyte. Two to the thirtieth power (exactly 1,073,741,824) bytes.

Hz: Hertz.

Host card: The GE Intelligent Platforms circuit card that installs in the host computer.

Host system: The computer system to which the Expansion Enclosure is attached.

Initiator: Same as Master.

ISR: Interrupt Service Routine.

K byte: Kilobyte. Two to the tenth power (exactly 1024) bytes.

LED: Light Emitting Diode. The indicator lights on the expansion enclosure are LEDs.

Master: One of the two devices involved in a data transfer. The master initiates the transfer to the target. See also Target.

Mbyte: Megabyte. Two to the twentieth power (exactly 1,048,576) bytes.

MB/s: Megabytes per second. Exactly 1,000,000 bytes per second.

MHz: MegaHertz.

msec: Millisecond. 1/1,000 of a second.

nsec or **ns:** Nanosecond. 1/1,000,000,000 of a second.

PCI: Peripheral Component Interconnect.

PCI-to-PCI Bridge: A device that interconnects two PCI buses so that the buses operate independently, yet can communicate with each other.

Round-Robin Arbitration: A system used by the Expansion Unit to force the add-in cards to take turns using the PCI bus.

Target: One of the two devices involved in a data transfer. The target responds to the master's request. See also Master.

Upstream transaction: A data transfer in which the initiator is on a PCI bus further away from the host system than the target is. See also Downstream transaction.

µsec: Microsecond. 1/1,000,000 of a second.

Window: A range of addresses that the Unit responds to for a specific function; a reserved area of memory.

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