Deskside POWER CHALLENGE™ and CHALLENGE® L Owner's Guide

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About This Guide

This guide is designed to help you learn to use, manage, and troubleshoot your POWER CHALLENGE™ or CHALLENGE™ L deskside server. For purposes of brevity, the term Challenge is used generically to describe both models unless there is a specific reason to differentiate them.

This document is organized as follows:

Chapter 1	"Introducing the Challenge Deskside Servers" describes the system and its capabilities.
Chapter 2	"Touring the Chassis" describes all of the system components and reviews all of the controls, indicators, and connectors.
Chapter 3	"Getting Started" reviews hardware-specific operating procedures.
Chapter 4	"Installing Optional Peripherals" covers the installation or removal of front-loading devices (FLDs), printers, and modems.
Chapter 5	"Troubleshooting" describes some common problems and possible solutions, along with hardware diagnostics.
Chapter 6	"Safety and Comfort" describes basic human factors guidelines for system operation.
Appendix A	"Hardware Specifications" lists system specifications.
Appendix B	"Maintaining Drives" lists care and maintenance procedures for removable media drives.
Appendix C	"System Controller Messages" lists messages that can appear in the System Controller's event history log.

Appendix D	"Challenge IO4 PROM, Mezzanine, and Troubleshooting" supplies information about the Challenge IO4 PROM monitor functions, mezzanine boards, and basic troubleshooting.
Appendix E	"Challenge L VMEbus Implementation" provides information to help users select third-party VME boards for the POWER Challenge and Challenge L systems. The chapter supplies information about the board size, power available, and pin functions.

Start at the beginning to familiarize yourself with the features of your new system, or proceed directly to the information you need using the table of contents as your guide.

Additional software-specific information is found in the following software guides:

- *Personal System Administration Guide*
- *IRIX Admin: System Configuration and Operation*
- *IRIX Admin: Software Installation and Licensing*

Conventions

The *Deskside POWER Challenge and Challenge L Owner's Guide* uses these conventions:

- References to documents are in *italics*.
- References to other chapters and sections within this guide are in quotation marks.
- Names of commands that you type at the shell prompt are in *italics* as are IRIX filenames.
- Steps to perform tasks are in numbered sentences. When a numbered step needs more explanation, the explanation follows the step.

Compliance Information

FCC WARNING

This equipment has been tested and found compliant 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 users will be required to correct the interference at their own expense.

This product requires the use of external shielded cables in order to maintain compliance with Part 15 of the FCC rules.

International Special Committee on Radio Interference (CISPR)

This equipment has been tested to and is in compliance with the Class A limits per CISPR publication 22, Limits and Methods of Measurement of Radio Interference Characteristics of Information Technology Equipment; and Japan's VCCI Class 1 limits.

Canadian Department of Communications Statement

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus as set out in the Radio Interference Regulations of the Canadian Department of Communications.

Attention

Le present appareil numerique n'emet pas de bruits radioelectriques depassant les limites applicables aux appareils numeriques de Classe A prescrites dans le Reglement sur le Brouillage Radioelectrique etabli par le Ministere des Communications du Canada.

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　従って、住宅地域またはその隣接した地域で使用すると、ラジオ、テレビジョン受信機等に受信障害を与えることがあります。
　取扱説明書に従って正しい取り扱いをして下さい。

Figure In-1 VCCI Information

Figure In-2 CE insignia

Manufacturer's Regulatory Declarations

This workstation conforms to several national and international specifications and European directives as listed on the "Manufacturer's Declaration of Conformity," which is included with each computer system and peripheral. The CE insignia displayed on each device is an indication of conformity to the European requirements.

Caution: Your workstation has several governmental and third-party approvals, licenses, and permits. Do not modify this product in any way that is not expressly approved by Silicon Graphics, Inc. If you do, you may lose these approvals and your governmental agency authority to operate this device.

Chapter 1

Introducing the Challenge Deskside Servers

The Challenge deskside systems, model CMN A011, are high-performance servers in a compact deskside enclosure. This guide contains information for end users about the POWER Challenge and Challenge deskside systems hardware.

Features and Options

Your Challenge deskside server comes with the following features:

- POWER Challenge models come with an IP21 or IP25 CPU board using the R8000™ or R10000™ microprocessor on each board (see Table 1-1).
- Challenge models come with an IP19 or IP25 CPU board using the R4400™ or R10000 microprocessor on each board (see Table 1-1).

  Note: A POWER Challenge or Challenge system with an IP25 (R10000) CPU board is called the POWER Challenge 10000 or the Challenge 10000.
- Up to 2 GB of RAM on Challenge system memory boards and up to 6 GB of RAM in POWER Challenge systems.
- An IO4 board with multiple control functionality and expandability (also known as the POWERchannel-2).
- Space for up to seven half-height SCSI peripherals in the chassis.
- The Silicon Graphics® Ebus, which supports protocols for consistent data sharing and high-speed block data transfers between main memory and the I/O subsystem; the 256-bit Ebus (also known as the POWERpath-2 system bus) supports multiple processor operations.

- A 40-bit address bus, which provides addressing to parity-checked high-speed data transfers between the CPU(s) and memory board(s).
- 64-bit operating system support (on POWER Challenge).

Table 1-1 CPU Board Type and System Relationship

CPU board	Processor	Applicable System
IP19	R4400	Challenge
IP21	R8000	POWER Challenge
IP25	R10000	Challenge 10000 or POWER Challenge 10000

- Five VME™ expansion slots (only two slots are available when a system is ordered with the visualization console option).
- One RS-422 and three RS-232 serial ports.
- A 25-pin parallel port.
- An independent system status monitor (System Controller) that records error information during any unplanned shutdown.

Available options include:

- VMEbus I/O and controller boards.
- additional half-height and full-height SCSI devices.
- external 1/2-inch and 8 mm SCSI-controlled tape backup systems.
- a system console ASCII terminal.
- CPU and memory upgrades.
- additional IO4 controller boards.
- a visualization console option providing a basic color graphics interface to the POWER Challenge system.
- optional IO4 mezzanine daughter boards (also known as HIO modules) for expanded and varied functionality of the IO4.

Although the Challenge deskside servers are similar in size and external appearance to previous Silicon Graphics deskside systems, most internal features are different in design.

The internal drive rack supports up to seven half-height (or one half-height and three full-height) devices that are controlled by either one or two SCSI-2 buses.

The Challenge Board Set

The basic Challenge board set consists of

- an IP19, IP21, or IP25 CPU board
- an MC3 memory board (also known as a POWERpath-2™ interleaved memory board)
- an IO4 controller board

The backplane supports the addition of two more boards selected from the three standard types listed. The Onyx deskside graphics workstation system supports a RealityEngine^2™ (RE^2) or VTX™ graphics board set that is not available with the Challenge deskside backplane. The POWER Challenge system does support an optional visualization console, providing a basic color graphics interface to the system.

Figure 1-1 shows a functional block diagram of the Challenge deskside subsystems. The IP25, IP21, or IP19 board is the heart of the Challenge deskside system.

The IP25 board in your Challenge 10000 or POWER Challenge 10000 deskside system can house one, two, or four MIPS R10000 64-bit microprocessors. Your system can house up to three IP25s with a potential system total of 12 microprocessors. The four-way superscalar R10000 microprocessor can fetch four instructions and issue up to five instructions per cycle. A superscalar processor is one that can fetch, execute and complete more than one instruction in parallel.

The IP21 CPU board in your POWER Challenge deskside can house either one or two R8000 microprocessors. Your system can house up to three IP21s with a potential system total of six R8000 microprocessors. Each R8000 microprocessor assembly uses a customized cache controller, a separate floating point unit, and two tag RAM and two SRAM cache units in addition to the main integer unit. Board logic on the CPU is “sliced” to give each microprocessor its own dedicated support logic. This allows each microprocessor to run independently.

Note that all optional upgrade R8000 CPU boards ordered for the POWER Challenge come with two microprocessors on each board.

Each IP19 CPU board in your Challenge deskside can house up to four MIPS R4400 64 bit RISC microprocessors. Your system can house up to three IP19s with a potential system total of 12 microprocessors. Board logic on the IP19 is “sliced” to give each R4400 its own dedicated support logic. This allows each R4400 to run independently.

The MC3 system memory board can be populated with 16 MB or 64 MB SIMM modules. The MC3 has 32 SIMM sockets. Up to 2 GB of on-board memory is available for Challenge and up to 6 GB for POWER Challenge.

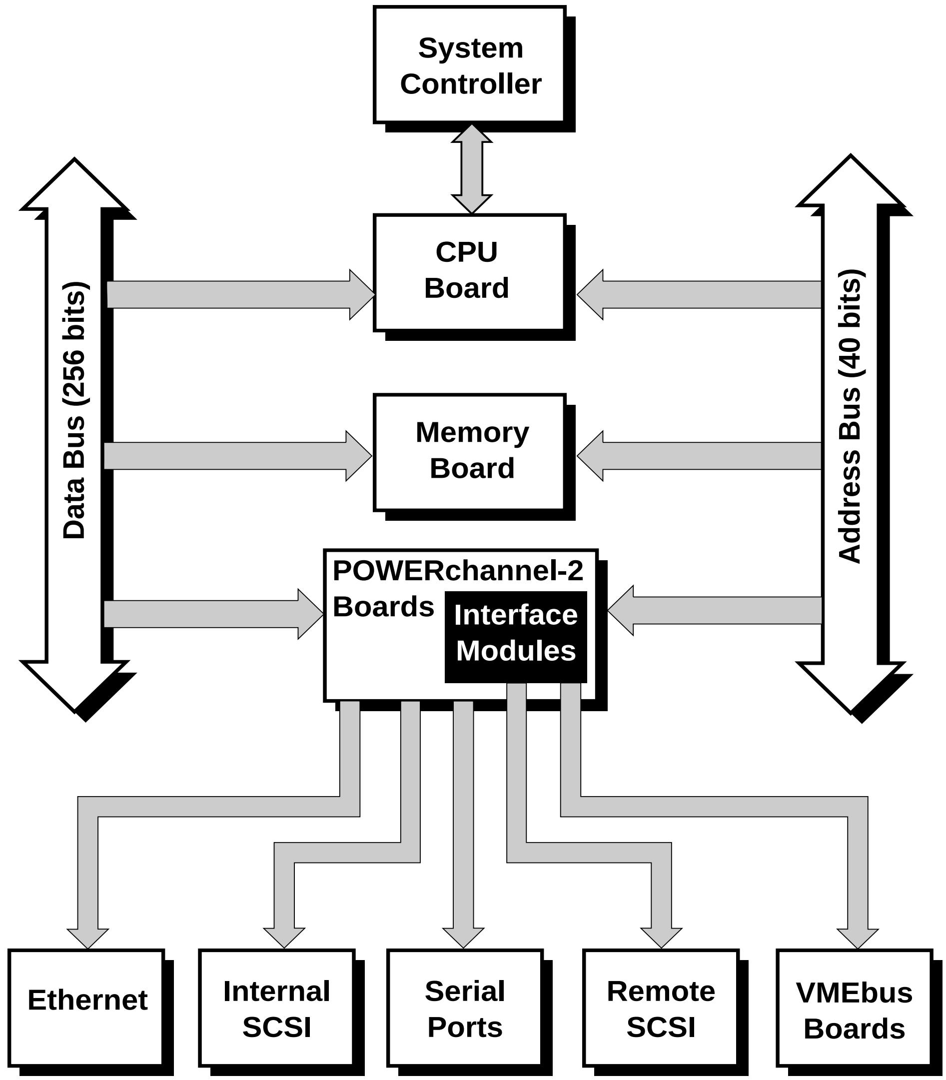

Figure 1-1 Challenge Deskside System Functional Block Diagram

I/O Interfaces

The main Challenge I/O subsystem consists of one or more IO4 boards, which plug directly into the Ebus and use optional mezzanine cards. Mezzanine cards are daughter boards that plug into IO4 boards to allow expansion and customizing. See Appendix D for additional information on mezzanine boards.

Controllers for I/O devices connect to the 64-bit-wide Ibus. The Ibus connects to the Ebus through the IA and ID processors. These devices manage transfers between the 1.2 GB per second Ebus and the 320 MB per second Ibus. I/O resources connect to the 320 MB per second Ibus. Up to two optional mezzanine cards plug into the Ibus on each IO4 board.

The IO4 is the fundamental component of the I/O subsystem. It contains all of the I/O controllers needed to implement a basic Challenge system:

- an Ethernet controller
- two fast and wide 16-bit SCSI-2 controllers
- a VME interface port (using the VCAM or GCAM)
- four serial ports
- a parallel port

In addition, the IO4 board contains the logic for a flat cable interface (FCI), which is used to connect to the VMEbus and optional visualization console. The IO4 board also has connections for mezzanine cards, which are used to provide expansion I/O controllers.

Ibus Interface

The IA and ID application-specific integrated circuits (ASICs) act as bus adapters that connect the Ibus to the much faster Ebus. In addition to making the necessary conversions back and forth between the two buses, the IA and ID ASICs perform virtual address mapping for scatter/gather direct memory access (DMA) operations and maintain cache coherency between the Ebus and the I/O subsystem.

Flat Cable Interface

The IO4 contains two FCI interfaces that are proprietary to Silicon Graphics. FCIs are synchronous, point-to-point interfaces that allow communication between devices connected by a cable. The FCI is used to connect to the VME64 bus adapter. FCIs can operate at up to 200 MB per second for VMEbus adapters.

The FCI on the first IO4 in a system is connected to the VME Channel Adapter Module (VCAM) board, which contains a VME adapter subsystem in the backplane.

POWER Challenge systems using the visualization console option have a Graphics Channel Adapter Module (GCAM) board. The GCAM contains a VME adapter subsystem and interfaces to the optional visualization console graphics board in the fifth VME slot. An FCI interface is routed to a connector on the front of the optional GCAM.

Note that the optional visualization console graphics board uses VME slots 3, 4, and 5 when installed. This leaves two VME slots available for use.

VMEbus Interface

The VMEbus is supported through a VCAM interface (GCAM with the visualization console option) connected to an IO4 board. This bus is standard equipment and is located in the main backplane, next to the Ebus. The VCAM or optional GCAM plugs directly into the IO4 board without any cabling.

The VME interface supports all protocols defined in Revision C of the VME Specification, plus the A64 and D64 modes defined in Revision D. The D64 mode allows DMA bandwidths of up to 60 MB per second. The VME interface can operate as either a master or a slave. It supports DMA to memory on the Ebus and programmed I/O operations from the Ebus to addresses on the VMEbus.

In addition to interfacing with the VMEbus, the VCAM or optional GCAM provides scatter/gather virtual address translation capability and a DMA engine that can be used to increase the performance of non-DMA VME boards. See Appendix E for additional VME information.

SCSI-2 Interface

The IO4 contains two 16-bit SCSI-2 device controllers. Each controller can operate with a bandwidth of up to 20 MB per second and can be configured for either single-ended or differential operation.

To accommodate extra SCSI channels, optional SCSI mezzanine cards contain three 16-bit SCSI-2 controllers. Two of the controllers are differential only; the third is configurable as single-ended or differential. These controllers are identical to those used on the main IO4 board.

SCSI mezzanine cards can be plugged into either or both of the mezzanine card slots on an IO4 board, allowing up to eight SCSI-2 controllers per IO4 board. With the optional visualization console the GCAM covers one of the available mezzanine connectors on the standard I04. This leaves room for a maximum of one optional SCSI mezzanine board on the first I04 (three extra SCSI connectors).

Ethernet Interface

The IO4's Ethernet interface operates at the standard Ethernet rate of 10 Mb per second and supports an AUI (15-pin) physical connection. The controller is intelligent; it requires no direct CPU involvement when packets are transmitted or received.

Parallel Port

The IO4 contains a DMA-driven parallel port capable of operating printers or performing high-speed data transfer to or from external equipment at rates up to 300 KB per second.

Serial Ports

The IO4 contains one RS-422 and three RS-232 serial ports, all of which are capable of asynchronous operation at rates up to 19.2 Kbaud. The RS-422 port can be operated at 38.4 Kbaud, provided the RS-232 ports are not all in use.

System and SCSI Backplanes

The enclosure comes with an 11-slot cardcage and backplane that includes five VME expansion slots. Note that only two VME slots are available when a POWER Challenge system uses the optional visualization console.

To the right of the cardcage is room for seven half-height (or one half-height and three full-height) SCSI devices. Each drive sits in its own individual “sled” and slides into the drive rack. When fully inserted, the drive and sled assembly plugs into the SCSI backplane at the rear of the rack.

See “SCSI Drive Rack” in Chapter 2 for specific information about peripheral locations.

SCSI I/O Devices

SCSI drives are the *only* devices internally supported by the Challenge deskside system. The system’s drive rack has space for seven half-height devices. All drives must be front loaded after being mounted on a special drive sled. Supported devices include hard disks, Digital Linear Tape (DLT) drives, 1/4-inch cartridge, 4-mm and 8-mm tape drives, and CD-ROM drives. Installing a full-height drive (such as the 8-mm or DLT) requires using two half-height slots. See Chapter 4 for installation instructions.

System Controller

Located just above the SCSI drive rack is an on/off key switch and the System Controller display panel. The System Controller is a microprocessor-controlled, subsystem that is mounted directly to the system backplane. It monitors various system operations, including chassis temperature, system fan speed, backplane voltages, and the system clock. Battery backup supports the System Controller’s NVRAM and time-of-day system clock.

When any operating parameter exceeds or drops past a specified limit, the System Controller can execute a controlled shutdown of the Challenge deskside system. During such a shutdown procedure, the System Controller maintains a log with the last error message(s) received before the shutdown.

Chapter 2 shows the location of the System Controller's front panel on the chassis. Figure 3-4 in Chapter 3 identifies its related control buttons. To understand and use the System Controller, see "Using the System Controller" in Chapter 5.

Operating Considerations

This section covers the basic requirements for physical location to ensure proper chassis operation.

The Challenge deskside chassis is designed to fit into a typical work environment. Keep the system in good condition by maintaining the following operating conditions:

- The chassis should ideally have a 6-inch (15-cm) minimum air clearance above the top. The first line of Table 1-2 shows the side clearances required. If the chassis is positioned under a desk or other equipment and the top air clearance is less than 6 inches (15 cm), make sure that the side air clearances are at least as great as those listed on the second line of Table 1-2.
- The chassis should be kept in a clean, dust-free location to reduce maintenance problems.
- The available power should be rated for computer operation.
- The chassis should be protected from harsh environments that produce excessive vibration, heat, and similar conditions.

Table 1-2 Required Air Clearances for the Deskside Chassis

Top Clearance	Left Side[a]	Right Side[a]	Front	Back
More than 6″	3″ (8 cm)	6″ (15 cm)	6″ (15 cm)	6″ (15 cm)
Less than 6″	6″ (15 cm)	10″ (25 cm)	8″ (20 cm)	8″ (20 cm)

a. Side as viewed from the front of the chassis.

Additional specifications are provided in Appendix A, "Hardware Specifications."

If you have any questions concerning physical location or site preparation, contact your Silicon Graphics system support engineer (SSE) or other authorized support organization representative before your system is installed.

Chapters 2 through 5 in this guide discuss hardware topics common to all Challenge deskside configurations.

Chapter 2

Touring the Chassis

This chapter describes the major features of the Challenge deskside server chassis, along with its controls, connectors, and indicators.

Warning: To avoid electric shock and to prevent a fire hazard, do not disassemble the Challenge system. No user-serviceable parts are located within the chassis. All installation and maintenance must be performed by Silicon Graphics-trained personnel. Contact the Silicon Graphics Technical Education department for information about customer training.

This chapter is intended to give you a better overall understanding of Challenge deskside systems. It is *not* intended as a guide for system disassembly or removal/replacement of components, except where end-user access is specified.

The Challenge deskside chassis houses all boards, drives, and other components in a single, upright enclosure. With its small physical dimensions and quiet operation, the chassis fits into a lab, server room, or normal office environment. Figure 2-1 shows the external appearance of the Challenge deskside chassis.

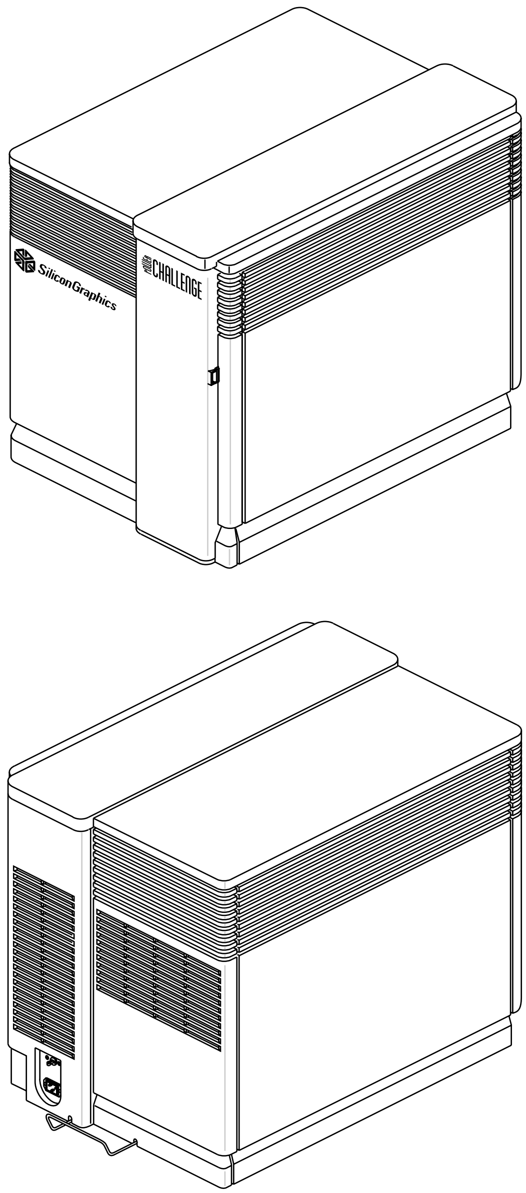

Figure 2-1 Chassis Front and Rear Views

Challenge Deskside System I/O Panels and Connectors

The Challenge deskside chassis is a compact unit that contains an 11-slot cardcage, system boards, a power supply, and selected peripherals and cables. System connector locations are indicated in Figure 2-2, and connector descriptions are listed in Table 2-2.

The I/O Panel

The I/O panel is used to connect external devices to the Challenge deskside system. These devices include the system console terminal, a printer, and a modem. Specific instructions for connecting these devices are located in Chapter 3, "Getting Started."

The I/O panel configuration for the basic server board set is shown in Figure 2-2.

Table 2-2 describes the standard I/O interface connectors that come with the Challenge deskside system shown in Figure 2-2. They are listed from left to right, starting with the parallel printer connector.

Note: If you disconnect a cable from a peripheral device, you should also disconnect it from the I/O connector on the I/O panel. This helps prevent the system from picking up external electrical noise.

The single-jack interrupt ports require stereo-audio type 3.5 mm plug connectors with shielded cables. These plugs are not for use with headphones, microphones, and so on.

The I/O panel configuration for the Extreme graphics optional visualization console is shown in Figure 2-3. Table 2-2 lists the connector types and descriptions for the visualization console option.

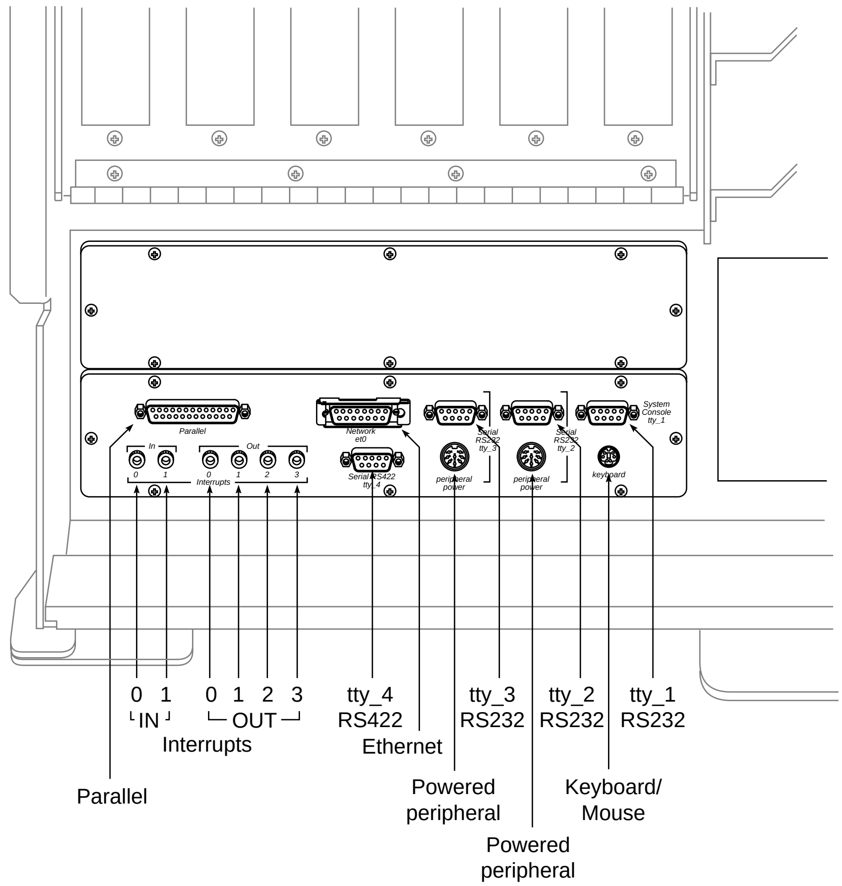

Figure 2-2 Basic I/O Panel Configuration

Table 2-1 Standard I/O Connectors

Connector Type	Connector Description	Connector Function
25-Pin sub-D parallel	Centronics® compatible parallel port	Drives parallel printer
15-Pin sub-D Ethernet	15-Pin Ethernet	Standard AUI Ethernet connection
9-Pin sub-D RS-232 or round 8-pin DIN powered RS-232	RS-232 serial port tty_3 (Use only one connector)	Supports either RS-232 powered or unpowered serial interface
9-Pin sub-D RS-232 or round 8-pin DIN powered RS-232	RS-232 serial port tty_2 (Use only one connector)	Supports either RS-232 powered or unpowered serial interface
9-Pin sub-D RS-232	RS-232 serial port tty_1	Supports RS-232 Serial Interface for System Console Terminal
3.5-mm tip-ring-sleeve interrupt 0-1 input jacks	Single jack plugs	External interrupt to system
3.5-mm tip-ring-sleeve interrupt 0-3 output jacks	Single jack plugs	Interrupt generation to external system
9-Pin sub-D RS-422	RS-422 serial port tty_4	Supports RS-422 Serial Interface
6-Pin mini DIN	Keyboard connector	Supports keyboard and mouse

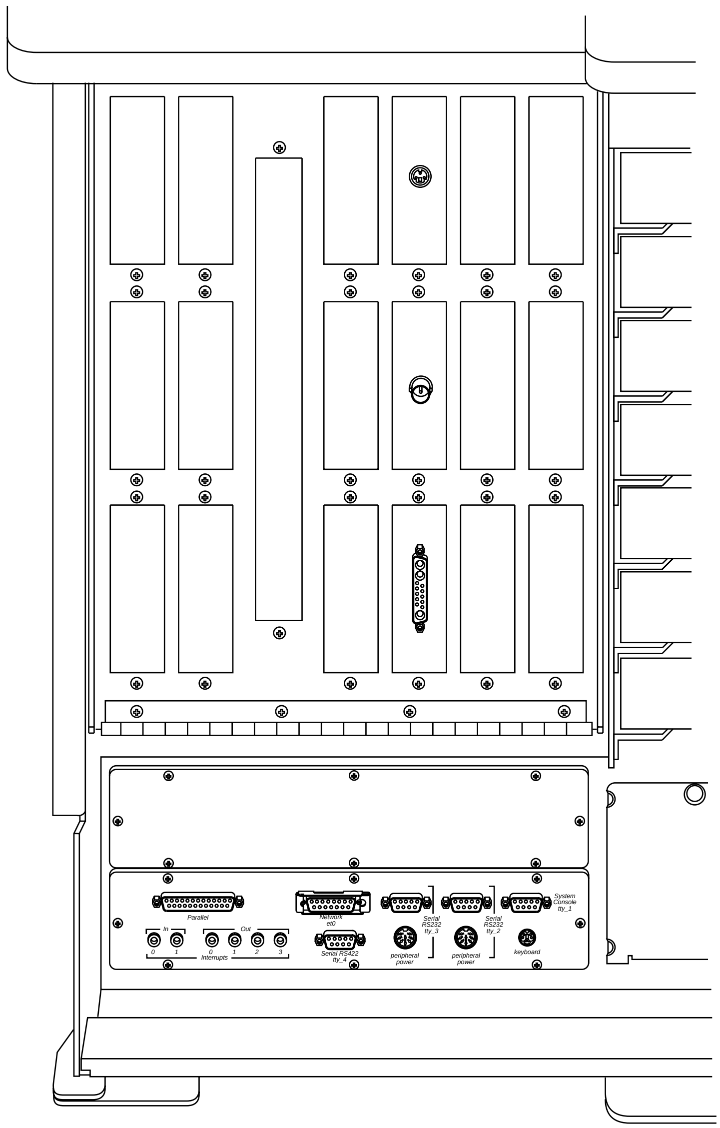

Figure 2-3 Optional Visualization Console I/O Panel (Extreme) Graphics Connectors

Table 2-2 Optional Visualization Console Video Connector Description

Connector Type	Connector Description
Video	13W3
Genlock	BNC
Stereoview	4-pin powered peripheral

Serial and DIN Connectors

The Challenge system provides three types of serial ports.

- A 9-pin RS-232 unpowered D-sub connector (see Figure 2-4)
- A 9-pin RS-422 unpowered D-sub connector (see Figure 2-4)
- An 8-pin RS-232 powered DIN connector (see Figure 2-5)

Caution: Neither of the two RS-232 connectors conform to EIA/TIA industry standards, so a serial cable must either be ordered through a Silicon Graphics supplier or be specially constructed.

Both powered and unpowered serial connectors are provided on the Challenge deskside system. Terminals, modems, printers, and other peripherals with independent power sources use the 9-pin sub-D connectors (see Figure 2-4 and Table 2-3). Powered peripherals use a circular 8-pin DIN connector for data and DC power (see Figure 2-5 and Table 2-3).

Each serial port supports one device. Do not attach (daisy-chain) more than one device to each sub-D or DIN connector. For ports tty_2 and tty_3, you must use either the 8-pin powered connector or the 9-pin sub-D; you cannot use both simultaneously.

For all POWER Challenge and Challenge systems, Silicon Graphics recommends the use of RS-232 serial cables no longer than 30 feet (9.15 meters). Longer runs introduce a greater possibility of line noise occurring. This can affect data transmission and cause errors. For cable runs longer than 30 feet (9.15 meters), use an appropriate extender device.

Do not run cables through areas that are electrically noisy, such as areas where large electric motors, welding apparatus, or X-ray machines operate. Bury outside wiring in conduit, as lighting strikes can damage the system.

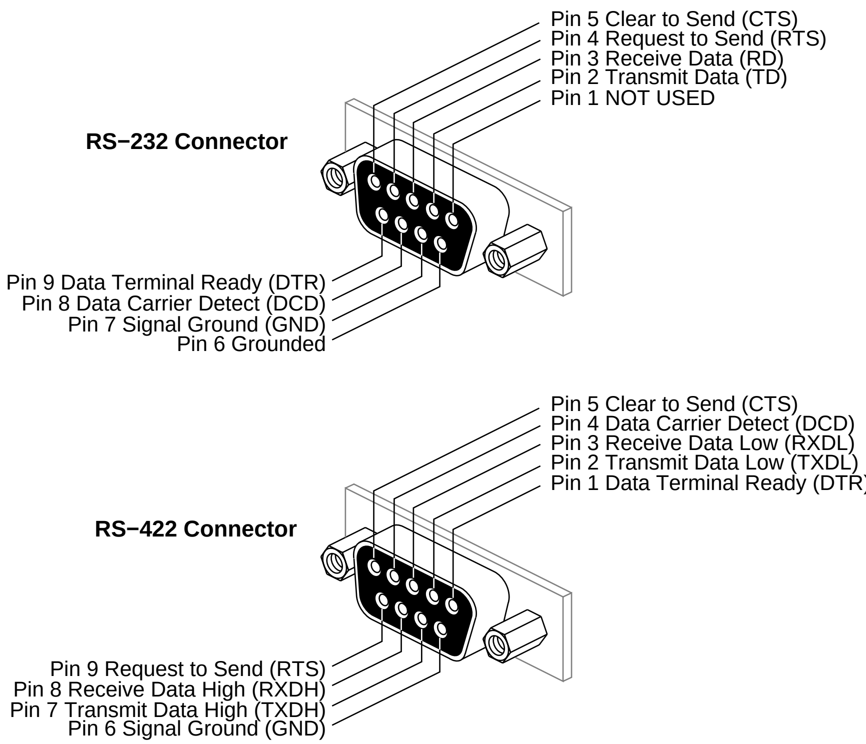

Figure 2-4 RS-232 and RS-422 Serial Connectors

Table 2-3 RS-232 (9-Pin Unpowered) and RS-422 Connector Detail

Connector Type	Description	Pin Number	Signal	Flow from chassis
RS-232 (see Figure 2-4)	Serial port tty1 9-pin D-sub receptacle. RS-232 protocol. Serial ports 0 and 1 provide a choice of this or an 8-pin DIN receptacle. Only one receptacle from each port can be used at a given time.	1	not used	
		2	TXD	output
		3	RXD	input
		4	RTS	output
		5	CTS	input
		6	GND	
		7	GND	
		8	DCD	input
		9	DTR	output
RS-232 (see Figure 2-4)	Serial ports tty2, tty3 for unpowered peripherals. 9-pin D-sub receptacle. RS-232 protocol. Serial ports 0 and 1 provide a choice of this or an 8-pin DIN receptacle. Only one receptacle from each port may be used at a given time.	1	not used	
		2	TXD	output
		3	RXD	input
		4	RTS	output
		5	CTS	input
		6	GND	
		7	GND	
		8	DCD	input
		9	DTR	output
RS-422 (see Figure 2-4)	Serial port tty4 RS-422 protocol. 9-pin D-sub receptacle.	1	DTR	output
		2	TXD low -[1]	output
		3	RXD low -[2]	input
		4	DCD	input
		5	CTS	input
		6	GND	
		7	TXD high +[1]	output
		8	RXD high +[2]	input
		9	RTS	output

[1] Pins 2 and 7 must be a twisted pair in cable.

[2] Pins 3 and 8 must be a twisted pair in cable.

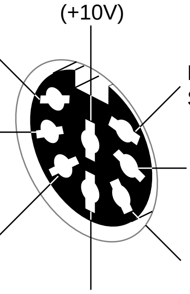

Figure 2-5 RS-232 Powered 8-Pin DIN Connector

Table 2-4 RS-232 (8-Pin Powered) Connector Detail

Connector Type	Description	Pin Number	Signal	Flow from chassis
RS-232 (see Figure 2-5)	Serials ports tty2, tty3 for powered peripherals. 8-pin DIN receptacle.	1	DTR	output
		2	CTS	input
		3	Stereo Sync	output
		4	RXD	input
		5	TXD	output
		6	GND	
		7	GND	
		8	Power +10V	output

Enabling Additional Serial Ports

Use the steps in the following example (if necessary) to enable the additional serial ports provided when you order an optional IO4.

1. Edit the file */var/sysgen/system/irix.sm*.
2. Find a line that looks similar to the following:

   *VECTOR: bustype=EPC module=epcserial unit=1 slot=? ioa=1

3. Remove the leading "*" and enter the appropriate slot number of the additional IO4 that has serial ports that require enabling. For example, you would change the question mark after *slot*= to a 4 if an additional IO4 was installed in slot 4.

   VECTOR: bustype=EPC module=epcserial unit=1 slot=4 ioa=1

4. Write and quit the file, then rebuild the kernel (using the */etc/autoconfig* command).

5. Reboot the system and create the appropriate device nodes by entering */dev/MAKEDEV ttys*. This should create something like the following:

```
/dev/ttyd45 Major=0, Minor=5:
/dev/ttyd46 Major=0, Minor=6:
/dev/ttyd47 Major=0, Minor=7:
/dev/ttyd48 Major=0, Minor=8:
/dev/ttyf45 Major=0, Minor=101:
/dev/ttyf46 Major=0, Minor=102:
/dev/ttyf47 Major=0, Minor=103:
/dev/ttyf48 Major=0, Minor=104:
/dev/ttym45 Major=0, Minor=37:
/dev/ttym46 Major=0, Minor=38:
/dev/ttym47 Major=0, Minor=39:
/dev/ttym48 Major=0, Minor=40:
```

   Additional connector labeling information is shown in Table 2-5.

Table 2-5 Server System IO4 Board Connector Labelling

IO4 Board Number	IO4 Filter Board Label (Server)	Serial Connectors	Server Parallel Connectors	Network Connectors
1	EBus 5	RS-232: tty1-3[a] RS-422: tty4	plp5	et0
2	EBus 4	tty45-47[b]	plp4	et1
3	EBus 3	tty49-51[b]	plp3	et2

a. Connectors are labelled sequentially from right to left.

b. Connectors are labelled sequentially from top to bottom.

6. Edit the */etc/inittab* file and change the word "off" to "respawn" in the line associated with the *ttys* you have just enabled.

Note: Since there is no I/O panel connection for the RS-422 port (which corresponds in this example to ttyd48), there is no reason to change it.

7. Enter **`telinit q`** to force the init process to reread */etc/inittab* and create *gettys* on the additional RS-232 ports.

Device nodes of the form *tty[fm]** are for use with modems. For additional information on these topics, see the reference (man) pages for:

- getty(1M)
- uugetty(1M)
- init(1M)
- gettydefs(4)
- inittab(4)

Note that comments in the file */etc/inittab* are somewhat outdated and can be potentially confusing as they refer to nomenclature and architecture of older Silicon Graphics systems when referring to serial ports. When “I/O” board is mentioned you should infer “VME serial I/O controller,” and where “CPU board” is mentioned you should read “IO4 board.”

Parallel Printer Ports

The parallel printer port on the system I/O panel is a 25-pin, Centronics-compatible connector. Table 2-6 shows the pin assignments and the signals that they carry.

Note: The optimum recommended length for a cable used with this parallel port is 10 feet (3 meters). Maximum length should not exceed 20 feet (6 meters).

To enable an additional parallel printer port on an optional IO4 installed in your Challenge deskside, input the following:

```
% cd /dev
# ./MAKEDEV plp
```

These commands create the necessary device nodes required to use the additional parallel port on an optional IO4. The *MAKEDEV* command automatically checks the hardware configuration of your Challenge and makes parallel port device nodes for additional ports.

Table 2-6 Centronics Compatible Parallel Port Pin Assignments

Pin	Assignment
1	STB (Data Strobe)
2	DATA 0
3	DATA 1
4	DATA 2
5	DATA 3
6	DATA 4
7	DATA 5
8	DATA 6
9	DATA 7
10	DATA ACK
11	BUSY
12	PE (Paper Empty)
13	SLCT (Select)
14	AUTOFD
15	ERROR
16	INIT (Reset)
17	SLCTIN
18 through 25	GND

System Controller

A narrow front door on the right side of the chassis allows you to access the System Controller front panel and install front-loading devices in the drive rack. The System Controller panel is located just above the drive rack. Figure 2-6 shows the location of the key switch and indicators on the System Controller front panel.

The position of the key switch determines what mode the System Controller is monitoring (see Figure 3-4). Press the Menu button for a display of executable options. The Scroll Up and Scroll Down buttons allow you to move up and down through the menu list and scroll through a 10-message error file within the menu. Press the Execute button, and the System Controller performs the option that is listed.

The key switch on the System Controller front panel serves two purposes:

- It turns the system boards and peripherals on and off.
- When the key switch is in the On position, and the key is removed, it prevents unauthorized shutdown or alteration of system operations from the control panel.

When the key switch is in the On position, no alteration of system function can be executed from the front panel menus. If the switch is moved into the Manager position, system operations can be modified, reset, or limited. Access to the Manager functions should be limited to trained system administrators and service personnel only.

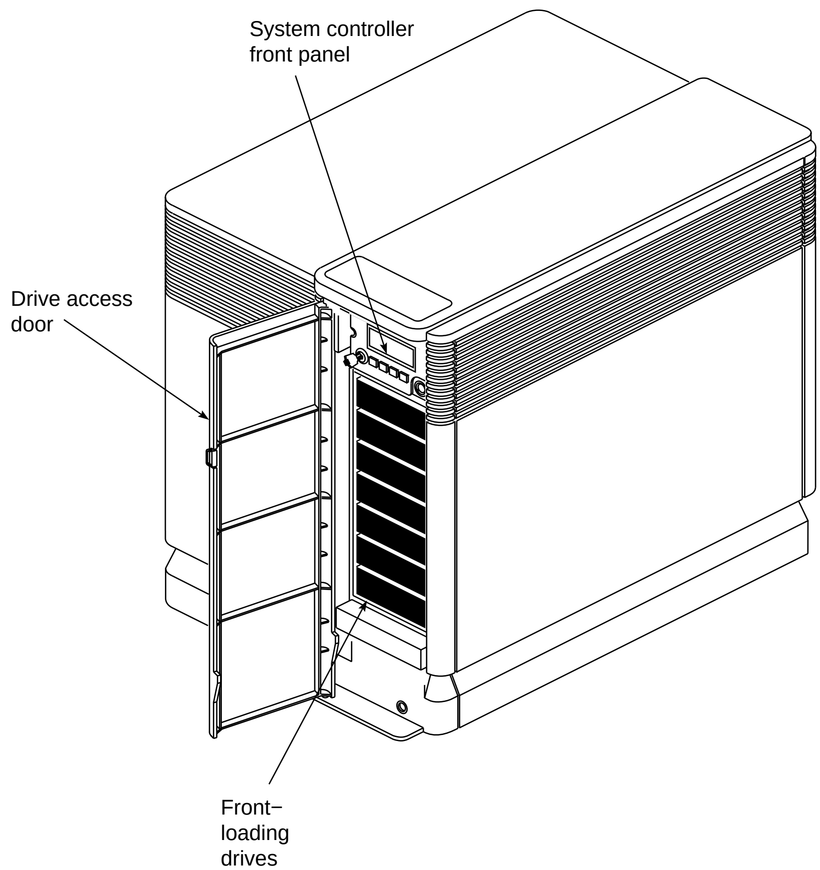

Figure 2-6 Challenge Deskside System Controller and Drives Location

Note: Always remove the key from the System Controller's front panel before closing the front door covering the LCD panel and drive bays. For a detailed description of how to use the System Controller, see the System Controller information in Chapter 5, "Troubleshooting."

SCSI Drive Rack

The SCSI drive rack (shown in Figure 2-5) is a vertically oriented enclosure, with seven half-height drive bays. Each bay is defined by a sheet-metal drive tray. The SCSI drive sled slides into the tray and locks in place with its connectors pushed into the SCSI backplane. The sheet-metal drive trays can be removed to allow the installation of full-height devices.

The internal SCSI backplane provides a maximum of two SCSI channels. The channels are terminated on the backplane and are not used to control externally mounted SCSI devices. The channels are compatible with either 8-bit or 16-bit SCSI buses, and they are configured at the factory to support single-ended and differential SCSI devices in the drive rack. Channel A is set to single-ended and channel B to differential operation.

Note: It is important that the operational setting on the drive sled printed circuit board agree with the setting of the IO4 SCSI channel. If you are installing a single-ended device in the internal rack, the drive should be plugged into channel A on the sled board. If you are installing a differential device, it should plug into channel B on the sled board. Chapter 4 provides details of what happens if you violate these guidelines.

Caution: Never plug a front-loading or external SCSI device into your Challenge system while it is powered on.

Cooling System

The Challenge deskside chassis is cooled by a combination of one rotary "blower box" and two conventional 5-inch (12.7-cm) fans that draw in ambient air. The 9.7-inch (24.6-cm) vaned rotor provides the main chassis cooling by drawing air in through openings near the top and exhausting it out the lower side and rear. See Figure 2-7.

One 5-inch fan cools the system power supply, while the other draws air from front to back, helping to cool the drive tray assembly.

Caution: Never operate your Challenge system with any of its sheet-metal panels open or removed. The system will overheat, and damage to internal components may result.

The vaned rotor is in contact with the System Controller and changes speed to provide more or less airflow, depending on the temperature of incoming air (see Figure 2-7). These changes are initiated by a temperature sensor that helps the System Controller adjust the rotor fan for efficient cooling with the lowest possible noise level.

Note: If the rotary blower fan does not run after the main power is turned on, the system will not boot. If the blower experiences a failure while the system is running, the System Controller shuts down the server immediately after notifying the CPU.

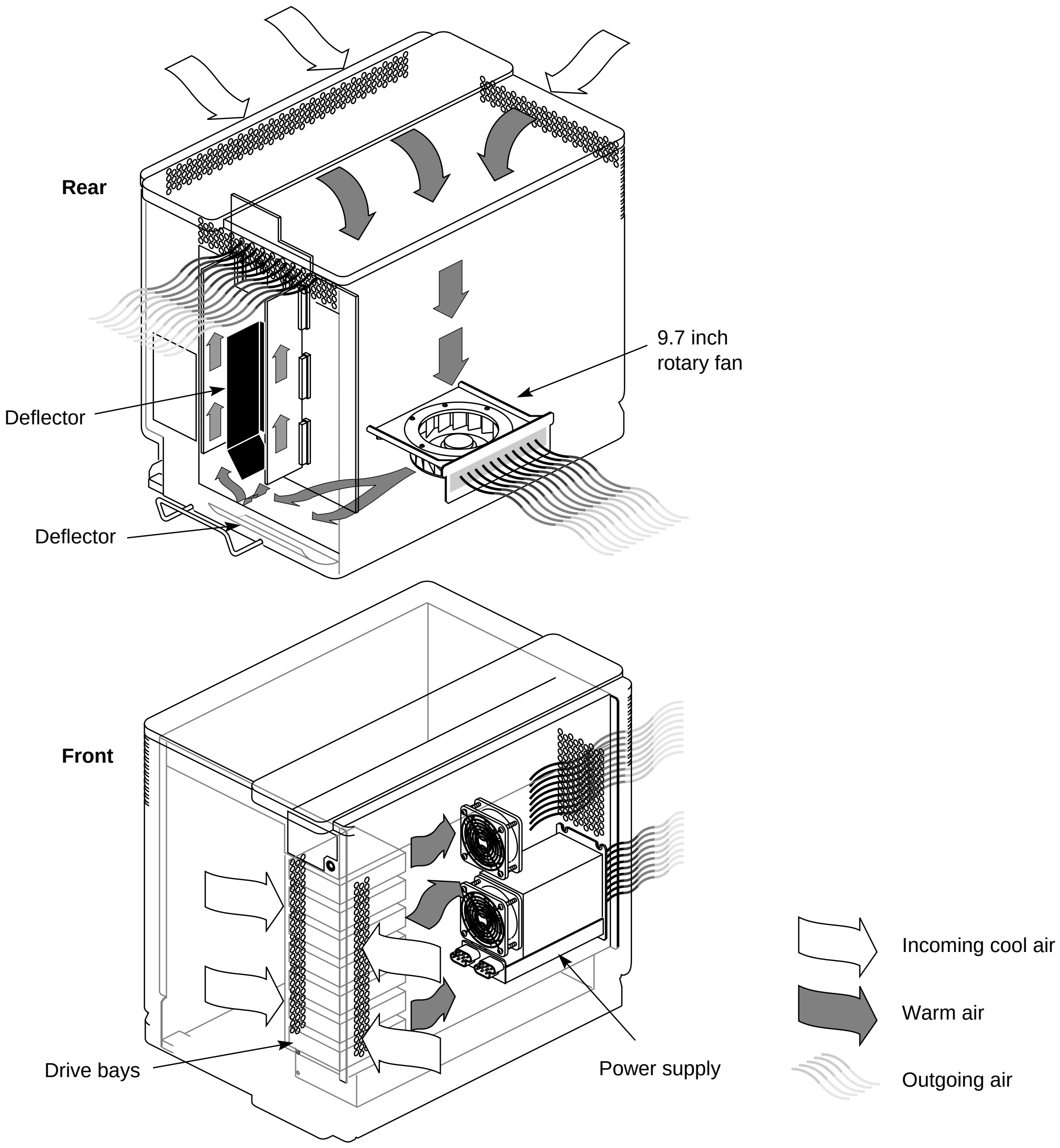

Figure 2-7 Chassis Cooling

Power Supplies

AC voltage feeds into a power receptacle and circuit breaker assembly located on the lower left rear panel of the Challenge deskside system. The circuit breaker switch controls the main power supply to the chassis and provides alternating current (AC) circuit protection. The power receptacle and circuit breaker are shown in Figure 2-8.

The Challenge deskside system is available as either a 110 VAC or 220–240 VAC system. Certain system configurations or upgrades may require the use of a 220–240 VAC supply; check with your sales or service representative.

Voltage is routed into a special power supply known as an offline switcher (OLS). The OLS supplies up to 1900 watts of power to the chassis backplanes by converting the AC voltage to 48 VDC. The 48 VDC is converted by power boards that plug into the backplanes and provide voltages needed by system boards and devices.

Five VME slots are provided for the addition of third-party, special application boards.

Note: POWER Challenge systems using optional visualization console graphics have only two VME slots available.

Sun VME power pin (9U VME) conventions are supported. Silicon Graphics supports the Sun convention for additional power and ground pins on the P3 connector. VME option boards increase the chassis power requirements. Check with an authorized service representative to confirm that a new VME board fits within the power budget of the chassis.

Caution: It is the responsibility of the chassis owner to verify that a new board meets VME specifications; otherwise, the board or chassis can be damaged during installation. VME boards should be installed only by qualified service personnel.

See Appendix E for additional VME related information.

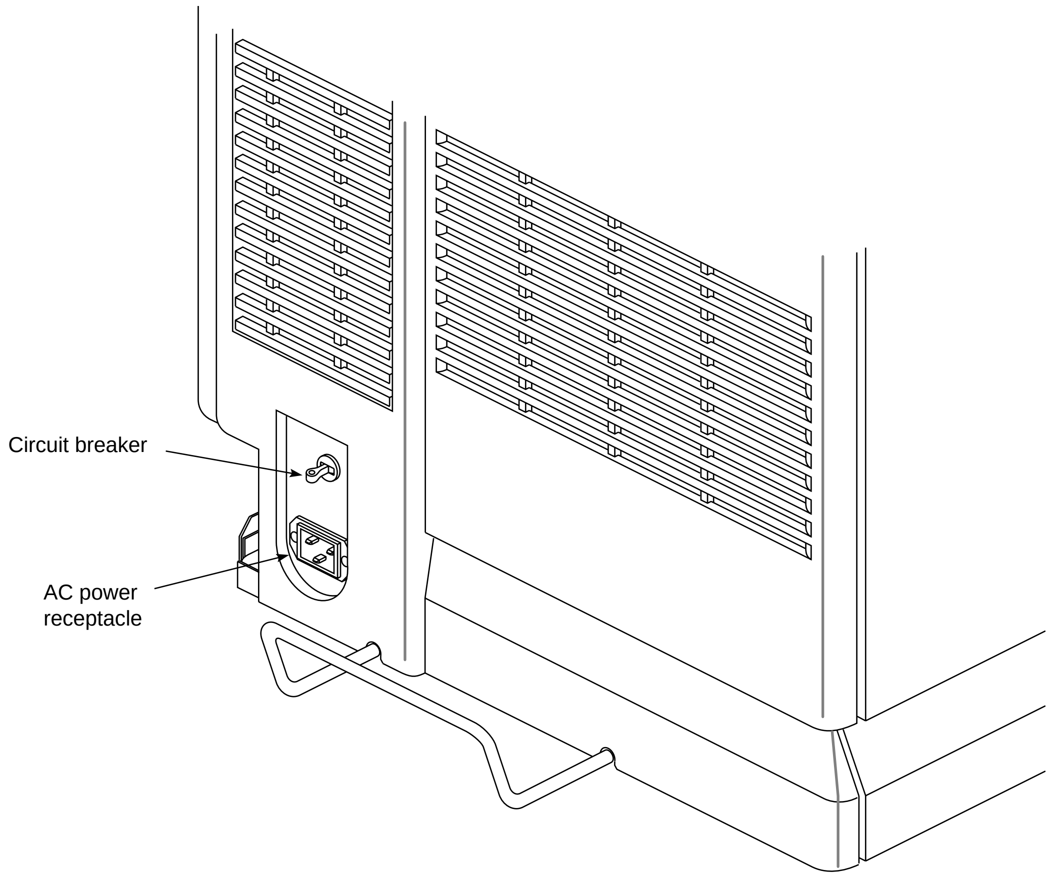

Figure 2-8 Power Receptacle and Circuit Breaker on Rear Panel

Chapter 3

Getting Started

This chapter describes the procedures you should follow to operate your Challenge deskside server chassis correctly.

Customer maintenance is limited to the outside of the chassis, which comprises plastic panels, front loading devices (FLDs), customer-related connections, and cables attached to the I/O panel. No user-serviceable parts are found within the chassis.

Note: This product requires the use of external shielded cables in order to maintain compliance with Part 15 of the FCC rules.

Chassis Components

The operating procedures described in this section are designed to ensure your safety and the integrity of your new system.

The Challenge deskside chassis can be configured for either 110 VAC or 220–240 VAC operation. The system requires alternating current (AC) service at specified voltage and current ratings for proper operation. Verify that the correct AC line voltages are selected for each peripheral.

Figure 3-1 shows user-accessible system components.

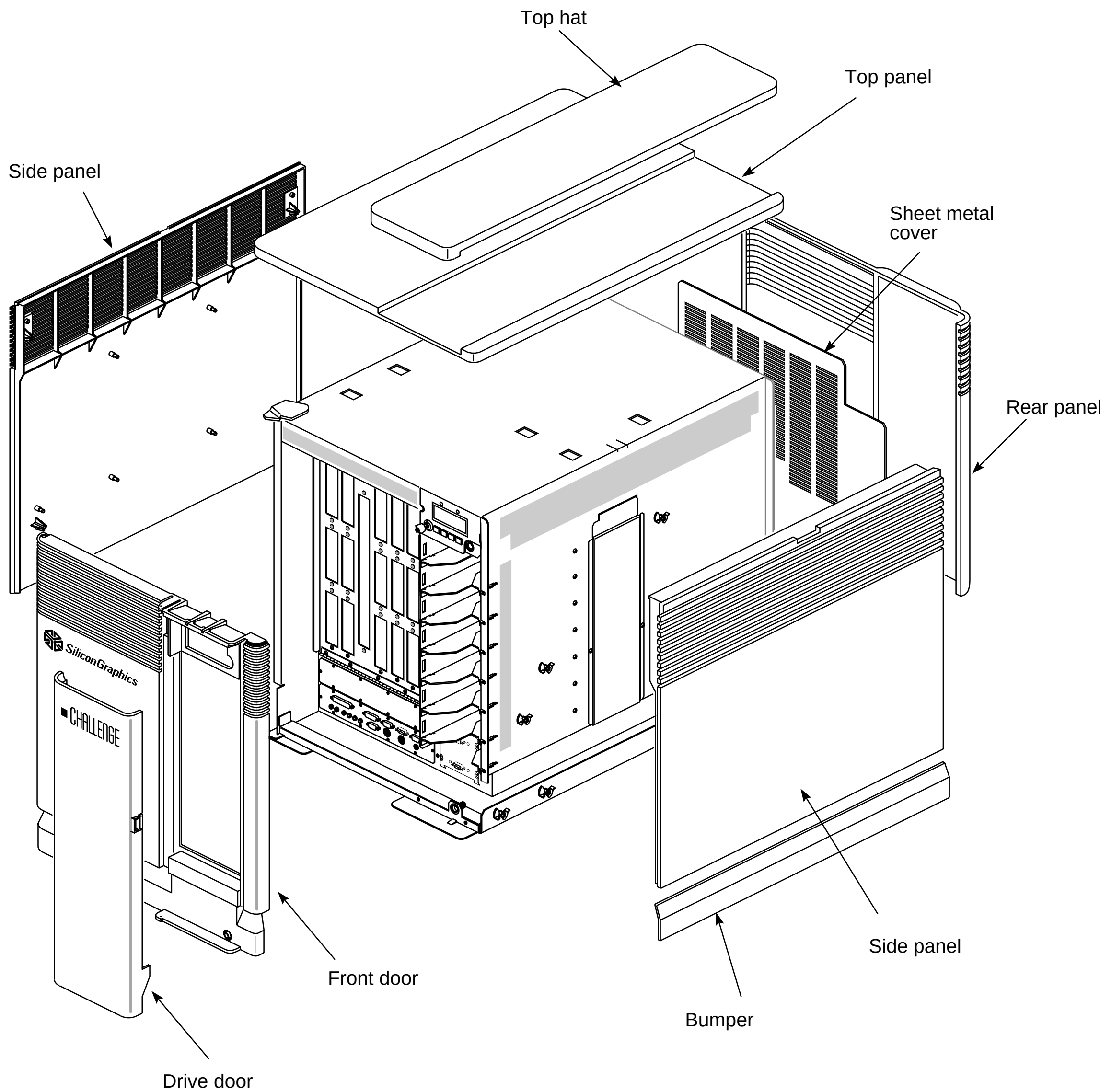

Figure 3-1 Challenge Deskside Components

Warning: To avoid electric shock and/or a fire hazard, do not disassemble the Challenge system chassis. No user-serviceable parts are located inside the unit.

Note: Before connecting or disconnecting any terminal, peripheral, or front-loading drive, be sure the system is powered off and the primary power source is disconnected. The system power connection should be unplugged at the wall or back of the chassis before you open either door.

Opening the Front Door

To access the I/O panel, you must first open the front door by using the following information:

1. Be sure that the system power is turned off, according to the procedures in this section.
2. Open the drive door to expose the drives and front panel retainer latches.
3. Release the two retainer latches by fully depressing and releasing each latch with a pointed object, such as the tip of a Phillips screwdriver; be careful not to mar the surface. The pointed object must be narrow enough to depress the inner button completely; Figure 3-2 shows the latch location and operation.

   The chassis front door is released and can be pivoted on the hinge pins located on the left side of the door.
4. To close the front door, swing it to the closed position, then use a pointed object to fully depress and release the retainer latches.

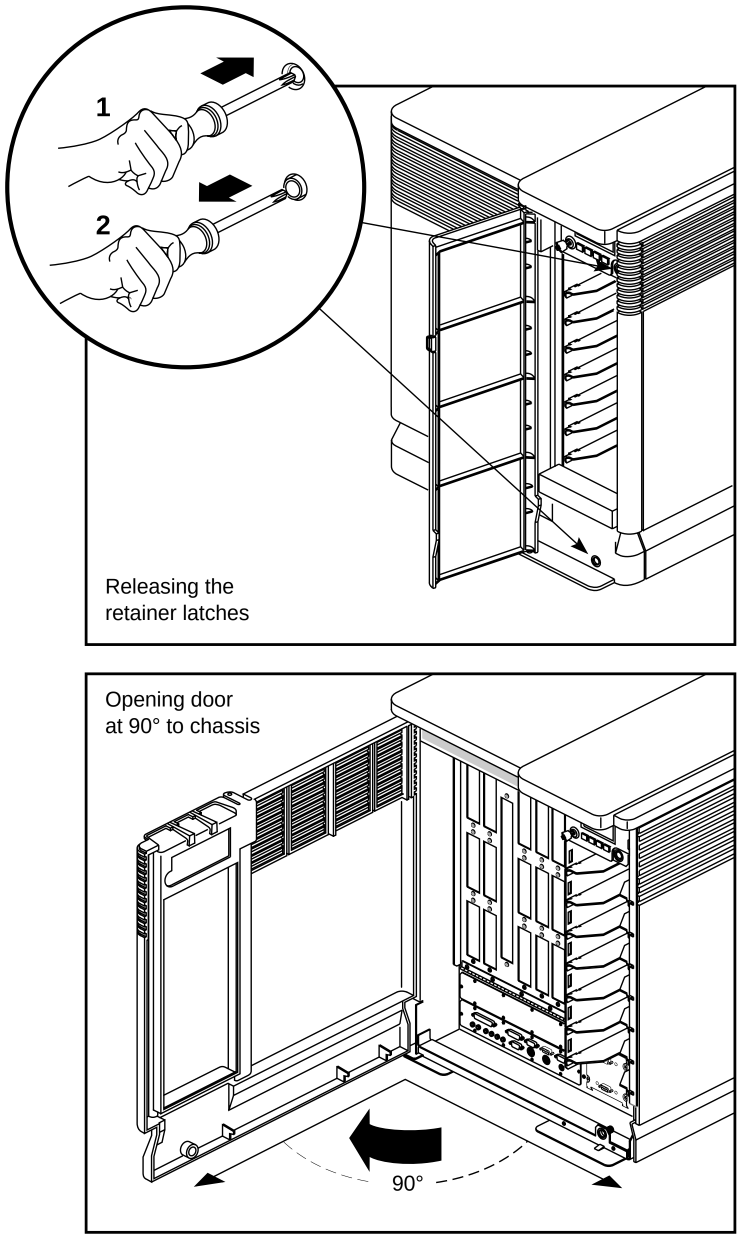

Figure 3-2 Opening the Chassis Front Door

Internal Front-Loading Drives

The Challenge deskside system comes standard with a SCSI drive rack that holds seven half-height, front-loading devices (FLDs). Each FLD must be mounted on a drive sled before it can be mounted in the rack. The drive sled adapts the drive's power and signal connectors to the connectors on the SCSI drive backplane.

See the list of SCSI configuration rules at the beginning of Chapter 4 to better understand the importance of proper SCSI bus configuration.

Note: FLDs can be installed and removed with the front door closed and only the drive door open.

Caution: Use proper handling and storage procedures to minimize the loss of data and equipment. In particular, do not remove disk drives while they are operating. Always power down the system before removing an FLD. Be sure to use standard electrostatic discharge prevention precautions when removing, storing, transporting, or replacing the FLDs.

The drives being plugged into the rack can be configured to run on either SCSI channel A or B. They must also be set to operate with either single-ended or differential SCSI protocols. The configuration for these functions is set on the drive sled's adapter module board.

Caution: The operating protocols of a drive must match the setting of the SCSI channel. If they do not, the drive and/or the SCSI bus will not operate properly. Be sure to read the instructions and warnings in Chapter 4 carefully before installing a SCSI device.

SCSI Limitations

The drive rack in the Challenge deskside system accommodates up to seven half-height devices, or three full-height devices and one half-height drive.

Drive channels A and B are terminated on the SCSI drive backplane. There is no provision for plugging in an extension of the SCSI bus to the internal SCSI backplane.

To operate external SCSI devices, you must order your system's IO4 with extra mezzanine SCSI channel daughter boards. These are the mezzanine options mentioned in Chapter 1; they connect to the I/O panel and then to external devices. You may also order up to two additional IO4 boards for your server.

Note: The maximum SCSI cable length for single-ended applications is 19.6 feet (6 meters). Differential lines are allowed a maximum of 81 feet (25 meters). Be sure to include both external and internal cabling when you calculate the lengths for the SCSI bus. Keep cable lengths as short as possible to ensure optimum data transfer rates.

Connecting the System to an Ethernet

Your Challenge comes standard with a 15-pin (AUI) Ethernet connector.

You can order optional boards for additional Ethernet connections.

Observe the following procedures when making Ethernet connections:

1. Identify the Ethernet drop intended for your system, and route it to the rear of the system. Repeat for additional connections.
2. You can install the cable by pushing it through the gap between the top of the plastic bumper and the bottom of the side panel (see Figure 3-1). Alternately, you can push the cable into the cable trough on the lower left side of the system; repeat as necessary. Feed the cable in until it reaches the front of the system.
3. Plug in the Ethernet connector (make sure to secure the 15-pin connector with the slide latch). See Figure 3-3.

Continue with any additional peripheral connections or installations, or close and restart the system.

Challenge L systems enable the Ethernet only on the master (first) IO4 by default. To enable an additional Ethernet port on an optional installed IO4 board you can use the following steps:

1. Edit the file */var/sysgen/system/irix.sm*.
2. Add a vector line that looks similar to the following:

   VECTOR: bustype=EPC module=epcserial unit=1 slot=4

   This vector line configures the Ethernet interface on the IO4 in slot 4 as et1. The first two options (bustype and module) are mandatory and tell *lboot* that you're configuring an Ethernet interface. The "unit" option specifies the Ethernet unit number. The unit number must be greater than 0. The "slot" option specifies the cardcage slot of the IO4 where the Ethernet interface is being configured as et1.
3. Write and quit the file, then rebuild the kernel (using the */etc/autoconfig* command).
4. To make the new interface available, reboot the machine with the newly installed kernel information.

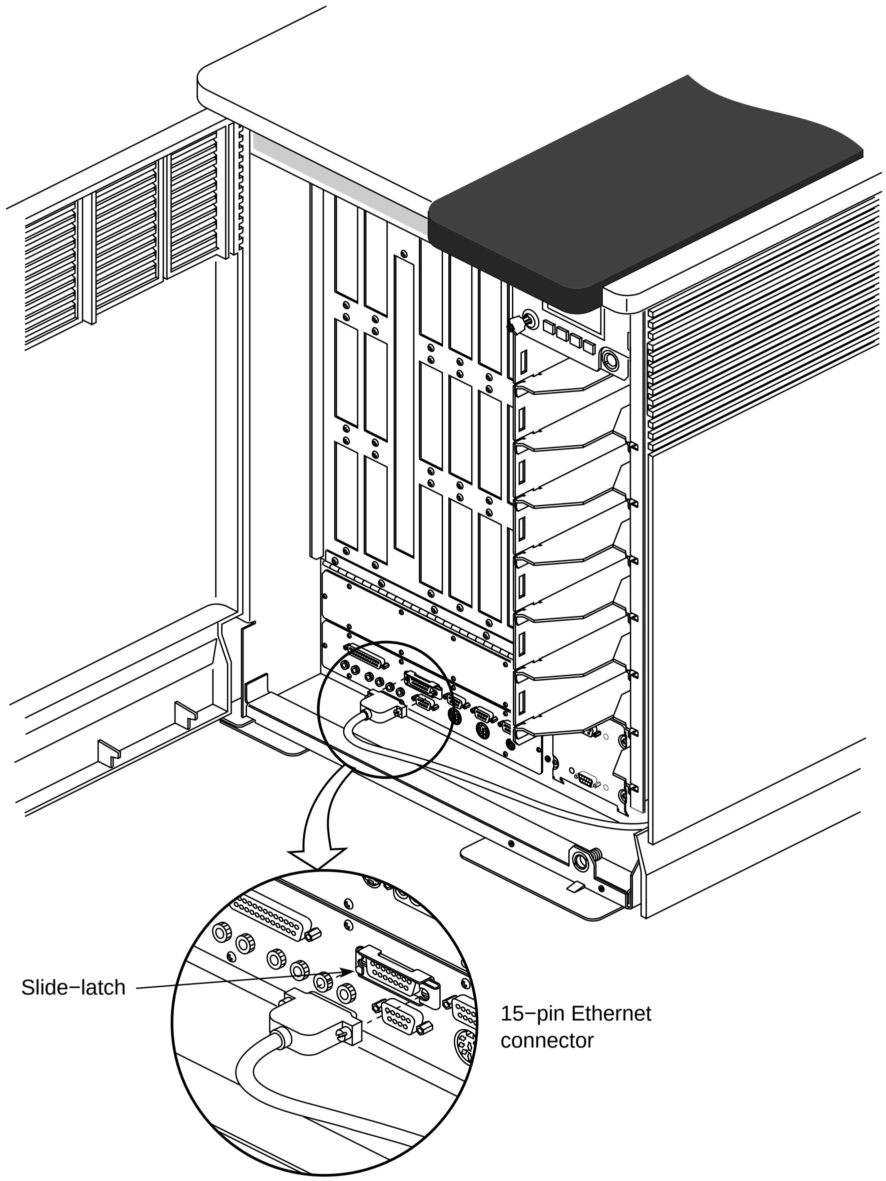

Figure 3-3 Connecting an Ethernet Cable

Powering On the Challenge Deskside System

Use the following procedure to power on your Challenge deskside chassis:

1. Make sure the power switches on all of the equipment are turned off.
2. Plug the power cord into each component. Make sure to connect the cords to three-pronged, grounded outlets only.
3. Turn on the power switches in the following order:
   - Breaker switch on the power-in panel on the back of the chassis
   - Terminal or other video output devices
   - Printer (if installed)
   - System Controller key switch
4. After you turn on the system power, the system begins the boot process.
5. Do not reboot the system during this time or you will continue to delay system initialization.
6. The System Controller begins the system boot-up sequence. As the system comes up, its progress is automatically displayed on the controller's front panel by using a series of boot messages. Pushing any of the control buttons at this time will interrupt the sequence of boot messages that are appearing (see Table 3-1). Pushing a control button during the boot process may cause the following message to appear:

   ```
   BOOT ARBITRATION ABORTED
   ```

   Note: To monitor and understand the boot process on the System Controller's front panel, see "Using the System Controller" in Chapter 5.

   When the power-on diagnostic has completed, a message similar to the following appears:

   ```
   Starting up the system...
   To perform System Maintenance instead, press <Esc>.
   ```

   If you don't press <Esc> within five seconds, the system will come up. If this happens, and you still want to access the system maintenance menu, log in, become superuser, then shut down the system by using the */etc/halt* command.

If you pressed <Esc> within five seconds after the completion of the power-on diagnostic, you should see a menu similar to the following:

```
System Maintenance Menu

1) Start System
2) Install System Software
3) Run Diagnostics
4) Recover System
5) Enter Command Monitor

Option ?
```

Select **5**, enter the "Command Monitor," and see the >> prompt.

Type **hinv** then press <**Enter**> to display the hardware inventory of your system.

Note: See the *IRIS Software Installation Guide* for information about installing system software or reconfiguring your system.

7. Quit the Command Monitor by entering **Exit** at the >> prompt.
8. The System Maintenance Menu reappears. Enter **1** to select the "Start System" command and IRIX comes up.

Table 3-1 System Controller Boot Status Messages

Boot Status Message	Message Description
BOOT ARBITRATION NOT STARTED	The system CPU boards have not begun the arbitration process.
BOOT ARBITRATION IN PROGRESS	The system CPU boards are communicating to decide which one will be the system master CPU.
BOOT ARBITRATION IS COMPLETE SLOT #0X PROC #0X	The chosen system master CPU has identified itself to the Controller and communication is fully established.
BOOT ARBITRATION INCOMPLETE FAULT NO MASTER	The system was unable to assign a system master CPU.
BOOT ARBITRATION ABORTED	An operator pushed one of the front panel buttons while the System Controller was searching for the system master CPU.

Powering Off the Challenge Deskside System

The server should be completely powered down *only* for relocation, routine maintenance, or repair. Before beginning this procedure, log out and shut down the software using the software instructions that follow:

1. To halt operating system activity and prepare the system for power off, become superuser and enter **`/etc/halt`** in a functional UNIX® window. The */etc/halt* command gracefully shuts down the system software and leaves you at the firmware monitor level. If you are remotely logged in to the system, you will be prompted before the shutdown procedure is executed.
2. Turn the System Controller key switch to the Off position to eliminate all power to the boards and peripherals. See Figure 3-4.
3. Switch the system circuit breaker to the Off position to eliminate all power to the OLS and backplane.
4. Unplug the power cord from the socket to cut off all electrical power to the system.

Rebooting Your System

To reboot the Challenge deskside server, use the */etc/reboot* command, either input to the system console or entered from a remote terminal. You must be superuser before trying to input this command. If you are remotely logged in to the system, it will prompt you to confirm the command before executing it.

After successfully executing the command, the system gracefully halts and then automatically restarts.

Caution: Use the key switch (not the main system circuit breaker switch) to power-cycle your system only if the system is completely unresponsive. Using the system circuit breaker to power-cycle the system can cause damage to system software and data.

See Figure 3-4 for the location of the key switch and the Off and On positions.

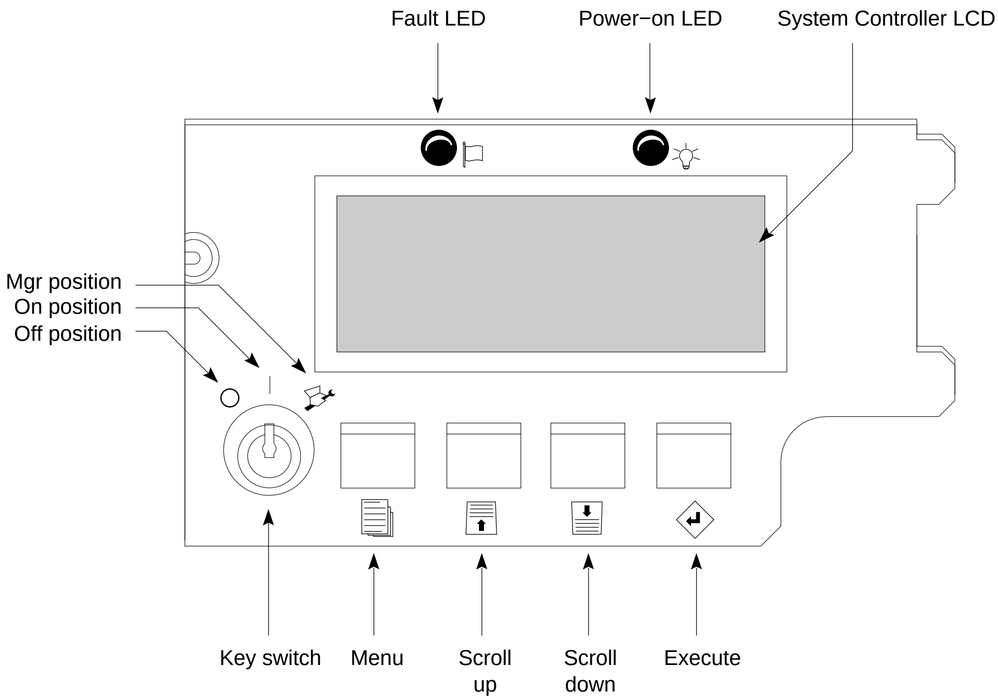

Figure 3-4 Key Switch Positions on the System Controller Front Panel

Chapter 4

Installing Optional Peripherals

This chapter describes the procedures you should use to correctly install your Challenge deskside front-loading devices (FLDs) into the chassis.

Customer maintenance is limited to the outside of the chassis, which comprises plastic panels, FLDs, customer-related connections, and cables attached to the I/O panel. No user-serviceable parts are located within the chassis. No internal parts or devices should be added to the system by the end user. Doing so may void UL, CSA, and TUV safety agency approvals. Check with your service provider or Silicon Graphics before attempting any internal alteration to the system.

SCSI Configuration

Challenge deskside systems support a sophisticated and complex assortment of SCSI protocols. This results in a lower-cost, high-performance system. It also requires extremely careful attention to proper configuration and connection of drives.

Previous Silicon Graphics systems used differential SCSI exclusively to extend the length of the bus. Your Challenge deskside system uses a differential SCSI bus to communicate directly with fast (20 MB per sec) and wide (16-bit) differential drives.

The Challenge SCSI scheme supports

- differential SCSI
- single-ended SCSI-1 and SCSI-2
- 8- and 16-bit transfer protocols
- transfer rates of 5 MB, 10 MB, and 20 MB per second

It is important to know the exact type of drive and the protocols it uses before you configure and connect it to your system. If you are unsure, contact your sales representative or service provider before the installation; otherwise, you may degrade SCSI performance or crash your system.

Note: This product requires the use of external shielded cables in order to maintain compliance with Part 15 of the FCC rules.

If you are going to have an authorized service provider install peripherals, add external SCSI devices, or reconfigure SCSI bus channels, be sure they understand the rules in the following list.

Caution: Improper SCSI implementation will cause degraded system performance, a system crash, and/or possible damage to the hardware.

- If you plug a single-ended drive into a bus configured for differential operation, nothing on the bus will work.
- If you plug a differential drive into a bus configured as single-ended, the differential drive will not work. Single-ended drives on the bus may continue to work.
- Configuration jumpers at the IO4, drive rack backplane, and the sled board must all be set for the same mode or the bus will not work.
- Front-loading SCSI devices, both half-height and full-height, that are installed in front-loading bays do not require terminators. Any terminators mounted on a drive should be pulled out before installing a device in a Challenge system.

  Caution: Never use a single-ended SCSI terminator on a differential channel. Connecting a single-ended terminator to a differential channel will short +5 V directly to ground, resulting in blown fuses and possible equipment damage.
- Using a differential terminator on a single-ended bus will cause SCSI bus malfunction.

The service person must follow the guidelines in Table 4-1 to make a SCSI drive work in a deskside system.

Table 4-1 Overview of Drive Installation Guidelines

Drive Configuration	Drive Sled Board Channel Configuration	SCSI Rack Backplane Configuration	IO4 Configuration	Transfer Rate Jumpers on SCSI Adapter Board
8-bit and 16-bit single-ended internal devices	All jumpers in	A22P50 jumper in TRMPWR jumper in A26P52 jumper in	Bus set to single-ended	Both jumpers in
8-bit and 16-bit single-ended external devices	Not applicable	Not applicable	Bus set to single-ended	Both jumpers out
8-bit differential	Middle jumpers in	All jumpers in	Bus set to differential	Not applicable
16-bit differential	Middle jumpers in	All jumpers in	Bus set to differential	Not applicable

Installing and Configuring Additional FLDs

The Challenge deskside chassis uses both half-height and full-height front-loading devices. The power must be off to install or remove storage devices.

FLDs are easily removed and replaced, allowing flexible and secure data management.

Note: Be careful not to push the drive ID selector when moving the sled release lever to the right. An incorrect SCSI device ID may cause SCSI bus failure. FLDs can be installed and removed with the front door closed and only the drive door open.

Caution: Use proper handling and storage procedures to minimize the loss of data and equipment. In particular, do not remove disk drives while they are operating. Always power off the system before removing an FLD. Be sure to use standard electrostatic discharge prevention precautions when removing, storing, transporting, or replacing an FLD.

Each internally installed FLD must mount on a sled that uses a SCSI channel adapter board. To determine the sled board settings, do the following:

- Be sure the sled-to-drive connector cable is plugged into the correct SCSI channel: single-ended(A) or differential (B).
- Set both jumper blocks H1 and H2 on the sled board to reflect the SCSI channel operation, regardless of which channel is plugged into the drive (see Figure 4-1).
- If the SCSI backplane bus is only single-ended or only differential, set all the jumpers in H1 and H2 for that mode of operation (see Figure 4-1).

Note: Incorrect jumpering on an unused jumper block can cause unwanted noise on the bus.

The factory shipped your Challenge deskside server with Channel A configured as single-ended and B as differential. If the system has been modified, or if you are uncertain as to the configuration of SCSI Channels A and B, you will have to remove an existing drive. Pull the locking lever on the drive sled to the left and pull the drive and sled assembly gently out of the rack. Compare the settings on the adapter board to those in Figure 4-1 or Figure 4-1. Match the configuration of the new device's adapter board with the intended mode of operation (single-ended or differential).

Note: Your system disk should always be set to SCSI ID 1. Be sure each SCSI device on a bus has a unique SCSI address (ID). The SCSI bus cannot function properly if more than one device has the same SCSI ID.

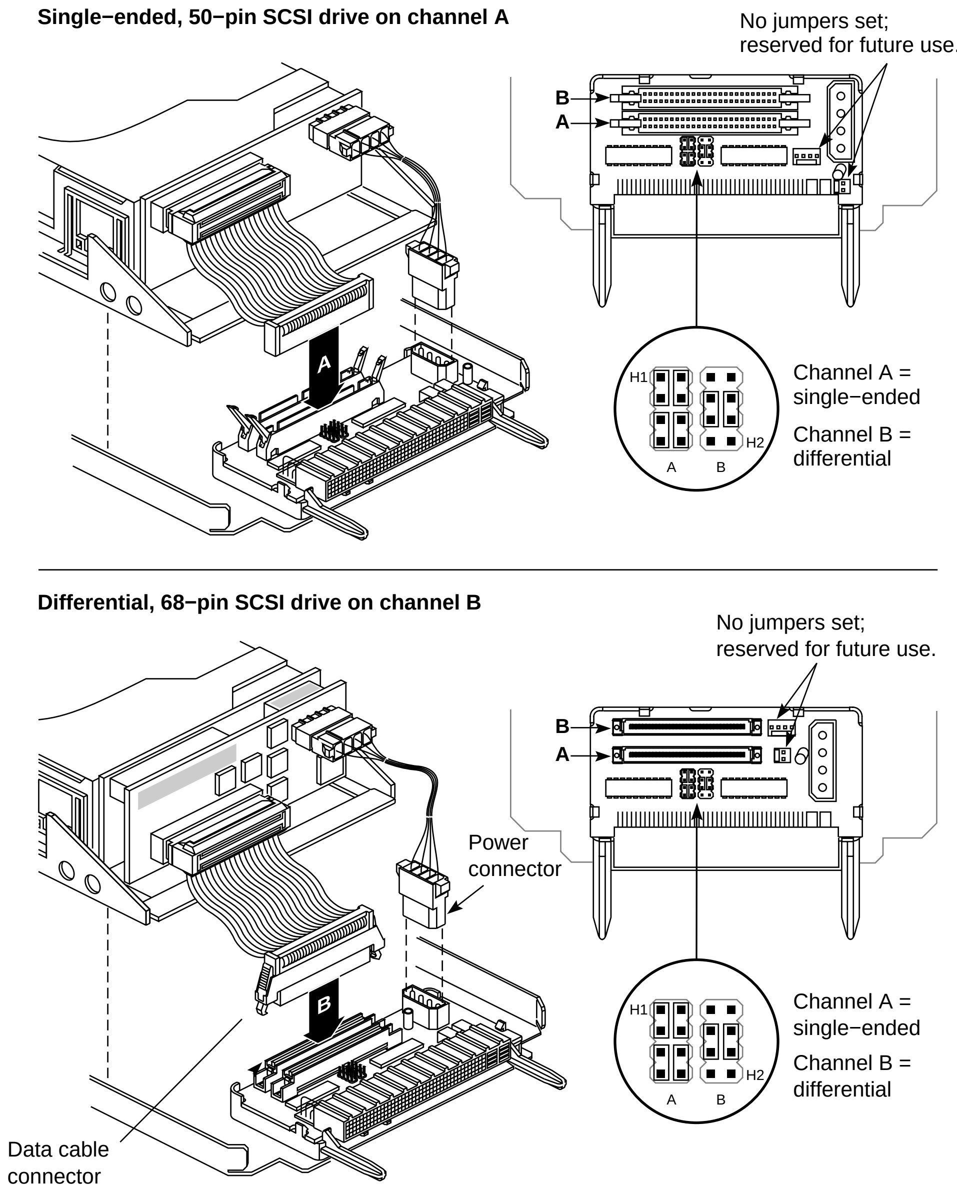

Figure 4-1 Configuring a Drive Sled Adapter Board (Different Channels)

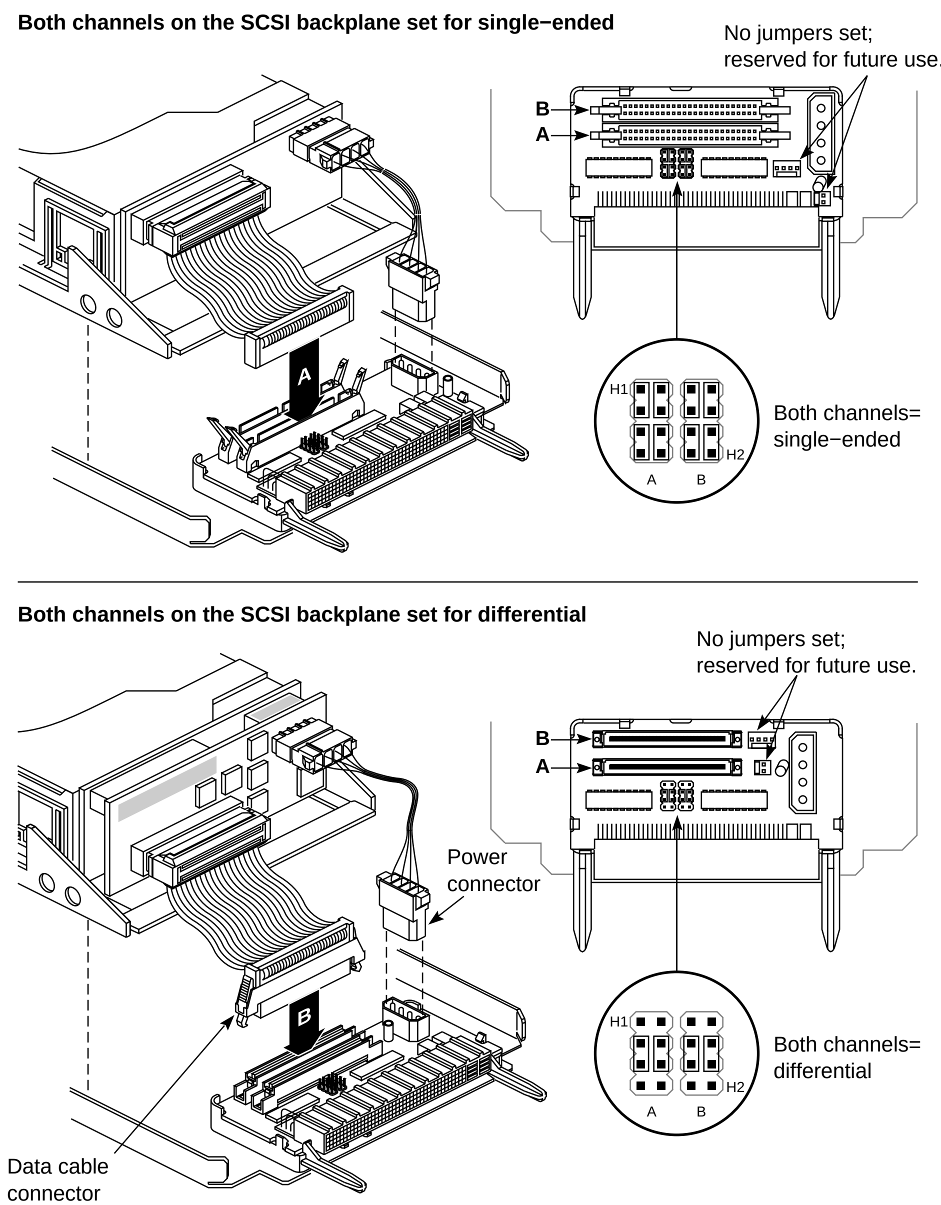

Figure 4-2 Configuring a Drive Sled Adapter Board (Identical Channels)

Installing a Half-Height FLD

The drive must be properly mounted on a drive sled and configured for a channel and operating protocol (single-ended or differential). See Figure 4-3.

Follow these instructions to install a half-height front-loading device:

1. If your drive did not come already mounted on a sled, place it on top, as shown in Figure 4-3. Be sure the EMI shield is affixed to the bottom of the drive and is aligned as shown in the drawing.

   Note: If your drive did not come with an EMI shield, installation of the part is not necessary.

2. Secure the drive to the bottom of the sled with the four screws provided.
3. Plug the drive-to-adapter cable into the proper channel connector.
4. Orient the FLD and sled assembly so that the connectors on the back are on the bottom half of the drive and face away from you.
5. Carefully insert the device into the drive bay until it seats firmly into the lever catch and the locking lever has moved all the way to the right.

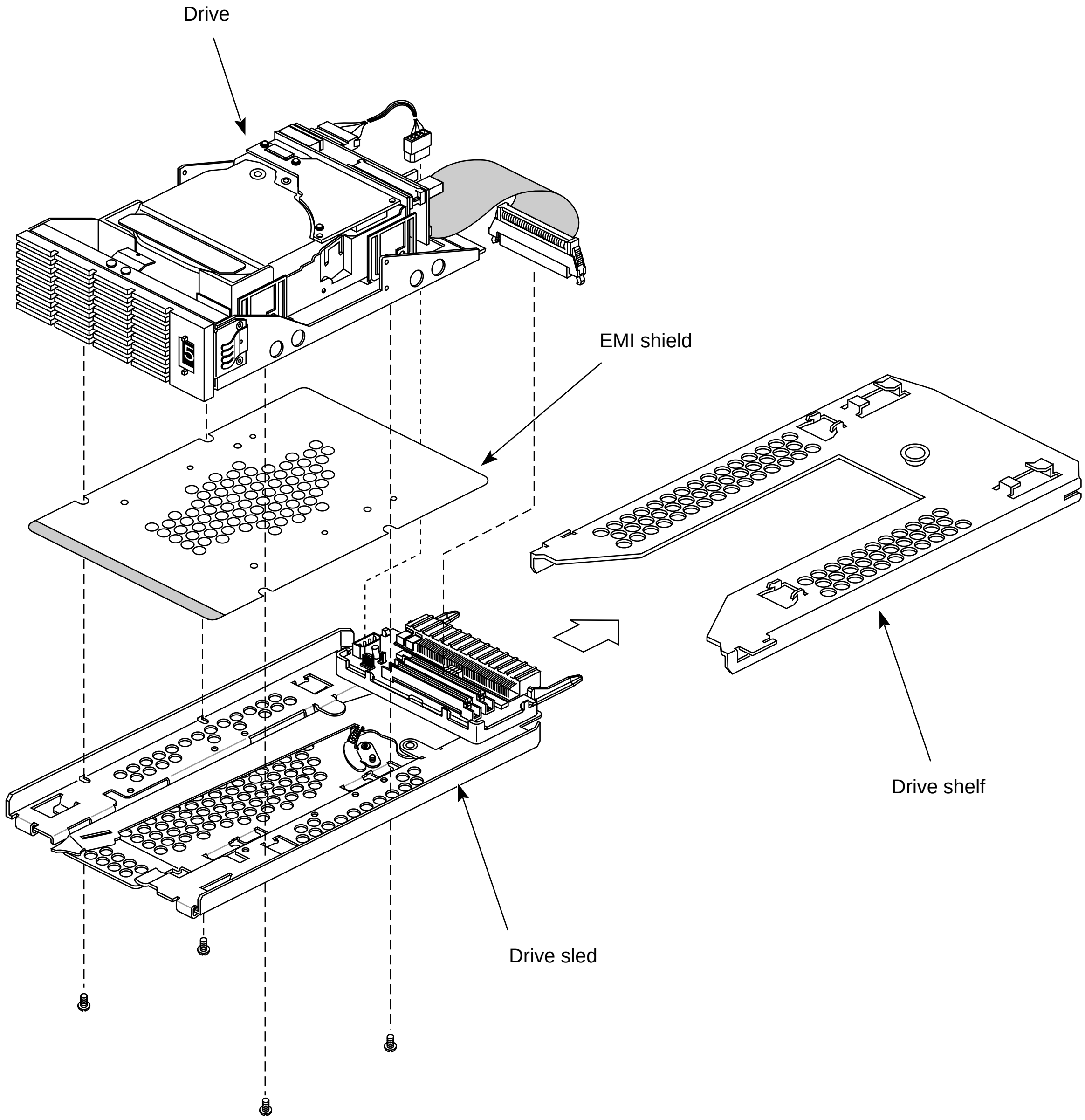

Figure 4-3 Installing a Half-Height SCSI Drive on a Sled and Loading It

Removing an FLD

Follow these instructions to remove a front loading device:

1. Power off the system, as described in Chapter 3.
2. Open the drive door.
3. Slide the locking lever on the drive sled all the way to the left and gently pull the drive and sled assembly out. See Figure 4-4.

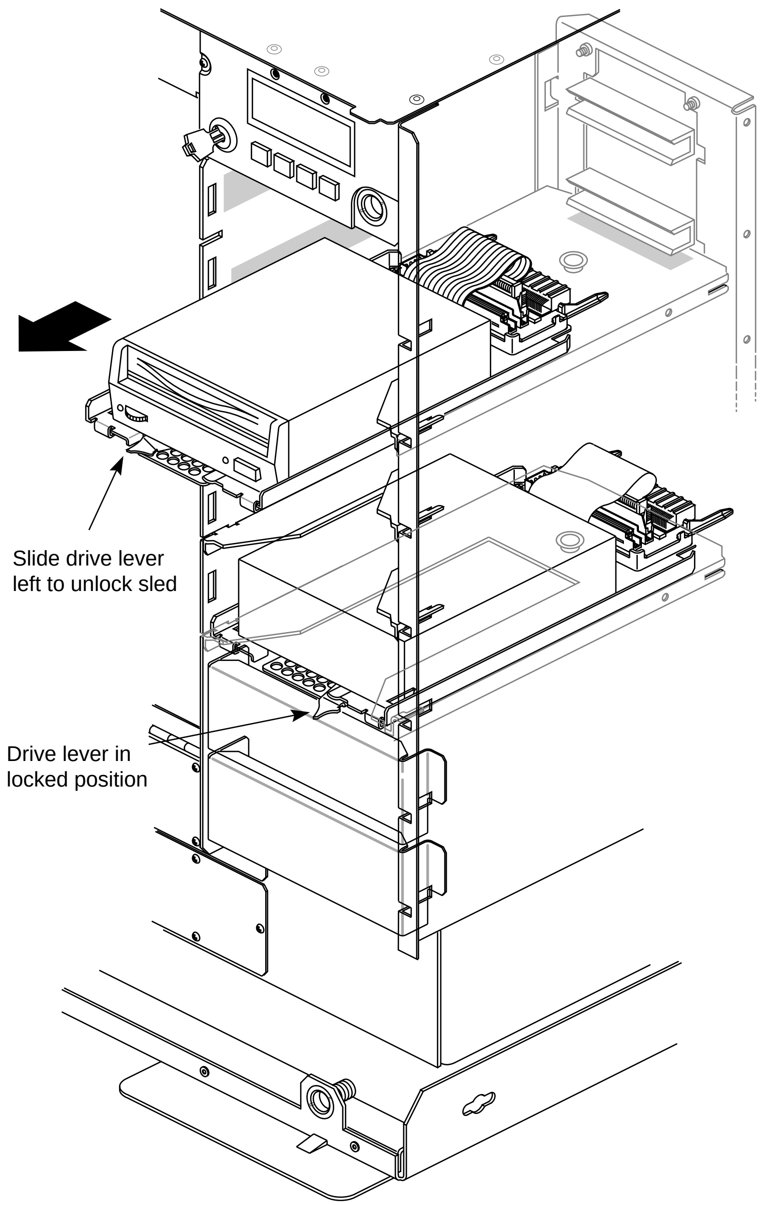

Figure 4-4 Drive Removal Example

Installing a Full-Height FLD

Each drive must be properly mounted on a drive sled and configured for a particular channel and SCSI transmission protocol (single-ended or differential). Refer to Figure 4-3 for the mounting position of the drive on a sled.

Follow these instructions to install a full-height front loading device:

1. Carefully remove the plastic side panel by first grasping the bottom edge of the panel. See Figure 4-5.
2. Pull the panel away from the chassis until the ball and socket fasteners release.
3. Carefully set the panel aside.
4. Identify the retaining screw that holds the drive shelf directly above the chosen drive bay, then remove it with a Phillips screwdriver.
5. Pull the drive shelf straight out of the chassis. See Figure 4-6.

   Note: The design of the deskside drive housing precludes placing an optional DLT drive on the third drive shelf down from the top, or the bottom drive shelf. See Figure 4-7 and keep this in mind when preparing for the installation.

   After removing the drive shelf, the plastic side panel can be replaced by aligning the ball connectors with the sockets in the chassis and reversing steps 1 and 2.
6. Orient the FLD and sled assembly so that the connectors on the back are on the bottom half of the drive and face away from you.
7. Carefully insert the device into the drive bay until it seats firmly into the lever catch and the lever will not move any farther to the right. See Figure 4-6.

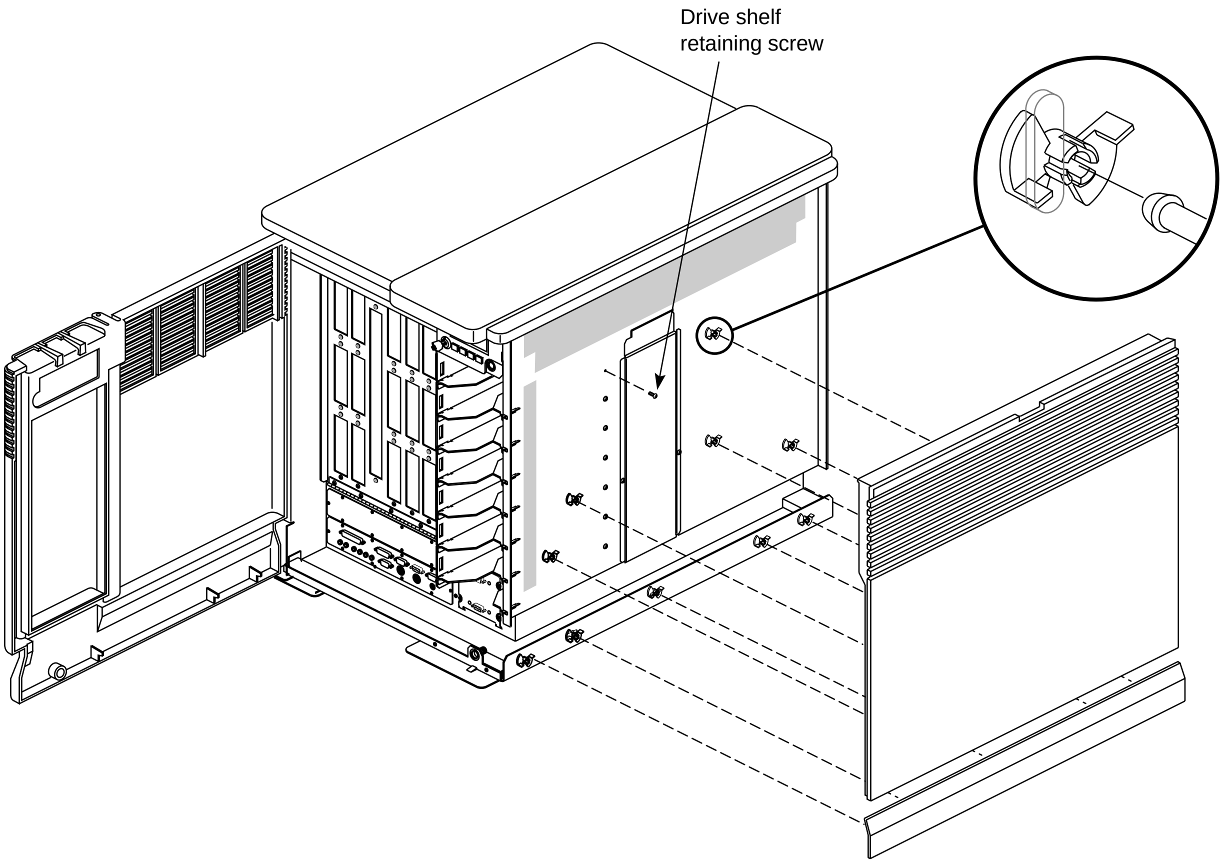

Figure 4-5 Pulling Off the Side Panel and Removing the Retaining Screw

Note: Retain the drive shelf if there is a possibility that you will need to install half-height drives at a later date.

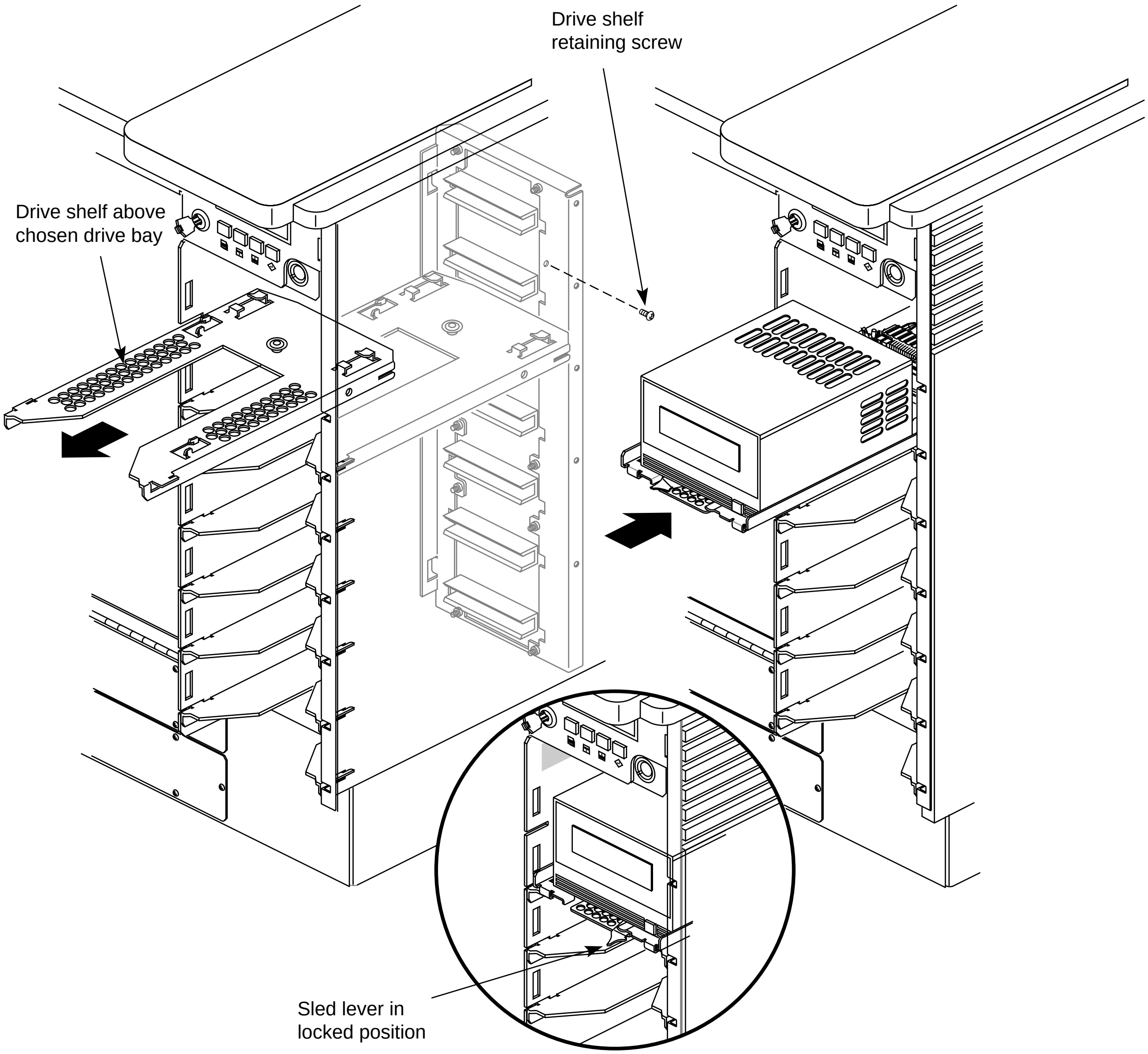

Figure 4-6 Installing a Full-Height Front Loading Device

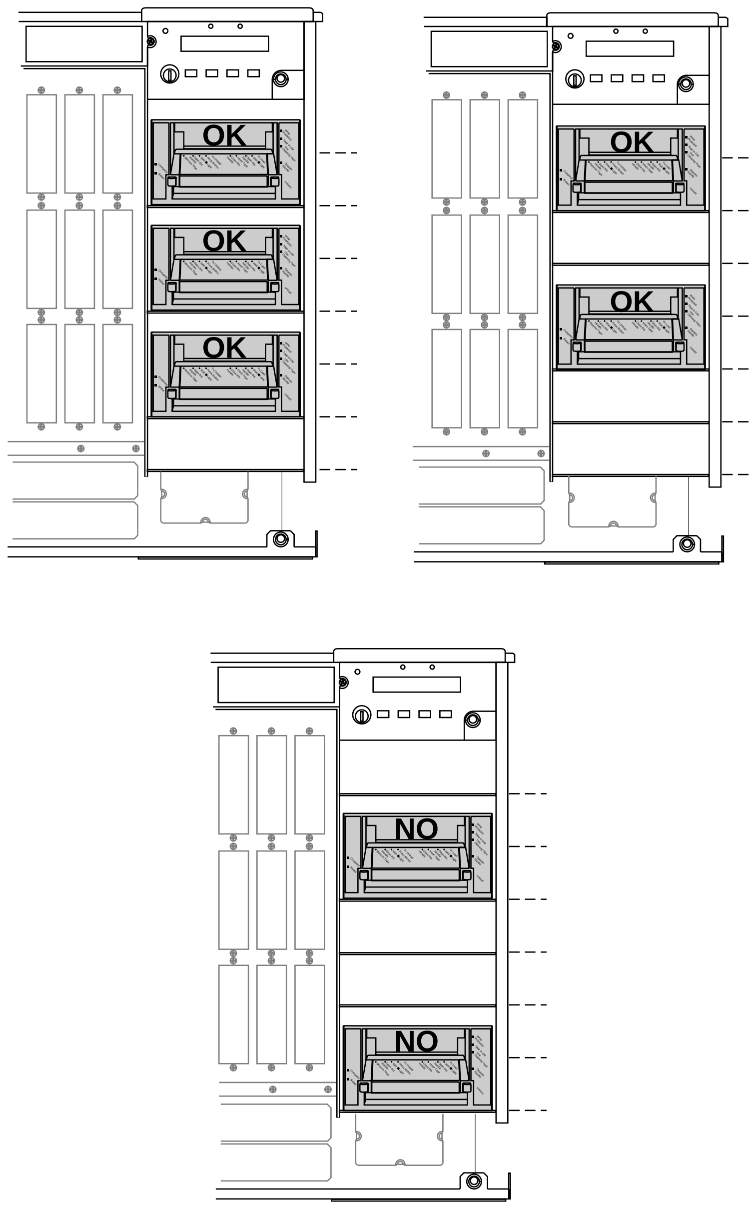

Figure 4-7 Deskside Installation Positions for Optional DLT Drives

Installing and Using an Optional CD-ROM

Follow these instructions to prepare the CD-ROM for use:

1. Install the CD-ROM drive into a half-height slot on the Challenge deskside chassis. Follow the instructions in the previous section to install the FLD.
2. Find the disc that contains the operating system.
3. Open the CD-ROM caddy by squeezing the tabs on its sides.
4. Tilt the CD-ROM into the caddy, as shown in Figure 4-8. The CD-ROM fits under the groove at the end of the caddy.
5. Close the caddy.
6. Hold the caddy by its tabs and orient it as shown in Figure 4-9.
7. Slide the caddy into the CD-ROM drive; see Figure 4-10 for the location of the drive door.
8. See the *IRIX Admin: Software Installation and Licensing* manual for complete instructions on loading software.
9. Load IRIX 5.3 or later; 6.0 or later for POWER Challenge; or IRIX 6.2 or later for the Challenge 10000 or POWER Challenge 10000, from the initial prompt. Select 2, as shown in the following example menu, to load the operating system from a CD-ROM FLD.:

```
System Maintenance Menu:

 1) Start System
 2) Install System Software
 3) Run Diagnostics
 4) Recover System
 5) Enter Command Monitor

 Option? 2 <Enter>

          Installing System Software...
          Press <Esc> to return to the menu.

   1) Remote Tape 2) Remote Directory X) Local CD-ROM X)
   Local Tape

 Enter 1-4 to select source type, <Esc> to quit,
```

```
or <Enter> to start: :
```

If a CD-ROM or Local Tape is attached, a number will be listed next to them instead of an 'X'.

10. A series of dots appears as the operating system loads.

See Appendix B for information on proper maintenance and use of your CD-ROM drive and discs.

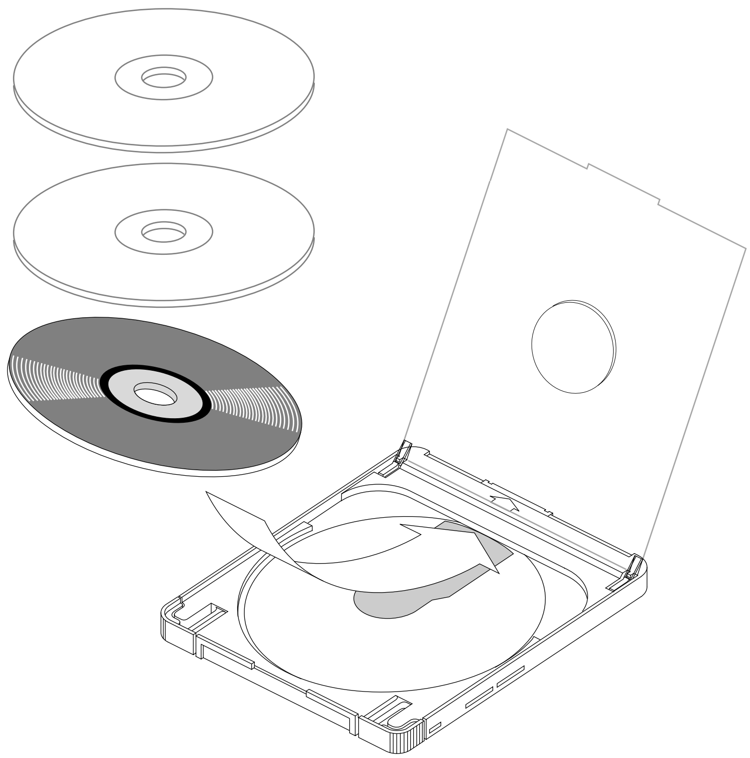

Figure 4-8 Loading a Disc Into the CD-ROM Caddy

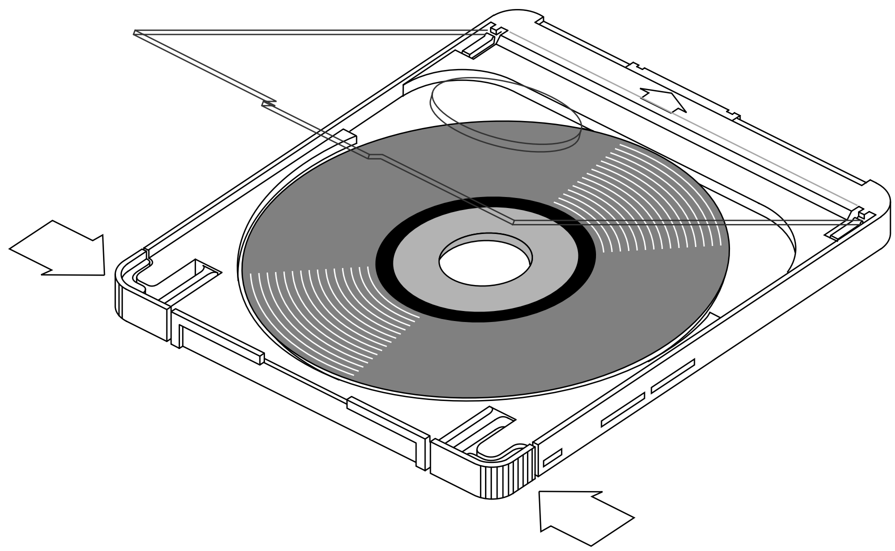

Figure 4-9 Disc Loaded in Caddy

Note: Do not insert the disc into the drive without a caddy.

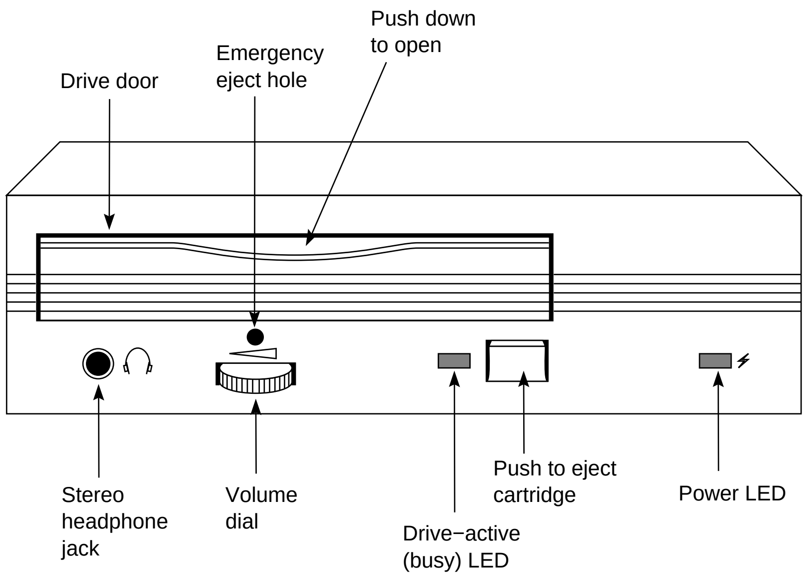

Figure 4-10 CD-ROM Drive Front Panel Controls

Installing External SCSI Devices

External SCSI devices connect to the system using an optional 68-pin differential (DF SCSI) or single-ended (SE SCSI) connector that must first be installed on the I/O panel. Figure 4-11 illustrates how to connect an external SCSI device. Table 4-2 and Table 4-3 provide pinout information for these connectors.

Note: See Chapter 3, “Getting Started,” for limitations on SCSI cable lengths.

The external SCSI connector on Challenge products does not come as a standard, pre-connected feature from the factory. The external SCSI connector must be connected and configured by a trained field installer during or after the installation of the deskside system.

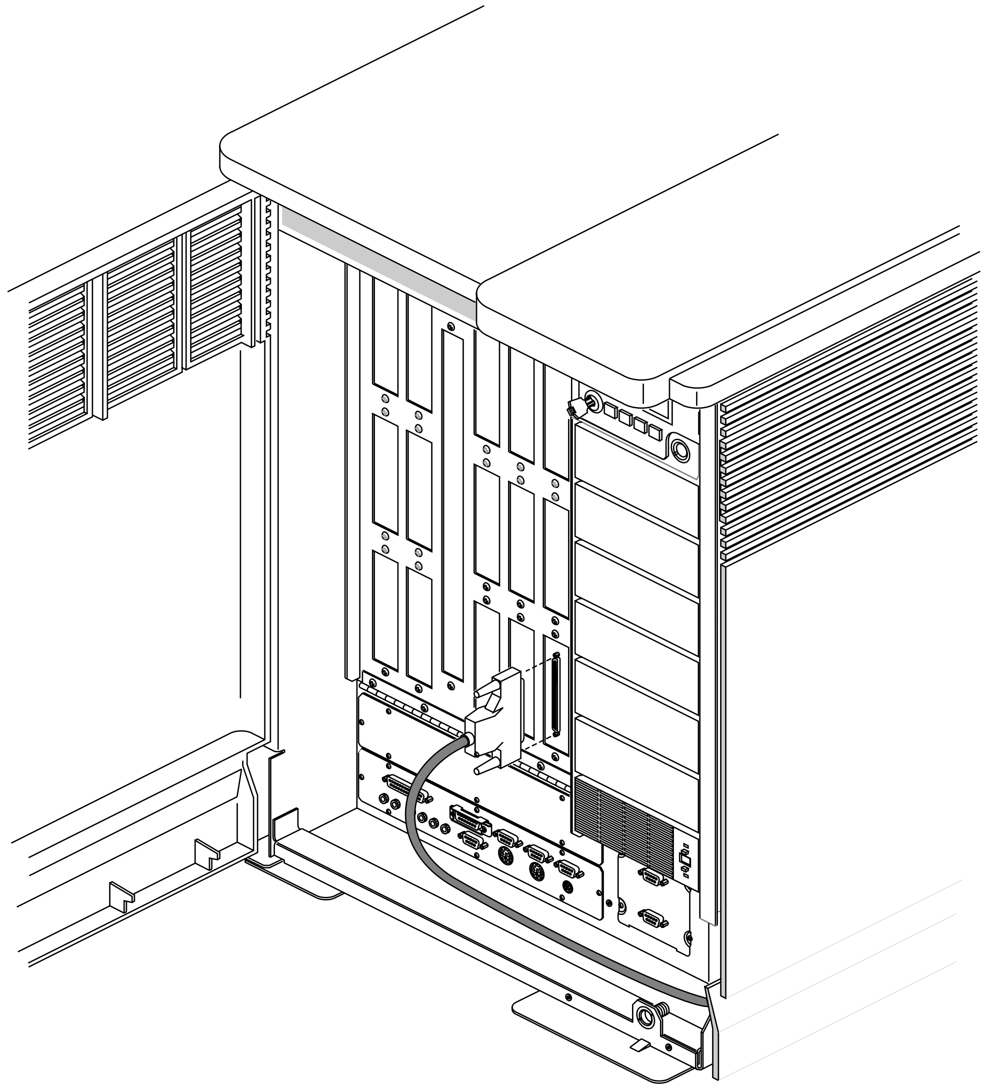

Figure 4-11 Connecting an External SCSI Device

Note: A differential connector is labeled DF SCSI and a singled-ended connector is labeled SE SCSI.

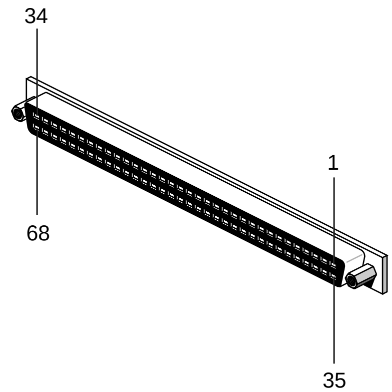

Figure 4-12 Single-Ended 68-Pin Connector

The hyphen preceding a signal name indicates that the signal is low. Note that 8-bit devices that connect to the P-cable leave these signals open: -DB(8), -DB(9), -DB(10), -DB(11), -DB(12), -DB(13), -DB(14), -DB(15), -DB(P1). All other signals are connected as shown in Table 4-2.

Table 4-2 68-Pin Single-Ended, High-Density SCSI Pinouts

Signal Name	Pin Number	Pin Number	Signal Name
Ground	1	35	-DB(12)
Ground	2	36	-DB(13)
Ground	3	37	-DB(14)
Ground	4	38	-DB(15)
Ground	5	39	-DB(P1)
Ground	6	40	-DB(0)
Ground	7	41	-DB(1)
Ground	8	42	-DB(2)
Ground	9	43	-DB(3)
Ground	10	44	-DB(4)
Ground	11	45	-DB(5)

Table 4-2 (continued) 68-Pin Single-Ended, High-Density SCSI Pinouts

Signal Name	Pin Number	Pin Number	Signal Name
Ground	12	46	-DB(6)
Ground	13	47	-DB(7)
Ground	14	48	-DB(P)
Ground	15	49	Ground
Ground	16	50	Ground
TERMPWR	17	51	TERMPWR
TERMPWR	18	52	TERMPWR
Reserved	19	53	Reserved
Ground	20	54	Ground
Ground	21	55	-ATN
Ground	22	56	Ground
Ground	23	57	-BSY
Ground	24	58	-ACK
Ground	25	59	-RST
Ground	26	60	-MSG
Ground	27	61	-SEL
Ground	28	62	-C/D
Ground	29	63	-REQ
Ground	30	64	-I/O
Ground	31	65	-DB(8)
Ground	32	66	-DB(9)
Ground	33	67	-DB(10)
Ground	34	68	-DB(11)

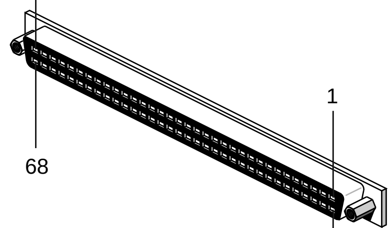

Figure 4-13 68-Pin Differential SCSI Connector

The hyphen preceding a signal name indicates that the signal is low. Note that 8-bit devices that connect to the P-cable leave these signals open: -DB(12), -DB(13), -DB(14), -DB(15), -DB(P1), -DB(8), -DB(9), -DB(10), -DB(11), +DB(12), +DB(13), +DB(14), +DB(15), +DB(P1), +DB(8), +DB(9), +DB(10), +DB(11). All other signals are connected as shown in Table 4-3.

Table 4-3 68-Pin Differential, High-Density SCSI Pinouts

Signal Name	Connector Contact Number	Cable Contact Number	Signal Name
+DB(12)	1	35	-DB(12)
+DB(13)	2	36	-DB(13)
+DB(14)	3	37	-DB(14)
+DB(15)	4	38	-DB(15)
+DB(P1)	5	39	-DB(P1)
Ground	6	40	Ground
+DB(0)	7	41	-DB(0)
+DB(1)	8	42	-DB(1)
+DB(2)	9	43	-DB(2)
+DB(3)	10	44	-DB(3)

Table 4-3 (continued) 68-Pin Differential, High-Density SCSI Pinouts

Signal Name	Connector Contact Number	Cable Contact Number	Signal Name
+DB(4)	11	45	-DB(4)
+DB(5)	12	46	-DB(5)
+DB(6)	13	47	-DB(6)
+DB(7)	14	48	-DB(7)
+DB(P)	15	49	-DB(P)
DIFFSENS	16	50	Ground
TERMPWR	17	51	TERMPWR
TERMPWR	18	52	TERMPWR
Reserved	19	53	Reserved
+ATN	20	54	-ATN
Ground	21	55	Ground
+BSY	22	56	-BSY
+ACK	23	57	-ACK
+RST	24	58	-RST
+MSG	25	59	-MSG
+SEL	26	60	-SEL
+C/D	27	61	-C/D
+REQ	28	62	-REQ
+I/O	29	63	-I/O
Ground	30	64	Ground
+DB(8)	31	65	-DB(8)
+DB(9)	32	66	-DB(9)
+DB(10)	33	67	-DB(10)
+DB(11)	34	68	-DB(11)

Connecting a Serial Printer

A serial printer can be connected to your system by connecting a printer or null modem cable to one of the 9-pin RS-232 serial connectors on the I/O panel. Printers vary, but if you are building a 9- to 25-pin cable connection, the pins typically map as shown in Table 4-4.

Table 4-4 Typical DTE to DTE Serial Printer Connection

System Connector Signal	Pin #	25-Pin Connector to Printer
Transmitted Data (TXD)	2	3 (RXD)
Received Data (RXD)	3	2 (TXD)
Request to Send (RTS)	4	5 (CTS)
Clear to send (CTS)	5	4 (RTS)
Signal Ground (GND)	7	7 (GND)
Data Terminal Ready (DTR)	9	6 Data Set Ready (DSR)

Once you are sure that your cable is correctly configured, use the following procedure to connect a printer to your system:

1. Make sure that the power switch on the printer is turned off and the power cord is not connected to an outlet.
2. Attach the printer cable to the printer.
3. Open the main door of the cabinet to expose the I/O panel.
4. Attach the 9-pin connector on the other end of the printer cable to one of the 9-pin serial connectors on the I/O panel, as shown in Figure 4-14.
5. Attach the printer power cord and turn on the printer.

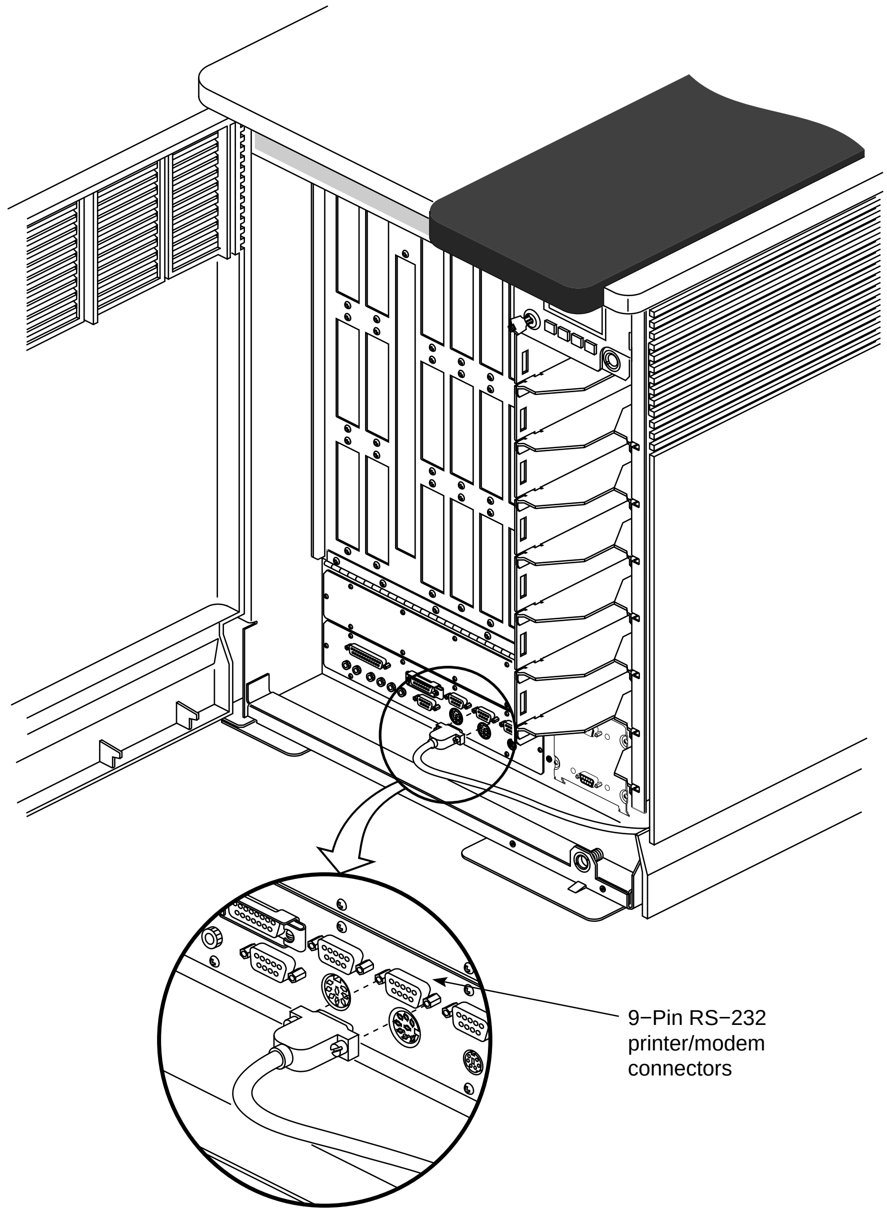

Figure 4-14 Connecting a Serial Printer or Modem

Your serial printer must work in concert with the LP spooling system that your Challenge deskside server uses. The LP spooling system allows you to add or remove printers, and to change interface programs, devices, and the system default printer. Be sure to read the documentation that comes with your printer.

Use the following guidelines only as an example procedure for setting up a serial printer.

To add a dumb printer to serial port 2:

1. Become superuser and change the ownership of the printer device file:

   `# chown lp /dev/ttyd2`

2. Change the permissions of the printer device file:

   `# chmod 600 /dev/ttyd2`

3. Edit the *inittab* file using vi or your favorite line editor, and confirm that port 2 under "on-board ports" reads as follows:

   `# vi /etc/inittab`

   `t2:23:off:/etc/getty -N ttyd2 co_9600 # port 2`

4. Modify the line, if necessary, and reprocess the *inittab* file:

   `# telinit q`

5. Configure the LP spooling system for your dumb printer:

   `# /usr/lib/lpadmin -pEPSON -vttyd2 -mdumb`

6. Start the print spooler:

   `# /usr/lib/lpsched`

7. Enable the printer to accept print requests:

   `# /usr/lib/accept EPSON`

8. Activate the printer:

   `# enable EPSON`

To add a PostScript® serial printer to port 2, become the superuser, and enter the following:

```
# mkPS PostScript ttyd2
# /usr/lib/lpadmin -dPostScript
```

Refer to the *IRIX Admin: Peripheral Devices* manual for more information about configuring your printer.

Connecting an ASCII Terminal

You can connect an optional ASCII terminal to your server by using a simple null modem cable with a 9-pin connector. See Table 4-4 for the serial port to null modem cable pin assignments. Connect one end of the cable to the terminal and the other end to the 9-pin system console port labeled tty_1 on the main I/O panel. If you are building a 9- to 25-pin cable connection, the pins typically map as shown in Table 4-5.

Table 4-5 Typical ASCII Terminal Connection

System Connector Signal	Pin #	25-Pin Connector to Terminal
Transmitted Data (TXD)	2	3 (RXD)
Received Data (RXD)	3	2 (TXD)
Signal Ground (GND)	7	7 (GND)

The ASCII terminal must be set with the following operational characteristics:

- 9600 baud
- 8 bits
- 1 stop bit
- No parity

For your ASCII terminal to operate properly as the system console, it must be plugged into the RS-232-compatible connector labeled tty_1 on the system I/O panel.

To attach an ASCII terminal, complete the following steps:

1. Locate the RS-232 connector designated for the console and labeled tty_1.
2. Attach one end of the console cable to the RS-232 connector and route it out the back of the unit.
3. Connect the other end to the 9-pin connector on the null modem cable and plug the 25-pin null modem connection into the system console terminal.
4. Attach the keyboard and power connectors to the terminal.

   Caution: Before plugging the terminal into either a 110 VAC or a 220 VAC outlet, be sure that the electrical rating on the UL-CSA label is in either the 100–120 VAC or the 200–240 VAC range, whichever applies.
5. Power on the terminal before restarting your system.
6. Restart the system or continue with other peripheral connections as needed.

Your console terminal needs recognition from the system software. Be sure to read the documentation that comes with the terminal. Use the following guidelines to help check and confirm the setup of your console terminal:

1. Become superuser and choose the proper baud rate, prompt, and line conditioning from the */etc/gettydefs* file.

   ```
   # vi /etc/gettydefs
   ```
2. Modify the file */etc/inittab*, if necessary, to enable *getty* on port tty_1. The line is listed under “on-board ports” and should appear as shown below:

   ```
   # vi /etc/inittab
   t1:23:respawn:/etc/getty ttyd1 co_9600  # alt console
   ```
3. After modifying the */etc/inittab* file, inform *init* of any changes by entering the following:

   ```
   # telinit q
   ```
4. Look in */etc/ttytype* for the listed console port information. To keep the system from asking you what type of terminal you are using when you log in, remove the question mark.

5. Add the following line to your *~/.login* file. This sets the terminal type, syntax, and erase/kill parameters automatically when you log in:

   ```
   % eval 'tset -s -Q'
   ```

6. Check terminal connection and function using the following:

   ```
   % cat /etc/group > /dev/ttyd1
   % ps -def | grep getty
   ```

Helpful Serial Port Commands

To show the standard settings on a particular serial port, become superuser and enter

```
# stty < /dev/ttydx
```

where *x* is the number of the tty port on which you want information.

To show the various settings on a particular serial port, enter

```
# stty -a < /dev/ttydx
```

To change the baud rate on a particular serial port, enter the following (the example is 2400):

```
# stty 2400 < dev/ttydx
```

For additional useful information on serial ports and configuration, see the reference (man) pages for the following:

- inittab
- gettydefs
- ttytype
- terminfo
- stty
- termio

The following files are most commonly used to properly configure serial port operation for the server:

- */etc/inittab*
- */etc/gettydefs*
- */etc/ttytype*
- */usr/lib/terminfo*
- */etc/uucp/Systems*

Connecting a Modem

A modem can be connected to your system by connecting a modem cable to one of the 9-pin serial connectors on the I/O panel. The pin assignments are listed in Table 4-6. A 9-pin to 25-pin cable may be required. Silicon Graphics supports Hayes 2400 and Telebit modems. Edit the */etc/uucp/fix-hayes* or */etc/uucp/fix-telebit* files for information on specific models supported (see step 7 on the next page).

Be sure that the pin assignments, not the pin numbers, on the Challenge system's serial port are properly matched to the pin assignments on your modem.

Table 4-6 RS-232 Modem Connector Pin Assignments

9-Pin Connector Pin	25-Pin Connector Pin	Signal Description at Host
2	2	Transmitted Data (TXD)
3	3	Received Data (RXD)
4	4	Request to Send (RTS)
5	5	Clear to Send (CTS)
7	7	Signal Ground (GND)
8	8	Data Carrier Detect (DCD)
9	20	Data Terminal Ready (DTR)

Once you are sure that your cable is correctly configured, use the following general procedures to connect a modem to your system:

1. Make sure that the power switch on the modem is turned off.
2. Attach the cable to the modem.
3. Open the main door of the chassis to expose the I/O panel.
4. Attach the connector on the other end of the cable to one of the 9-pin serial connectors on the I/O panel, as shown in Figure 4-14.
5. Read the documentation that comes with your modem to determine model-specific connection and configuration procedures.
6. Attach the modem power cord and turn on the modem.
7. Install the *eoe2.sw.uucp* subsystem if it is not already installed.

Note: The *eoe2.sw.uucp* subsystem is shipped with each copy of the IRIX operating system, but is not installed by default. Confirm that *eoe2.sw.uucp* is installed by using the *versions* command. If it is not installed, see the *IRIS Software Installation Guide* for instructions.

Refer to the *IRIX Advanced Site and Server Administration Guide* for additional information about configuring modems. Entries in the */etc/inittab* and */etc/uucp/Devices* files may need to be modified.

Additional useful information on modem operation and configuration is available in the reference (man) pages for the following:

- dial
- cu

Connecting a Parallel Printer

To attach a parallel printer, complete the following steps:

1. Locate the 25-pin, sub-D parallel connector on the main I/O panel (see Figure 4-15).
2. Attach one end of the cable to the connector and route it out the back of the unit.

3. Connect the other end to the parallel printer. Be sure you have confirmed pin and signal compatibility before making the connection. (See Table 4-7.)

   Caution: Before plugging the printer into either a 110 VAC or a 220 VAC outlet, be sure that the electrical rating on the label is in either the 100–120 VAC or the 200–240 VAC range, whichever applies.

4. Turn on the printer before restarting your system.

Restart the system or continue with other peripheral connections as needed.

To enable the serial port on any optional additional IO4 boards, enter the following as the superuser:

cd /dev

./MAKEDEV plp

The *MAKEDEV* command checks the system's hardware configuration and makes parallel port device nodes for all possible ports.

Your parallel printer must work in concert with the LP spooling system that your Challenge deskside server uses. The LP spooling system allows you to add or remove printers and to change interface programs, devices, and the system default printer. Be sure to read the documentation that comes with your parallel printer.

Use the following instructions only as an example procedure:

1. Become superuser and configure the LP spooling system (the 03 in `-vplp03` represents the Ebus slot where the IO4 board is):

   `# /usr/lib/lpadmin -pTekprinter -vplp03`

2. Start the print spooler:

   `# /usr/lib/lpsched`

3. Enable the printer to accept print requests:

   `# /usr/lib/accept Tekprinter`

4. Activate the printer:

   `# enable Tekprinter`

Refer to the *IRIX Admin: Peripheral Devices* manual for additional information about configuring your parallel printer.

The parallel printer port on the system I/O panel is a 25-pin, Centronics compatible connector. Table 4-7 shows the pin assignments and signals as they relate to a 36-pin Centronics connector.

Table 4-7 Centronics Compatible Parallel Port Pin Assignments

25-Pin Serial Port Pin Assignment	36-Pin Centronics Pin Assignments	Signal
1	1	STB (Data Strobe)
2	2	DATA 0
3	3	DATA 1
4	4	DATA 2
5	5	DATA 3
6	6	DATA 4
7	7	DATA 5
8	8	DATA 6
9	9	DATA 7
10	10	DATA ACK
11	11	BUSY
12	12	PE (Paper Empty)
13	13	SLCT (Select)
14	N/A	AUTOFD
15	32	ERROR
16	N/A	INIT (Reset)
17	N/A	SLCTIN
18 through 25	20 through 27	GND

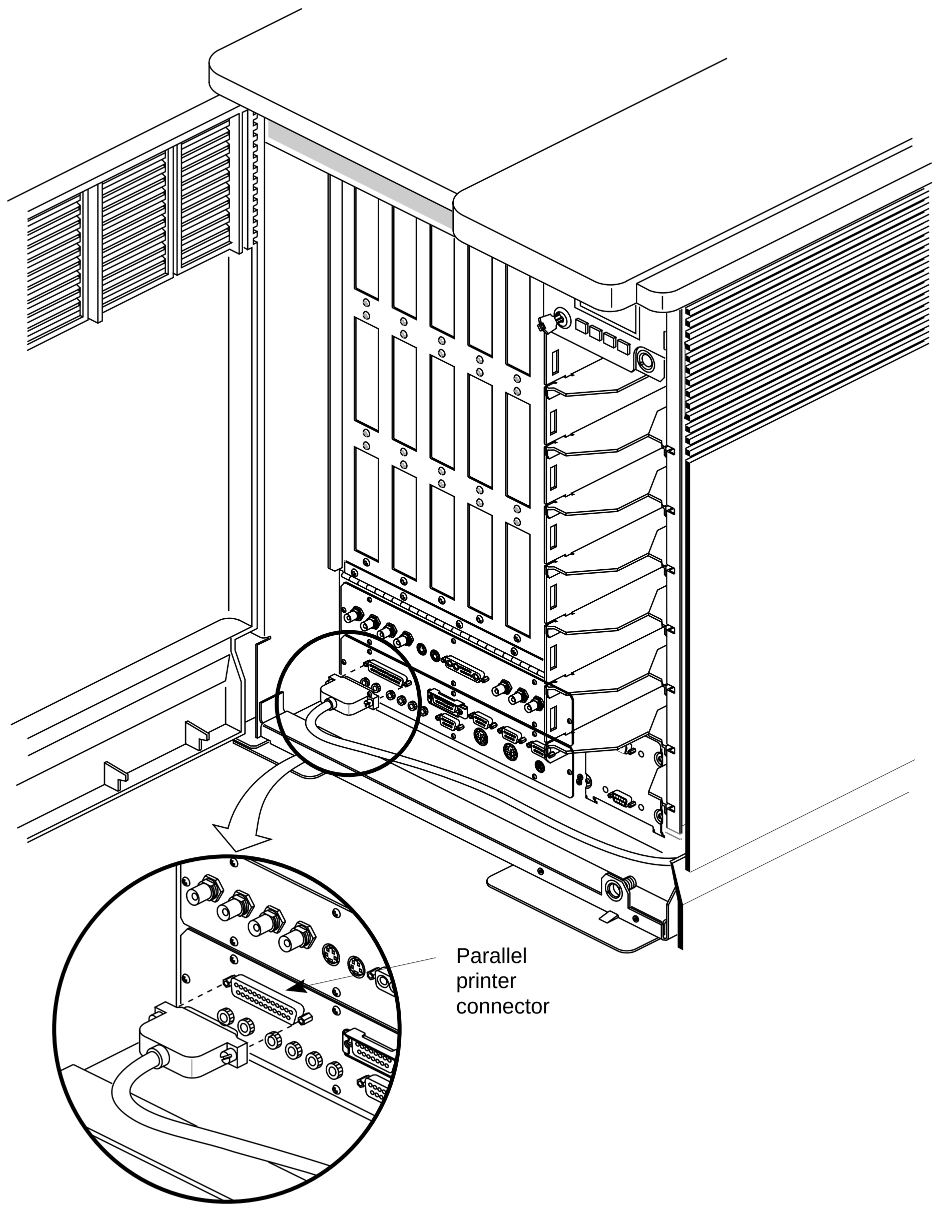

Figure 4-15 Connecting a Parallel Printer Cable

Chapter 5

Troubleshooting

This chapter contains hardware-specific information that can be helpful if you are having trouble with your Power Challenge or Challenge L deskside system.

Maintaining Your Hardware and Software

This section gives you some basic guidelines to help keep your hardware and the software that runs on it in good working order.

Hardware Do's and Don'ts

To keep your system in good running order, follow these guidelines:

- Do not enclose the system in a small, poorly ventilated area (such as a closet), crowd other large objects around it, or drape anything (such as a jacket or blanket) over the system.
- Do not connect cables or add other hardware components while the system is turned on.
- Always remove the key from the front panel switch before shutting the drive door or minor damage may result.
- Do not leave the front panel key switch in the Manager position.
- Do not lay the system on its side.
- Do not power off the system frequently; leave it running over nights and weekends, if possible. The system console terminal can be powered off when it is not being used.
- Do not place liquids, food, or extremely heavy objects on the system or keyboard.

- Ensure that all cables are plugged in completely.
- Ensure that the system has power surge protection.

Software Do’s and Don’ts

When your system is up and running, follow these guidelines:

- Do not turn off power to a system that is currently started up and running software.
- Do not use the root account unless you are performing administrative tasks.
- Make regular backups (weekly for the whole system, nightly for individual users) of all information.
- Keep two sets of backup tapes to ensure the integrity of one set while doing the next backup.
- Protect the root account with a password:
  - Check for *root UID = 0* accounts (for example *diag*) and set passwords for these accounts.
  - Consider giving passwords to courtesy accounts such as *guest* and *lp.*
  - Look for empty password fields in the */etc/passwd* file.

System Behavior

The behavior of a system that is not working correctly falls into three broad categories:

Operational	You can log in to the system, but it doesn’t respond as usual. For example, the text looks strange, or the monitor doesn’t respond to input from the keyboard.
Marginal	You cannot start up the system fully, but you can reach the System Maintenance menu or PROM Monitor.
Faulty	The system has shut down and you cannot reach the System Maintenance menu or PROM Monitor.

If the behavior of your system is operational, marginal, or faulty, first do a physical inspection using the checklist below. If all of the connections seem solid, go on to the section "Using the System Controller" on page 82 and try to isolate the problem. If the problem persists, run the diagnostic tests from the System Maintenance menu or PROM Monitor. See the *IRIX Admin: System Configuration and Operation* manual for more information about diagnostic tests.

If this does not help, contact your system administrator or service provider.

Physical Inspection Checklist

Check every item on this list:

- The console terminal and main unit power switches are turned on.
- The circuit breaker next to the main power cord is not tripped.
- The fans are running and the fan inlets/outlets are not blocked.
- The System Controller LCD screen may display fault messages or warnings.

Before you continue, shut down the system and turn off the power.

Check all of the following cable connections:

- The system console terminal power cable is securely connected to the terminal at one end and the power source at the other end.
- The Challenge deskside server power cable is securely connected to the main unit at one end and plugged into the proper AC outlet at the other end.
- The Ethernet cable is connected to the 15-pin connector port labeled Ethernet (and secured with the slide latch).
- Serial port cables are plugged in securely to their corresponding connectors.
- All cable routing is safe from foot traffic.

If you find any problems with hardware connections, have them corrected and turn on the power to the main unit. Use the System Controller to determine if internal system problems exist.

Using the System Controller

The System Controller has three basic operating modes:

- It acts as a control conduit when directed by an operator to power off or boot up the system. It actively displays a running account of the boot process and flags any errors encountered. It sends the master CPU a message when a system event such as power off or a reboot is initiated.
- When operating conditions are within normal limits, the System Controller is a passive monitor. Its front panel LCD offers a running CPU activity graph that shows the level of each on-board microprocessor's activity. Previously logged errors are available for inspection using the front panel control buttons to select menus.
- The System Controller can also act independently to shut down the system when it detects a threatening condition. Or it can adjust electromechanical parameters (such as blower fan speed) to compensate for external change. Error information stored in the log is available in both the On and Manager positions. Service personnel can use the Manager key position functions to probe for system error information.

When a system fault occurs in the cardcage, ventilation system, or power boards, the System Controller turns off the power boards but leaves the 48-V and V5_AUX on. This allows the yellow fault LED to remain lit and the System Controller to continue functioning. If, for example, the System Controller displays the error message `POKA FAIL`, your service provider can do a visual inspection of POKA indicator LEDs throughout the system to locate the failed component.

Note: If the system shuts down because an OVER TEMP condition occurs, the entire system shuts down. To find the fault, turn the key off and then on again. The LCD screen should show the OVER TEMP error; however, if the system is not given enough time to cool below the switch-off point, the System Controller will shut down again.

The System Controller also shuts down the entire system if a 48 V overvoltage fault occurs. If the System Controller removes power due to an overvoltage condition, the operator must execute the log function, turn the power off, and then turn it back on again. These steps are necessary to successfully power on the system. The purpose of this function is to prevent the operator from repeatedly applying power when an overvoltage condition exists.

The Power-On Process

You can monitor the boot process when you power on the system by watching the System Controller. When you turn the key switch to the On (middle) position on the System Controller front panel, it enables voltage to flow to the system backplane. The green power-on LED lights up, and immediately after that the yellow fault LED comes on. The System Controller initializes and performs its internal startup diagnostics. If no problems are found, the yellow fault LED shuts off.

Note: If the yellow fault LED stays on for more than a few seconds, a fault message should appear. If it stays on and no message appears on the display, you may have a faulty LCD screen or a problem with the System Controller. Contact your system administrator or service provider.

The following steps are similar to what you should see when you bring up the system:

1. When the System Controller completes its internal checks and the system begins to come up, two boot messages appear:

   ```
   BOOT ARBITRATION IN PROGRESS
   BOOT ARBITRATION COMPLETE SLOT OxY PROC OxZ
   ```

2. The screen clears and the message `STARTING SYSTEM` should appear.
3. A series of status messages scrolls by. Most pass by so quickly that they are unreadable. These messages indicate the beginning or completion of a subsystem test.
4. After all the system checks are complete, you receive a status message that looks similar to:

   ```
   PROCESSOR STATUS
   B+++
   ```

The B+++ shown in step 4 indicates that the bootmaster microprocessor is active along with three other functioning microprocessors on the CPU board.

If your CPU has only two microprocessors on board, you should see

```
PROCESSOR STATUS
B+
```

If you receive a processor status message followed by B+DD, you have a CPU with two of its microprocessors disabled. Contact your system administrator to determine why this was done.

If you receive a processor status message like B+-- or B+XX, the CPU has defective microprocessors on board. Make a note of the exact message and contact your service provider for help.

If the System Hangs

If the system does not make it through step 3 in the power-on process, an error message will appear and stay on the System Controller's LCD screen. A message like PD CACHE FAILED! indicates that a serious problem exists. Make a note of the final message the system displays and contact your service provider.

The message displayed on the System Controller LCD screen when a power-on hang occurs can give your service provider valuable information.

System Controller On Functions

Located just above the drive rack, the System Controller LCD and front panel provides users with information regarding any planned or unplanned shutdown of the system.

The System Controller monitors incoming air temperature and adjusts fan speed to compensate. It also monitors system voltages and the backplane clock. If an unacceptable temperature or voltage condition occurs, the System Controller will shut down the system.

Another major area the System Controller watches is the boot process. In the event of an unsuccessful boot, the controller's LCD panel indicates the general nature of the failure. A real-time clock resides on the System Controller, and the exact date and time of any shutdown is recorded.

When the System Controller detects a fault condition, it turns off power to the system boards and peripherals. The 48 VDC supplied to the system backplane stays on unless the shutdown was caused by an over-limit temperature condition or other situation that would be harmful to the system. The System Controller LCD screen displays a fault message, and the yellow fault LED near the top of the panel comes on. Fault LEDs are also positioned on other parts of the chassis to indicate a localized fault. Your service provider should check for these conditions before shutting down the system.

The front panel of the System Controller has two indicator LEDs and four control buttons in addition to the LCD screen. See Figure 5-1 for the location of the indicators and controls.

In the case of a forced shutdown, an error message is written into an event history file. This file can contain up to 10 error messages and can be viewed on the System Controller screen.

Note: If you wish to examine the error(s) recorded on the System Controller that caused a shutdown, *do not* reboot the system immediately.

When the system is rebooted, the System Controller transmits the errors it has logged in non-volatile random access memory (NVRAM) to the master CPU. They are then placed in */var/adm/SYSLOG*, and the error log in the System Controller is cleared.

As shown in Figure 5-1, the key switch has three positions:

- The Off position (with the key turned to the left) shuts down all voltages to the system boards and peripherals.
- The On position (with the key in the center) enables the system and allows monitoring of menu functions.
- The Manager position (with the key turned to the right) enables access to additional technical information used by service personnel.

As seen in Figure 5-1, there are four control buttons located on the System Controller front panel.

This list describes the buttons in order, from left to right:

- Press the Menu button to place the display in the menu mode.
- Press the Scroll up button to move up one message in the menu.
- Press the Scroll down button to move down one message in the menu.
- Press the Execute button to execute a displayed function or to enter a second-level menu.

The green power-on LED stays lit as long as 48 VDC voltage is being supplied to the system backplane. The yellow fault LED comes on whenever the System Controller detects a fault.

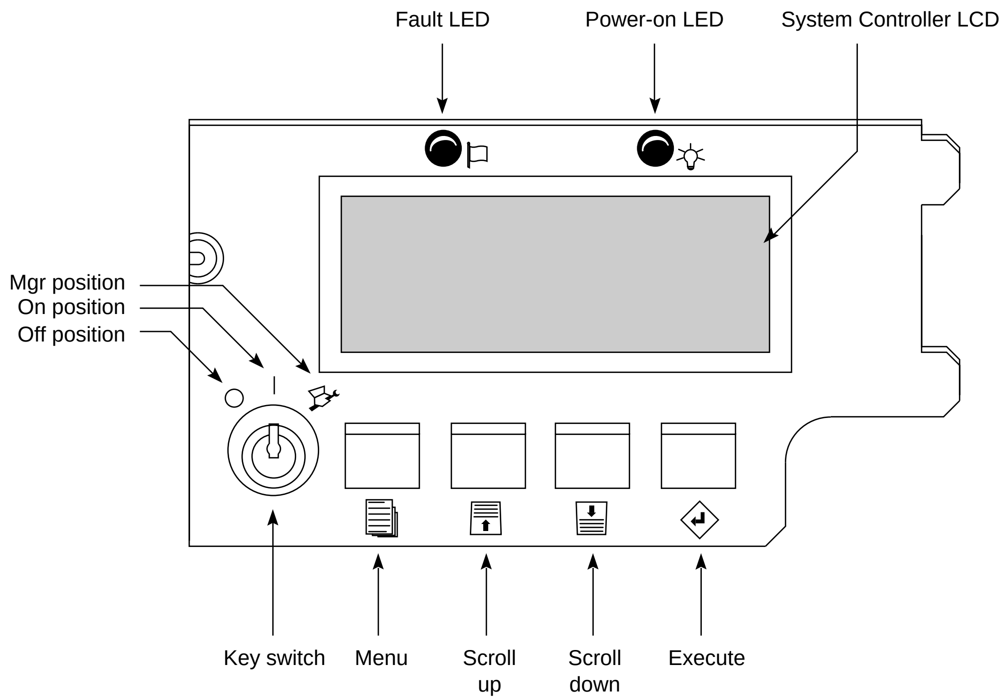

Figure 5-1 System Controller Front Panel Components

Four information options are available to the user when the key is in the On (middle) position:

- the Master CPU Selection menu
- the Event History Log menu
- the Boot Status menu
- the CPU Activity Display

The information displays are further described in the following sections, table, and figure.

The Master CPU Selection Menu

This menu monitors the current state of the system in the boot arbitration process. Table 5-1 shows the messages that may appear during and after the boot process.

The Event History Log Menu

The System Controller uses space in NVRAM to store up to 10 messages. All events logged by the System Controller are stored in the NVRAM log file. After the system successfully boots, the contents of the System Controller log file are transferred to */var/adm/SYSLOG* by the master CPU.

Three basic types of system occurrence are logged in the history menu:

- System error messages are issued in response to a system-threatening event, and the controller shuts down the system immediately after flagging the master CPU.
- System events that need attention are immediately transmitted to the master CPU; however, no shutdown is implemented by the System Controller.
- System Controller internal errors are monitored and logged in the menu just like system errors and events. They are transferred to */var/adm/SYSLOG* by the CPU just like other errors. If the System Controller internal error is significant, an internal reinitialization will

take place. An internal System Controller error never causes the Challenge deskside system to shut down.

Whenever possible, the System Controller alerts the master CPU that a system-threatening error situation exists and a shutdown is about to happen. The System Controller then waits for a brief period for the CPU to perform an internal shutdown procedure. The controller waits for a “Set System Off” command to come back from the master CPU before commencing shutdown. If the command does not come back from the CPU before a specified time-out period, the System Controller proceeds with the shutdown anyway.

Detection of a system event monitored by the System Controller automatically sends a message to the master CPU. The warning message is recorded in the event history log, and the CPU is expected to take corrective action, if applicable. No system shutdown is implemented.

See Appendix C for a complete list of messages that can appear in the event history log.

Boot Status Menu

The Boot Status menu supplies the last message sent by the master CPU after the master CPU selection process is concluded. A total of five status messages can appear under this menu selection. The messages are listed in Table 5-1, along with a brief explanation of their context and meaning.

Table 5-1 System Controller Master CPU Status Messages

Master CPU Status Message	Context and Meaning of Message
BOOT ARBITRATION NOT STARTED	The system CPU board(s) has not begun the arbitration process.
BOOT ARBITRATION IN PROGRESS	The system CPU boards are communicating to decide which one will be the system master CPU.
BOOT ARBITRATION IS COMPLETE SLOT #0X PROC #0X	The chosen CPU master has identified itself to the System Controller and communication is fully established.

Table 5-1 (continued) System Controller Master CPU Status Messages

Master CPU Status Message	Context and Meaning of Message
BOOT ARBITRATION INCOMPLETE FAULT NO MASTER	The system was unable to assign a system master CPU.
BOOT ARBITRATION ABORTED	An operator pushed one of the front panel buttons while the System Controller was searching for the system master CPU.

The CPU Activity Display

The activity display is a graph function that provides a series of moving bars placed next to each other on the System Controller's screen. Each of the vertically moving bars on the screen represents the activity of one of the microprocessors in the Challenge deskside server.

The activity display is the default menu that appears if the key is in the On position and no keypad selections have been made within the last 60 seconds.

Note: The activity graph is replaced by any detected fault message until the key is turned to the Off position.

The activity graph (also known as a histogram) indicates the processor activity level of each microprocessor within the system. This display is similar to the bar graph display of volume levels on modern stereo receivers. Each bar gives a running account of the volume of processes taking place in a particular microprocessor.

Note: Figure 5-2 shows a total of 12 microprocessor histogram bars. Your system may have as few as one, depending on the number of CPU boards installed and the on-board microprocessors that they host.

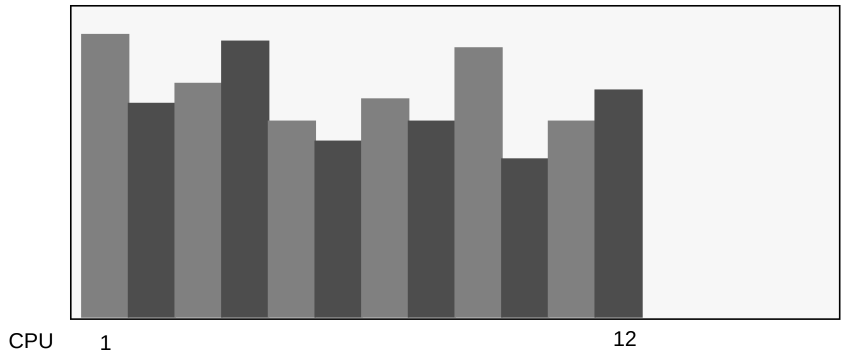

Figure 5-2 Challenge CPU Board Microprocessor Activity Graph (Histogram)

Recovering From a System Crash

To minimize data loss from a system crash, back up your system daily and verify the backups. Often a graceful recovery from a crash depends upon good backups.

Your system may have crashed if it fails to boot or respond normally to input devices such as the keyboard. The most common form of system crash is terminal lockup—your system fails to accept any commands from the keyboard. Sometimes when a system crashes, data is damaged or lost.

Note: Before going through a crash recovery process, check your terminal configuration and cable connections. If everything is in order, try accessing the system through the system console (if present) or remotely from another terminal.

If none of the solutions in the previous paragraphs is successful, you can fix most problems that occur when a system crashes by using the methods described in the following paragraphs. You can prevent additional problems by recovering your system properly after a crash.

The following list presents several ways to recover your system from a crash. The simplest method, rebooting the system, is presented first. If that fails, go on to the next method, and so on. Here is an overview of the different crash recovery methods:

- rebooting the system

  Rebooting usually fixes problems associated with a simple system crash.

- restoring system software

  If you do not find a simple hardware connection problem and you cannot reboot the system, a system file might be damaged or missing. In this case, you need to copy system files from the installation tapes to your hard disk. Some site-specific information might be lost.

- restoring from backup tapes

  If restoring system software fails to recover your system fully, you must restore from backup tapes. Complete and recent backup tapes contain copies of important files. Some user- and site-specific information might be lost. Read the following section for information on file restoration.

Refer to the *IRIX Admin: Backup, Security, and Accounting* manual for the instructions used to perform each of the recovery methods listed above.

If your system continues to fail, most likely you have a serious software problem, and you must restore the system software and files using the procedures described in the *Personal System Administration Guide* and the *IRIX Admin: Backup, Security, and Accounting* manuals for additional information. If the system fails to respond at all, call your service organization for assistance.

Chapter 6

Safety and Comfort

This chapter gives you some important information on setting up the workstations that are clients of your Challenge deskside server. The information is intended to help set up a workstation for maximum safety and comfort.

Human Factors Guidelines for Setting Up Your Workstation

You can increase the comfort and safety of your work environment and decrease your chances of cumulative trauma disorders by following the guidelines given below. These guidelines will help you to create a healthy and productive work environment by showing you how to

- use your workstation correctly
- properly choose a site for your system and its components
- set up your desk and chair correctly

ANSI Standard for VDT Workstations

Adjustment parameters for workstations are defined in Figure 6-1. Guidelines are shown for small adults (standing height of 150 cm or 59 in) and large adults (standing height of 185 cm or 73 in). Midpoints are also interpolated for persons of more average height. Table 6-1 shows recommended guidelines for furniture and system adjustment, as developed by the American National Standard Institute (ANSI).

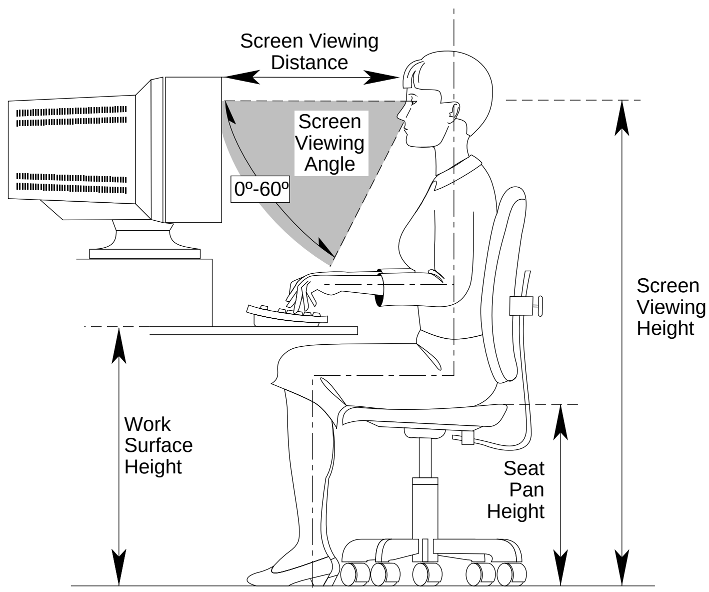

Figure 6-1 Basic Parameters of VDT Workstation Adjustment[1] (Adapted from ANSI/HFS 100–1988)

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[1]American National Standard for Human Factors Engineering of Visual Display Terminal Workstations. ANSI/HFS 100–1988. Available through the Human Factors Society, Inc., P.O. Box 1369, Santa Monica, CA 90406, USA

Local VDT guidelines issued by country, state, or municipality may apply and supercede the guidelines in Table 6-1.

Table 6-1 ANSI/HFS 100–1988 Guidelines for VDT Workplace Adjustment

Adjustment	Small Adult cm (in.)	Midpoint cm (in.)	Large Adult cm (in.)
Seat pan height	40.6 (16.0)	46.3 (18.2)	52.0 (20.5)
Work surface height (keyboard/mouse)	58.5 (23.0)	64.75 (25.5)	71.0 (28.0)
Screen viewing height	103.1 (40.6)	118.1 (46.5)	133.1 (52.4)
Screen viewing distance	>30.5 (>12)	>30.5 (>12)	>30.5 (>12)
Screen viewing angle	0-60 degrees	0-60 degrees	0-60 degrees

CAD Operator Preferences

If you work on a CAD system, you may feel more comfortable using the ranges of adjustment shown in Table 6-2.

Table 6-2 Workstation Adjustments Preferred by CAD Users

Adjustments[a]	Mean cm (in.)	Range cm (in.)
Seat pan height	54 (21.3)	50-57 (19.7-22.4)
Work surface height	73 (28.7)	70-80 (27.6 -31.5)
Monitor center above floor	113 (44.5)	107-115 (42.1-45.3)
Screen viewing distance	70 (27.6)	59-78 (23.2-30.7)
Work surface tilt	8.6 degrees	2-13 degrees
Monitor tilt[b]	–7.7 degrees	–15 to +1 degree

a. Derived from Grandjean, Etienne. Ergonomics in Computerized Offices. London: Taylor & Francis Ltd., 1987, p. 148.

b. Negative tilt is a forward monitor inclination (top of screen toward the operator).

Tips for Setting Up and Using Your Workstation

The following tips may be useful for setting up an ergonomic work environment that is safe, comfortable, and productive. Although you may be able to perform this procedure yourself, it is useful to work with a friend to achieve the best fit.

Facilities Selection

1. A good work chair should swivel, and you should be able to adjust the seat height while sitting. The seat should have a rounded front edge. The chair should have a large enough base to remain stable when adjusted to its maximum height. It should have castors or glides. Many chairs rock, which may partially relieve the muscle tension from sitting in a fixed position. Some chairs can also be adjusted for seat tilt and depth, armrest height, backrest angle, and lower back support. Check the chair instructions to take advantage of its adjustability features.
2. Select a work surface that provides enough space to do your work without excessive turning, twisting, or stretching. The height of the work surface should be adjustable, and, if possible, the workspace should be wide enough to use the mouse and keyboard at the same height. This will help your neck, shoulders, and upper arms to stay relaxed while you work.
3. Indirect lighting should be used, whenever possible, to prevent glare on the display screen. If you prefer a lower level of lighting (for example, 200-250 lx) than is usually found in offices, separate task lighting may be needed for reading documents. Wearing dark-colored clothing helps minimize glare reflections on the screen.

Adjusting Your Chair, Work Surface, and Monitor

1. Adjust your chair first, from a seated position if possible. Your lower leg and thigh should form approximately a 90-degree angle at the knee, and your feet should rest flat on the floor. If you are short, you may want to use a footrest for increased comfort.
2. Once your chair is adjusted, raise or lower your work surface to a height that allows you to keep the wrists flat and straight while using the keyboard and mouse. The angle between your lower and upper arm should be 70–90 degrees at the elbow. If necessary, use a padded wrist rest under the keyboard to support your wrists.
3. To minimize screen glare, position your monitor screen perpendicular to overhead lighting sources and windows. Do not set the monitor with its screen or its back facing a window, or parallel to other sources of light. Tilting the top of the screen forward slightly helps avoid glare. Adjusting the monitor controls to minimize brightness and maximize contrast may also reduce the effects of glare.
4. Adjust your monitor height so that your line of sight in your regular seated position is at or near the top of the screen. You should be able to see the whole screen without tilting your head forward or backward, within a 60-degree viewing angle of the normal line of sight. With smaller monitors, this may require using a display stand under the monitor base. With larger monitors, it may require a longer viewing distance (see Table 6-2).

These adjustment steps should be followed each time a different person uses the monitor.

System Usage

1. When using the keyboard, mouse, or other input devices, keep your wrists flat as much as possible, and do not rotate your hands inward toward the thumbs or outward.
2. Electronic keyboards and input devices do not require as much force to operate as manual typewriters. Type lightly on the keyboard and click the mouse gently.

3. Document stands can be mounted on the work surface, or can swing out on an arm to position documents next to the display. These can be helpful in maintaining a healthy posture for using the workstation (head in approximately a straight line with the body).
4. You may find it helpful to take rest breaks of several minutes every one to two hours. During breaks, focus your eyes on objects or scenery at least 30 feet away, stretch, and move around.

Electrostatic Discharge

Silicon Graphics designs and tests its products to be resistant to effects of electrostatic discharge (ESD). ESD is a source of electromagnetic interference and can cause problems ranging from data errors and lockups to permanent component damage.

While you are operating your Challenge deskside system, it is important that you keep all the covers and doors, including the plastics, in place. The shielded cables that came with the system and its peripherals should be installed correctly, with all screws and slide locks fastened securely.

To ensure the proper function and/or data integrity in the front loading devices (FLDs), electrostatic discharge precautions should be taken when removing or replacing the FLDs. An ESD wrist strap should be used, along with antistatic packaging materials, during FLD transport or storage.

Appendix A

Hardware Specifications

The physical, electrical, environmental, and power specifications for the Challenge deskside server chassis are listed in Table A-1.

Table A-1 Challenge Deskside Server Specifications

Parameter	Characteristics
Height	26 inches (65 cm)
Width	21 inches (54 cm)
Depth	29 inches (74 cm)
Weight	195 lbs (89 kg)—minimum
	300 lbs (136 kg)—in shipping carton
Airflow Clearance	Variable; see Table 1-1
Noise Level	60 dB approximate
Electrical Rating	110 VAC or 220–240 VAC
Frequency	47–63 Hz single phase at 110 VAC
	47–63 Hz at 220-240 VAC
Current	16 amps max. at 110 VAC
	13 amps max. at 220–240 VAC
Power Consumption	1500 watts nominal at 110 VAC
	1900 watts nominal at 220-240 VAC
Heat Dissipation – 110 VAC	6500 Btu/hr. max—system chassis
Heat Dissipation – 220-240 VAC	8100 Btu/hr. max—system chassis

Table A-1 (continued) Challenge Deskside Server Specifications

Parameter	Characteristics
AC Receptacle Type	Nema 5-20P for 110 VAC or Nema 6-20P for 220-240 VAC; IEC 30916A/220V 2P/3W International
Operating Temperature	5^{o} to 35^{o}C at sea level
Nonoperating Temperature	-15^{o} to $+65^{o}$C at sea level
Operating Humidity	20 to 80% relative, noncondensing
Nonoperating	10 to 90% relative, noncondensing

Maintaining Drives

This chapter describes how to use and maintain removable media drives. It includes descriptions of front panel lights and switches and instructions on cleaning and maintenance.

Note: Always use digital data grade tapes to store or back up information from your system. Use of a tape intended for audio or video recording may not provide a stable digital recording, and can make it difficult or impossible to retrieve accurate data.

Cleaning the 4-mm DAT and 8-mm Tape Drives

The following are manufacturers' recommended cleaning schedules:

- Clean the 4-mm DAT drive after every 25 hours of use.
- Clean the 8-mm tape drive once per month, or per every 60 GB of data transferred.

When the drive heads are dirty and need cleaning, the units may exhibit read and/or write errors.

To clean a drive, use only an approved cleaning kit. You can use a cleaning kit a limited number of times before you must replace it. For example, you can use the 4-mm drive kit approximately 60 times. Do not use cleaning kits that are intended for use in audio DAT units, since these cassettes are not recognized by the drives covered in this guide.

Archive Python 4320 NT (4 mm DAT Drive)

The Archive Python 4320 NT provides 1.3 GB of storage on a 60-meter DDS DAT cassette, and 2.0 GB of storage on a 90-meter DDS DAT cassette. The 4320 NT drive complies with the American National Standards Institute (ANSI) Digital Data Storage (DDS) format and uses a small DAT with 4-mm tape. The data transfer rate is 183 KB per second. Note that these capacity and transfer rate figures are approximate.

Loading and Unloading Cassettes

Insert the cassette so that the arrow on the top of the cassette enters the drive first. To load a cassette, insert it into the drive and push gently on the middle of the cassette until the tape is fully recessed in the drive unit.

When you load a tape into the drive, the unit checks to see if the tape is initialized. This checking process takes between 10 and 20 seconds. If the tape has never been initialized, the drive will initialize it when you first start to write data to the tape. Initializing the tape takes an extra 30 seconds beyond what is required to write the data.

Note: Do not remove the tape from the drive while it is being initialized. To remove a cassette, press the unload button on the face of the drive. The unit automatically rewinds the tape and ejects it partway. Grasp the cassette and remove it from the drive. Note that the unload button is disabled when the drive is in use.

Removing a Jammed 4-mm Cassette

To remove a 4-mm tape that has jammed in a drive, follow these steps:

1. Power-cycle the tape drive and then try ejecting it.
2. If that does not eject the drive, power-cycle it while holding down the unload button.

If neither of these two steps ejects the jammed cassette, contact your service provider.

Cleaning the 4-mm DAT Drive

To clean a 4-mm DAT drive:

1. Insert the cleaning kit into the drive. The drive automatically detects that the cassette is a cleaning cassette, then loads and runs the cassette. After about 10 to 15 seconds, the cleaning is complete and the drive ejects the cassette.
2. Remove the cleaning cassette from the drive and make a note, either in a log book or on the cassette itself, that you used the cleaning kit.

Front Panel Lights

The 4-mm drive has two LEDs, one green and one yellow, that indicate the status of the unit (see Table B-1).

Table B-1 4-mm DAT Front Panel LED Status Indicators

LED	Action	Meaning
Yellow	On (lit)	The drive is reading or writing the tape (normal operation).
Yellow	Flashing Rapidly	A hardware fault occurred or condensation was detected in the unit (error).
Green	On (lit)	A cassette is loaded in the drive and it does not generate excess errors (beyond a predefined error threshold): this is normal operation.
Green	Flashing Slowly	A cassette is inserted, but is generating excess soft errors (warning: heads may need cleaning).
Green	Flashing Slowly with Yellow LED	A prerecorded audio cassette is inserted and is being played automatically.
Green	Flashing Rapidly	The drive cannot write the tape correctly (error).

Care and Cleaning of the Exabyte 8-mm Tape Drive

Cleaning the tape drive requires use of an Exabyte® 8-mm cleaning cartridge, or one approved by Exabyte.

Caution: Use of cleaning materials not approved by Exabyte may void the tape drive's warranty.

To clean the tape drive:

1. Check to see if an 8-mm tape cartridge is present in the drive. If so, press the unload button and remove the cartridge. Leave the drive's door open.
2. Insert the Exabyte or Exabyte compatible cleaning cartridge and close the drive. The tape drive automatically runs through the 15-second cleaning cycle. The cleaning tape is automatically ejected when the cleaning is complete.

   Note: If the cleaning cartridge is ejected from the drive before the 15-second cleaning cycle ends, the cartridge has reached the maximum number of cleaning cycles and should be discarded. Do not rewind the cleaning cartridge or use it for more than its specified number of cleaning cycles.
3. Remove the cleaning cartridge from the drive, record the date on the label, and store it for future use.

Front Panel Lights

The 8-mm tape drive has two front panel lights: a yellow LED and a green LED. In general, the green LED indicates whether or not the drive is ready to accept commands, and the yellow LED indicates that the drive is busy or an error has occurred. See Table B-2.

Table B-2 8-mm Tape Drive Front Panel Status Indicators

Yellow LED	Green LED	Meaning and Corrective Action
On	On	Power-on initialization—approximately 60 seconds.
Off	Off	Passed power-on self tests.
Off	On	Tape is loaded, drive is ready.
Off or On	Slow Flashing	The drive is reading or writing a tape (normal operation).
On, Off, or Flashing	Flashes four times, then stays On	Servo error; press the unload button to reset the drive. If this does not clear the problem, power-cycle the drive. If the problem persists, call your service provider.
Slow Flashing	On or Off	A CRC error occurred within the first two seconds of a power-on reset. Power-cycle the drive. If the problem persists, the drive needs service.
Slow Flashing	On or Off	An unrecoverable fault has occurred during operation. Press the unload button to reset the drive. If this does not correct the problem, power-cycle the unit and clean the tape heads. If these steps fail, call your service provider.
Fast Flashing	Off	The drive failed a power-on self-test; try power-cycling the drive. If the problem persists, the drive needs service.

Removing a Jammed 8-mm Tape Cartridge

To remove a tape that has jammed in an 8-mm tape drive, follow these steps:

1. Power-cycle the tape drive and then try ejecting it.
2. If that does not eject the drive, power-cycle it while holding down the unload button.

If neither of these two steps ejects the jammed cassette, contact your service provider.

CD-ROM Care and Maintenance

CD-ROM drives are most vulnerable to damage when they are unpacked and not yet mounted in a computer system. When handling a drive after unpacking, there are two major types of damage to be aware of:

- rough handling (impact damage)
- electrostatic discharge (ESD)

Dropping an unpacked drive onto a hard surface can cause damage. A sharp jolt can cause the laser to track improperly.

Avoid touching the drive's printed circuit board (PCB). Leave the unit in ESD protective wrap as long as possible. Use a static-conductive mat and/or antistatic grounding devices when inspecting or handling the drive. Additional handling tips are given below:

1. Keep the drive in the packing box or antistatic bag until the installation.
2. Handle the drive by its frame; avoid touching the drive's PCB.
3. Install drives in a clean work area.

To remove dust or other particles from a CD, use a blast of air. You may also clean the CD in running water and then blot it dry with a soft, lintless cloth (do *not* use a paper towel). Wipe the cloth directly outward from the center of the disc. Do not rub in a circular motion as you would with a standard phonograph record.

Note: Never use solvents or other common cleaners, and *do not* use your mouth to blow dust or other particles off the disc.

Individual discs should be handled by the edges only (see Figure B-1). Touching or scratching the bottom of the disc can mar the finish and degrade the optical readability of the media. Do not write, label, or mark on any surface of the compact disc. An auto-eject occurs when a very dirty or badly scratched disc is inserted. A disc placed in the operating case (also known as the caddy) label side down also causes an auto-eject.

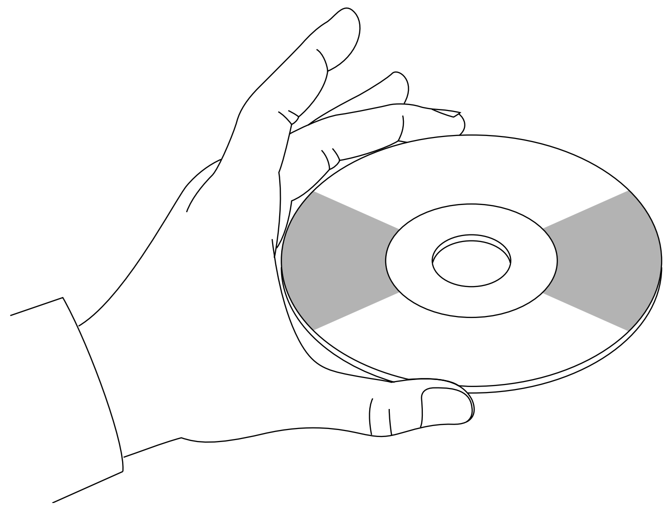

Figure B-1 Handling a Compact Disc

CD-ROM Environmental Considerations

Bringing a disc from a cold to a warm environment may cause moisture to form on its surface. Wipe any condensed moisture off with a soft lint-free cloth (not a paper towel) before use. Allow approximately one hour for the disc to acclimate to room temperature.

Protect the discs from dust, scratches, and warping by storing them in a caddy or nonfunctional plastic storage container (known as a jewel case). Never leave or store discs in the following areas:

- locations exposed to direct sunlight
- dusty or humid environments
- areas directly exposed to heating appliances or heat outlets
- a vehicle parked in the sun

CD-ROM Front Panel Operational Features

A number of operational items are located on the front panel of the CD-ROM drive:

- The *headphone jack* receptacle accepts a 3.5-mm diameter stereo plug. Monitoring of audio signals is available.
- Use the *volume control dial* (located to the right of the headphone jack) to adjust the sound level of the headphones.
- An *emergency eject hole* is located just above the volume control. It is used to eject the caddy when the normal procedure does not work. Power off the CD-ROM drive and remove the Phillips-head screw from the hole. Insert the end of a large, straightened paper clip into the hole until the caddy ejects.
- A *drive busy indicator LED* is located to the left of the eject button. When this LED is blinking, it indicates drive activity. The LED stays dark when no disc caddy is loaded in the drive. See Figure B-2 for details on blink patterns and the status they indicate for the drive.
- The *eject button* works *only* when the CD-ROM drive is powered on. The caddy will not eject if the CD-ROM is in an active (busy) state. After pushing the eject button, two to three seconds will elapse before release occurs.

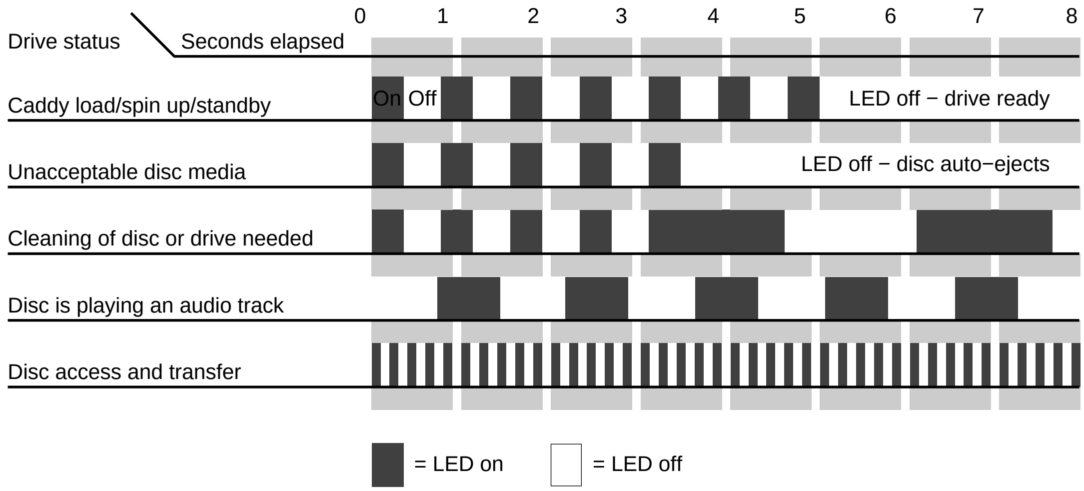

Figure B-2 CD-ROM Drive LED Status Indicators

150 MB Tape Drive Preventive Maintenance

Head cleaning is the only preventive maintenance required by the 1/4-inch tape drive. The tape head should be cleaned after every eight hours of tape drive operation, and after every two hours of operation when new tapes are used exclusively.

Note: The head cleaning procedure must be routinely done every two to eight hours of operation to ensure that the tape drive continues to function correctly.

Clean the tape head by following these steps:

1. Remove the tape cartridge from the tape drive.
2. Push the head loading lever to the right, as if you had installed a tape. This engages the tape head, allowing you to reach it.
3. Dip a clean, nonfibrous cotton swab in either tape head cleaning fluid or Freon-TF, and wipe the tape head (see Figure B-3).
4. Use a second, clean swab and wipe the head again to remove any residue.

Do not use wooden-stemmed cotton swabs; the tip of the swab can break off and become lodged in the tape drive.

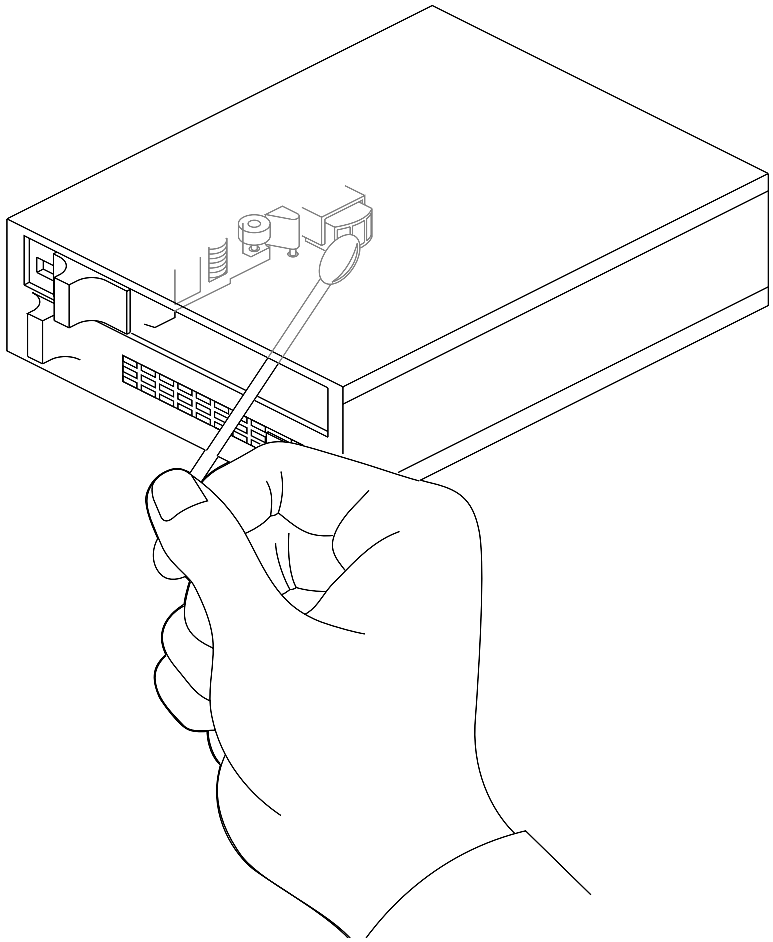

Figure B-3 Cleaning the Tape Head

Digital Linear Tape Maintenance

The Digital Linear Tape (DLT) drive is a high-performance, high-capacity, 1/2-inch streaming cartridge tape product designed for use on midrange and high-end computing systems. Using data compression and compaction, the DLT drive features a potential formatted capacity of 10-20 GB (depending on data compression capabilities) and a sustained user data transfer rate of up to 2.5 MB per second.

To clean a drive, use only an approved cleaning cartridge (see Figure B-4). You can use a DLT cleaning cartridge approximately 20 times before you must replace it. The cleaning cartridge and data cartridges are always different colors.

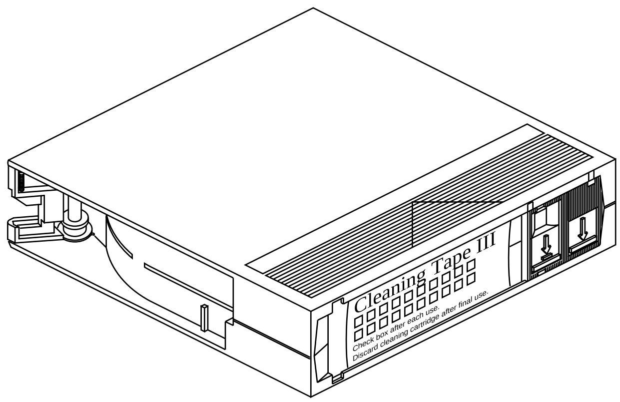

Figure B-4 DLT Cleaning Cartridge

Loading a Cleaning Cartridge

To clean a DLT drive:

1. Load the cleaning cartridge into the drive and close the handle. The drive automatically detects that the cartridge is a cleaning cartridge; it buzzes, then loads and runs the cartridge. After about 1.5 minutes, the cleaning is complete and the “tape in use” LED glows steadily.
2. When the cleaning cycle is finished, press the “unload” button and wait for the green “operate handle” LED to light before opening the handle.
3. Remove the cartridge from the DLT unit.
4. Make a note in a log book, or on the cartridge itself, that you used the cleaning cartridge.

Note: Do not attempt to remove the tape from the drive while it is going through the cleaning cycle.

DLT Tape Cartridge Care and Handling

To help your DLT cartridges last as long as possible, store them in a clean environment. Follow these guidelines for storing and using the tapes:

- Always store a cartridge in its plastic container in a room environment between 50-104^{o}F (10-40^{o}C).
- Keep the tape cartridges out of direct sunlight and away from artificial heat sources.
- Stabilize the tape if it has been exposed to extreme heat or cold by leaving it at operating room temperature for the same period of time (up to 24 hours).
- Store tape cartridges in a dust-free environment with the relative humidity between 20% and 80%.
- Place identification labels only in the slide-in slot on the front of the tape cartridge. Do not use adhesive tapes or labels.

Please observe the following precautions when handling or storing a tape:

- Do not drop or bang the cartridge on any hard surface. You may displace the tape leader, make the cartridge unusable, and/or cause damage to the DLT drive.
- Never place or store cartridges near electromagnetic sources such as terminals, electric motors, or video or X-ray equipment. Data on a tape may be altered or corrupted if it is placed in such an environment.
- Do not leave a cartridge in a vehicle parked in the sun.

Removing a Jammed Tape Cartridge

The following instructions are intended to help you if a tape cartridge becomes jammed in the DLT and will not unload. In the case of a stacker that fails to unload, note that a full magazine precludes the tape from unloading. Before calling your service provider, you should try the following:

1. Power the unit off and then on again, and then try pushing the unload button again.
2. Power the unit off and on again while pressing on the unload button.

If these steps fail, contact your system administrator or service provider for assistance.

System Controller Messages

Tables C-1 through C-4 list messages that can appear in the System Controller's event history log.

Table C-1 System Events—Immediate Power-Off

Error Message	Failure Area/Possible Solution
POKA FAIL	The System Controller detects a power supply fault and initiates the power-off sequence (except 48 V).
POKB FAIL	Same as above.
POKC FAIL	Same as above.
POKD FAIL	Same as above.
POKE FAIL	The System Controller detects a power supply fault. The condition is logged but no power-off sequence is initiated.
BRD/CHASSIS OVR TEMP	The System Controller detects an over-temperature condition and initiates a power-off sequence.
POWER FAIL WARNING	The System Controller detects an AC power failure.
NO SYSTEM CLOCK	The System Controller could not detect a system clock on the backplane/midplane, and initiates a power-off sequence.
1.5V OVER VOLTAGE	The System Controller detects a power supply fault and initiates a power-off sequence. The System Controller will not turn power on until the operator selects "MENU - System Log." This process guards against overvoltage damage by forcing the operator to examine the System Event Log.
5VDC OVER VOLTAGE	Same as above.

Table C-1 (continued) System Events—Immediate Power-Off

Error Message	Failure Area/Possible Solution
12VDC OVER VOLTAGE	Same as above.
-5.2VDC OVER VOLTAGE	Same as above.
-12VDC OVER VOLTAGE	Same as above.
48VDC OVER VOLTAGE	Same as above.
1.5VDC UNDER VOLTAGE	The System Controller detects a power supply fault and initiates the power-off sequence.
12VDC UNDER VOLTAGE	Same as above.
-5.2VDC UNDER VOLTAGE	Same as above.
-12VDC UNDER VOLTAGE	Same as above.
48VDC UNDER VOLTAGE	Same as above.
1.5VDC HIGH WARNING	The System Controller detects a voltage out of range. The condition is logged but no power-off sequence is initiated.
1.5VDC LOW WARNING	Same as above.
5VDC HIGH WARNING	Same as above.
5VDC LOW WARNING	Same as above.
12VDC HIGH WARNING	Same as above.
12VDC LOW WARNING	Same as above.

Table C-1 (continued) System Events—Immediate Power-Off

Error Message	Failure Area/Possible Solution
-5.2VDC HIGH WARNING	Same as above.
-5.2VDC LOW WARNING	Same as above.
-12VDC HIGH WARNING	Same as above.
-12VDC LOW WARNING	Same as above.
48VDC HIGH WARNING	Same as above.
48 VDC LOW WARNING	Same as above.
POWER CYCLE	The System Controller receives a command to perform a power-off, followed by a power-on, from the System Controller serial port.

Table C-2 System Events—Delayed Power-Off

Error Message	Failure Area/Possible Solution
AMBIENT OVER TEMP	The System Controller detects an over-temperature condition. An alarm is sent to the CPU; five seconds later, the System Controller initiates the power-off sequence.
BLOWER A FAILURE	The System Controller detects a fan problem. An alarm is sent to the CPU; five seconds later, the System Controller initiates the power-off sequence (rackmount systems only).
BLOWER B FAILURE	Same as above (rackmount systems only).
BLOWER FAILURE	Same as above (deskside systems only).

Table C-2 (continued) System Events—Delayed Power-Off

Error Message	Failure Area/Possible Solution
BLOWER A RPM FAIL	The System Controller detects a fan not at speed. An alarm is sent to the CPU, five seconds later the System Controller initiates the power-off sequence (rackmount systems only).
BLOWER B RPM FAIL	Same as above (rackmount systems only).
BLOWER RPM FAILURE	Same as above (deskside systems only).
TEMP SENSOR FAILURE	The System Controller detects a temperature sensor with a reading so far out of range that the sensor is assumed to have failed. The condition is logged but no power-off sequence is initiated.
FP BUTTON STUCK	The System Controller detects a status panel button stuck in the depressed position. After a 30-second wait, the power-off sequence is initiated (the depressed button interferes with the System Controller's normal monitoring operation.

Table C-3 System Events—Informative

Error Message	Error Meaning
SYSTEM ON	The System Controller reports the power-on sequence completed.
SYSTEM OFF	The System Controller reports the power-off sequence completed.
SYSTEM RESET	The System Controller generates a backplane reset, due to menu selection or serial port request.
NMI	The System Controller generates a backplane NMI, due to menu selection.
SCLR DETECTED	The System Controller detects a backplane reset, then initiates the bootmaster arbitration process.

Table C-3 (continued) System Events—Informative

Error Message	Error Meaning
BOOT ERROR	System Controller bootmaster arbitration could not find any host CPU responding on the serial bus. The System Controller is not able to communicate with the host CPU. The host CPU may not be running or may continue to boot normally.
INVALID CPU COMMAND	The System Controller detects bad command syntax from the host CPU on the Serial Bus. The command is ignored.

Table C-4 Internal System Controller Error Messages

Error Message	Error Meaning
BAD ALARM TYPE	The firmware attempted to send an invalid alarm to the CPU.
BAD MSG: CPU PROCESS	The CPU or System Controller process received an invalid message.
BAD MSG: DISPLAY	The display process received an invalid message.
BAD MSG: POK CHK	The power ok check process received an invalid message.
BAD MSG: SEQUENCER	The sequencer process received an invalid message.
BAD MSG: SYS MON	The system monitor process received an invalid message.
BAD WARNING/ALARM	The routine that decodes alarm and warning messages detected an invalid message.
BAD WARNING TYPE	The firmware attempted to send an invalid warning to the CPU.

Table C-4 (continued) Internal System Controller Error Messages

Error Message	Error Meaning
COP FAILURE	The Computer Operating Properly (COP) timer exceeded time limits. The System Controller firmware must write to a COP timer port before it times out. If the firmware exceeds the time allowed between writes to a COP port, an interrupt is generated. The System Controller firmware may have entered an endless loop.
COP MONITOR FAILURE	A Computer Operating Properly (COP) clock monitor failure was detected. The System Controller clock oscillator is operating at less than 10 KHz.
DEBUG SWITCH ERROR	The System Controller detected data corruption in the nonvolatile RAM debug switch location.
FP CONTROLLER FAULT	An error was detected in the front panel LCD screen control process.
FP READ FAULT	A read of the front panel status register did not complete successfully.
FREE MSG NODE ERROR	The free message node queue overflowed.
FREE TCB NODE ERROR	The free timer control block queue overflowed.
ILLEGAL OPCODE TRAP	The System Controller's microprocessor tried to execute an illegal instruction, probably because of a stack overrun followed by a process switch.
PULSE ACCU INPUT	An interrupt was detected on the pulse accumulator input port. The port is not used and an interrupt is treated as an error.
PULSE ACCU OVERFLOW	The pulse accumulator overflow port received an interrupt. This port is unused and the interrupt is treated as an error.
SPI TRANSFER	An interrupt was detected on the synchronous serial peripheral interface. This interface is not supported and the interrupt is treated as an error.

Table C-4 (continued) Internal System Controller Error Messages

Error Message	Error Meaning
STACK FAULT PID 0–6	One of the seven stack areas used by a System Controller process overflowed its assigned boundaries.
TEMP SENSOR FAILURE	The System Controller detected an invalid measurement from the temperature sensor.
TIMER IN COMP 1	The timer input compare port received an interrupt. The port is not used and the interrupt is treated as an error.
TIMER OUT COMP 1–5	One of the five timer output compare ports received an interrupt. The port is not supported and the interrupt is treated as an error.
XMITTER 1 TIMEOUT	The System Controller's 1st UART experienced a failure.
XMITTER 2 TIMEOUT	The System Controller's 2nd UART experienced a failure.

Challenge IO4 PROM, Mezzanine, and Troubleshooting

This appendix supplies information about the Challenge IO4 PROM (programmable read-only memory) Command Monitor. This information is separated into hardware configuration commands, environment variables, and known bugs. Basic mezzanine board configurations on the IO4 and troubleshooting tips are also covered.

Hardware Configuration Commands

The IO4 PROM allows you to examine and modify the hardware configuration of your system using a variety of commands.

Checking and Updating the Hardware Inventory

When the system first powers on, the IO4 PROM automatically examines all of the installed boards to determine if any of the components have failed. During this process, the IO4 PROM reads a copy of the system's hardware inventory from nonvolatile RAM and compares it to the system's current configuration. If there are differences between the current and stored hardware inventories, the IO4 PROM inventory checker will generate a warning message. When a difference is detected during this comparison of the hardware inventory, the PROM pauses to allow you to examine the error messages. In the following example, the PROM detected a missing processor on a CPU board:

```
Checking inventory...
*** Slice 1 on the IP19 in slot 2 isn't visible
Press <Enter> to continue
```

If system uptime is critical (for example, if your system is the central server) and operators are not available around the clock, you may not want the

PROM to wait for operator intervention when the inventory checker notices a problem. You can configure the system so that it continues to boot in spite of nonterminal failures by setting the *nonstop* environment variable (see the "Environment Variables" section that follows).

Because the PROM's hardware inventory checker cannot detect the difference between missing and broken hardware, you must explicitly update the system's hardware inventory whenever you change the system configuration. Update the hardware inventory as follows:

1. Enter the PROM Command Monitor by selecting the "Enter Command Monitor" option from the PROM menu.
2. When the PROM Command Monitor prompt (>>) is displayed, type **`update`** and press **`<Enter>`**. This tells the PROM that the system's current hardware configuration is correct.
3. Type **`reset`** and press **`<Enter>`** to reset your machine.

If you see error messages when there have been no modifications to the system's hardware inventory, you may be experiencing a component failure. Call your service provider and do not update the hardware inventory until a field engineer has examined the system.

Displaying Information About the Current Hardware Configuration

Display a list of the boards currently installed in your system by typing **`hinv -b`**. The "`-b`" causes bus-specific information to be displayed. The "`-v`" (verbose) option, when used in conjunction with "`-b`" causes more detailed information about the boards to be displayed. For example, typing

```
hinv -b -v <Enter>
```

displays the configuration of all of the processors, memory banks, and I/O adapters in the system.

POD (Power-On Diagnostics) Mode

In the unlikely event of an extreme hardware failure, the system may drop down into a low-level diagnostic environment known as POD mode. This mode is used as an aid to system diagnosis and is not intended for use by customers. If your system enters POD mode, contact your service provider.

Environment Variables

This section describes procedures that you can use to customize certain aspects of the PROM Command Monitor. Many aspects of the system startup process can be individually tailored by changing the PROM environment variables. These variables are changed using the *setenv* command while in the Command Monitor. Enter the Command Monitor by first selecting the “Stop for System Maintenance” option during the system startup. When the System Maintenance menu is displayed, enter the Command Monitor by typing **5**.

Some common modifications are described in the following subsections. Additional information is provided in the prom(1M) reference (man) page.

Booting From an Alternate Device

There are three environment variables in the PROM that are used to specify which device to boot from: the “SystemPartition,” the “OSLoadPartition,” and the “root” variable.

The “SystemPartition” variable specifies the location of the device volume header. Its default value is “dksc (0,1,8),” which specifies SCSI controller 0, disk 1, and partition 8 (by convention, the volume header is always partition 8).

The “OSLoadPartition” variable specifies the device from which the IRIX kernel should be loaded. Its default value is “dksc (0,1,0),” which tells the PROM to look for the kernel on SCSI controller 0, disk 1, on partition 0 (by convention, the kernel location is always partition 0).

The root variable tells IRIX the name of the device that holds the root filesystem. Because this variable is used by IRIX, rather than by the PROM, its format is different from the “SystemPartition” and “OSLoadPartition” variables. The default value for root is “dks0d1s0,” which specifies that the root filesystem is stored on SCSI controller 0, disk 1, on partition 0.

The following three examples show you what the command line looks like when you change the boot device.

To boot from disk number 2 on controller 0, enter the following:

```
setenv     SystemPartition dksc (0,2,8)
setenv     OSLoadPartition dksc (0,2,0)
setenv     root dks0d2s0
```

To boot from disk number 1 on controller 1, enter the following:

```
setenv     SystemPartition dksc (1,1,8)
setenv     OSLoadPartition dksc (1,1,0)
setenv     root dks1d1s0
```

To boot from disk number 3 on controller 2, enter the following:

```
setenv     SystemPartition dksc (2,3,8)
setenv     OSLoadPartition dksc (2,3,0)
setenv     root dks2d3s0
```

Starting the System Automatically

Each time the system is powered on, the PROM pauses briefly before starting the operating system. If the “Stop for System Maintenance” option is not selected, or if the <Esc> key is not pressed, the system loads the operating system from memory and begins to execute it. Setting the environment variable *autoload* to “yes” enables this feature. Setting *autoload* to “no” inhibits the automatic startup and causes the PROM to display the System Maintenance menu after running the power-on diagnostics.

Allowing the System to Boot in Spite of Nonterminal Hardware Failures

By default, the PROM stops and generates a warning message if it finds that a component has failed. However, the failure of a single processor or bank of memory may not be serious enough to prevent the system from coming up. To prevent a nonfatal hardware problem from stopping the system, set the *nonstop* variable to 1:

```
setenv nonstop 1
```

To ensure that the system displays a notification message in the event of any hardware failure, set the *nonstop* variable to 0:

```
setenv nonstop 0
```

Restoring Defaults

The PROM environment variables can be reset to their factory defaults by using the *resetenv* command while in the PROM Command Monitor. Since *resetenv* also resets the *netaddr* environment variable, note the machine's IP address before using this command.

Known Bugs

The following subsections describe all of the known IO4 PROM bugs. Since the IO4 PROM is software-writable, these bugs will be fixed by PROM updates in future releases of the operating system.

A Spurious CD-ROM Medium Is Displayed During Startup

A bug in the CD-ROM volume size code causes the SCSI driver to display an erroneous “No Medium Found” message if the CD-ROM caddy is empty when the system is booted. This message can be ignored.

Disk Formatting Fails Using Standalone fx

Systems running IRIX release 5.2 or earlier have a PROM problem that causes failure to format in the standalone version of *fx*. The PROM's SCSI driver improperly calculates the duration of timeout requests and the PROM times out prematurely. This terminates the formatting process before completion and leaves the disk in a corrupt state. In this case, attempts to read or write the disk will fail.

Always use the IRIX version of *fx* when formatting disks if the system is running operating system release 5.2 or earlier.

If the disk has been corrupted by use of the standalone *fx* process, it can be repaired by reformatting using the IRIX version of *fx*.

Mezzanine Board Configurations

Each Challenge deskside system comes with one standard IO4 interface board. See Chapter 1 for a technical overview of the IO4. The first IO4 in the system always supports either the VME Channel Adapter Module (VCAM) board or the Graphics Channel Adapter Module (GCAM) board.

If you are unsure of the system's hardware configuration, enter the *hinv* command at the console. You should see something similar to the following:

```
% hinv <Enter>
2 75 MHZ IP21 Processors
CPU: MIPS R8000 Processor Chip Revision: 2.1
FPU: MIPS R8010 Floating Point Chip Revision: 0.1
Data cache size: 16 Kbytes
Instruction cache size: 16 Kbytes
Secondary unified instruction/data cache size: 4 Mbytes
Main memory size: 256 Mbytes, 2-way interleaved
I/O board, Ebus slot 5: IO4 revision 1
Integral EPC serial ports: 4
Integral Ethernet controller: et0, Ebus slot 3
Integral SCSI controller 2: Version WD33C95A
Tape drive: unit 6 on SCSI controller 2: DLT
Integral SCSI controller 1: Version WD33C95A
Disk drive: unit 1 on SCSI controller 1
Graphics board: GU1-Extreme
```

```
CC synchronization join counter
Integral SCSI controller 0: Version WD33C95A
Disk drive: unit 4 on SCSI controller 0
Disk drive: unit 3 on SCSI controller 0
Disk drive: unit 2 on SCSI controller 0
Disk drive: unit 1 on SCSI controller 0
VME bus: adapter 0 mapped to adapter 3
VME bus: adapter 3
Integral IO4 parallel port: Ebus slot 5
```

Note: The GCAM board is used only on POWER Challenge systems that have the visualization console (Extreme) option installed.

Each system is slightly different, but all systems have at least one IO4 installed. The number of IO4s installed in your system determines the number of HIO mezzanine option boards it can support. It also determines the type of mezzanine options you can order. The VCAM or GCAM on the first IO4 precludes you from using "long" mezzanine boards. Long mezzanine boards stretch nearly to the backplane and do not fit on the IO4 when a VCAM or GCAM is installed. Table D-1 describes some of the HIO mezzanine option boards and their lengths.

Table D-1 Optional Mezzanine Board Descriptions

Board Name	Size	Number of Connectors
Flat Cable Interface	Long	2
Flat Cable Interface	Short	1
Three-Channel SCSI	Short	3

Mezzanine Options Available With One IO4

Figure D-1 shows the two possible configurations of the Challenge equipped with a single IO4. In the standard server configuration, the IO4 uses a VCAM and the IO4 may use up to two optional short mezzanine boards. With the POWER Challenge visualization console option and graphics, use of the GCAM allows only one optional short mezzanine board.

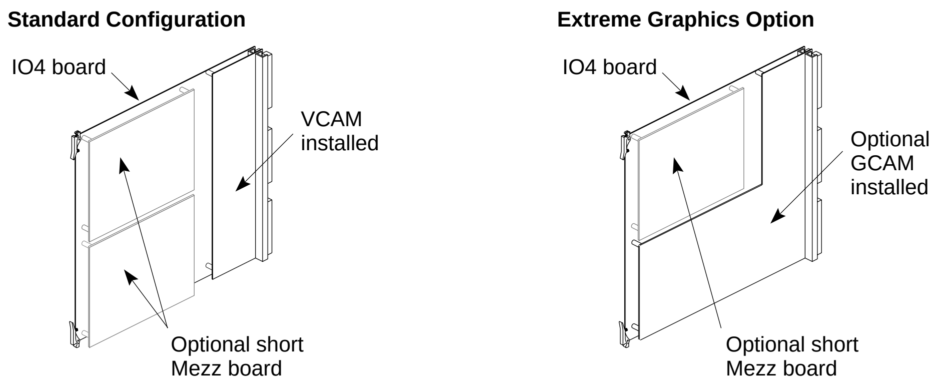

Figure D-1 IO4 With VCAM and GCAM

Mezzanine Options Available With Two IO4s

You can always have one or two short optional mezzanine boards installed on the primary IO4. This is determined by whether you have the visualization console option installed in your POWER Challenge system. When you order a second optional IO4 you can choose the option of having one of the following mezzanine configurations installed:

- up to two long mezzanine option boards
- up to two short mezzanine option boards
- one long and one short mezzanine option board

Figure D-2 shows the optional second IO4 and the potential configurations for additional optional mezzanine boards that might be installed.

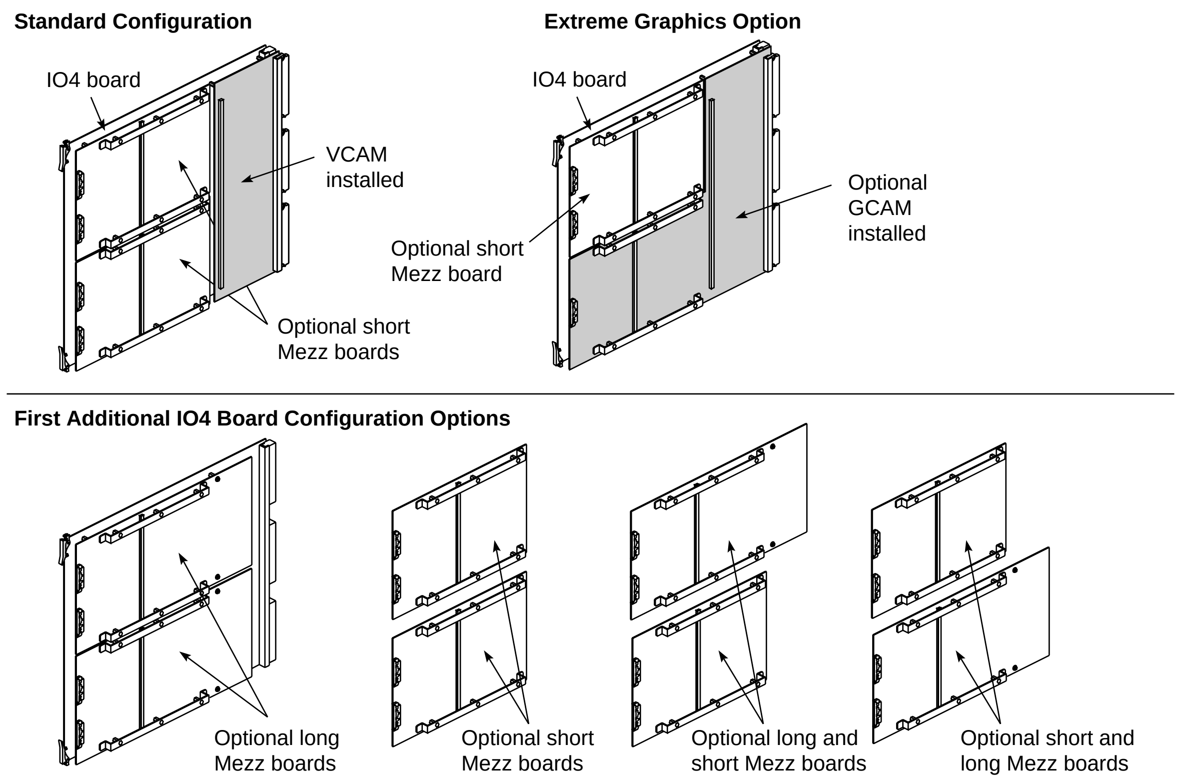

Figure D-2 Mezzanine Types Available With Optional Second IO4

Mezzanine Options Available With Three IO4s

You can have one or two short optional mezzanine boards installed on the primary IO4. When you order a third optional IO4 you can choose the option of having one of the following mezzanine configurations installed:

- up to two long mezzanine option boards
- up to two short mezzanine option boards
- one long and one short mezzanine option board

Figure D-3 shows both optional IO4s and the potential configurations for additional optional mezzanine boards that might be installed.

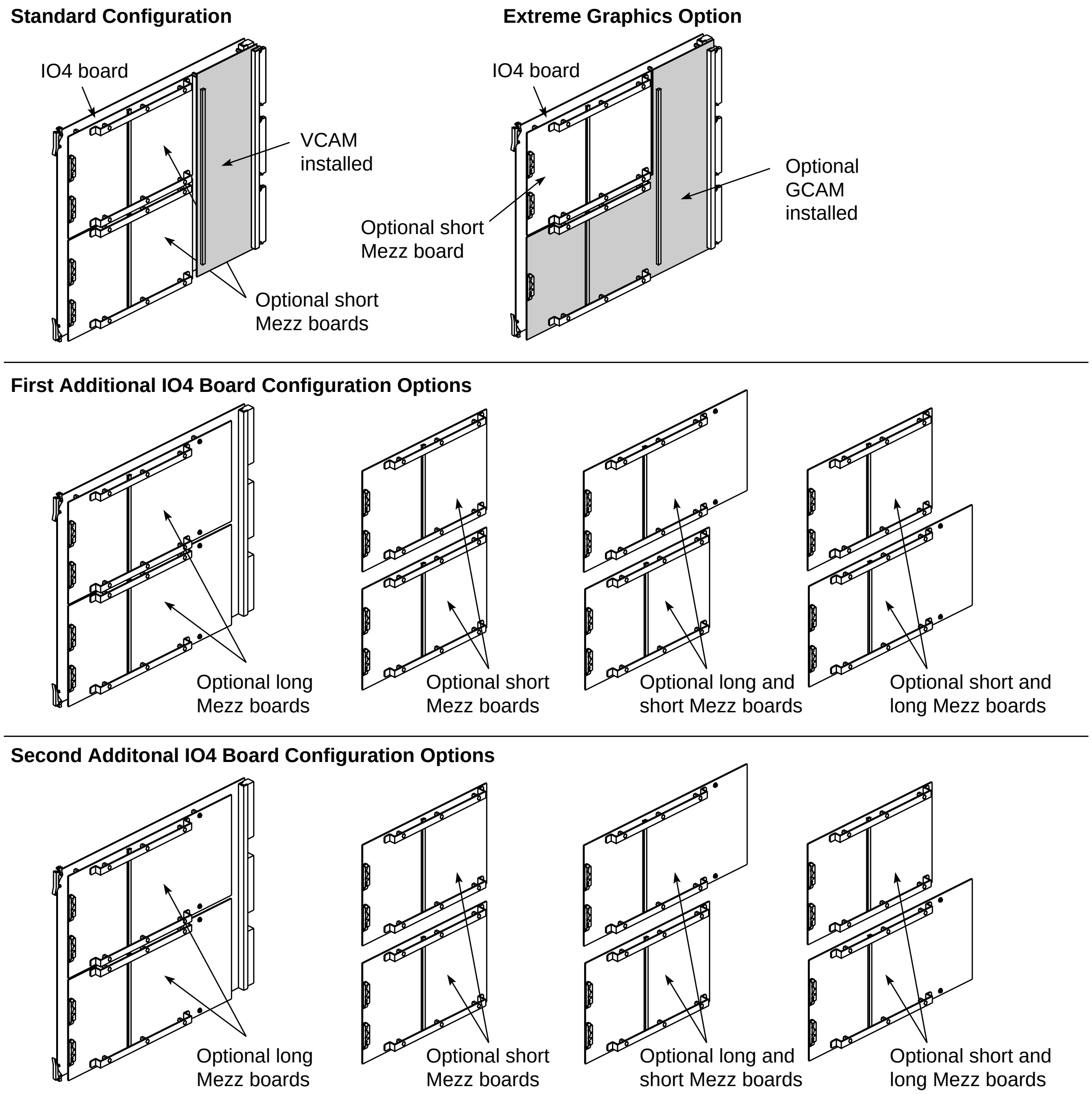

Figure D-3 Optional Second and Third IO4 Configuration

IO4 Troubleshooting

There are a number of troubleshooting steps you can use to identify if the IO4 is the cause of system level faults. Always check for loose connections or damaged cables when trouble with IO4 peripherals occurs.

Never plug the Ethernet connector in while the system is powered on. This action may result in a current surge that blows a fuse on the I/O adapter or IO4. Symptoms resulting from this problem include:

- Ethernet not working
- keyboard and mouse not working
- powered peripheral ports not working

This problem requires a visit from a trained field service engineer.

There is no mechanical connection available for the RS-422 connector on an optional second or third IO4.

Ethernet and RS-232 connectors connected to additional optional IO4 boards may need to be initialized to work properly after installation. See “Enabling Additional Serial Ports” in Chapter 2 for an example of how this is done.

Additional parallel printer ports on optional IO4s may also need to be initialized before they will work properly. For information on this topic see “Parallel Printer Ports” in Chapter 2.

Appendix E

VMEbus Implementation

The VME (versa modular European) interface in the Challenge and POWER Challenge system supports all protocols defined in Revision C of the VME specification, plus the A64 and D64 modes defined in Revision D. For the acceptable VME address ranges, read the */var/sysgen/system/irix.sm* file. Unless otherwise stated, the term Challenge refers to both the Challenge and POWER Challenge systems.

Note: The Challenge system does not support VSBbus mode.

Warning: All board installations or removals should be performed *only* by personnel certified by Silicon Graphics. Unauthorized access to the cardcage area could result in system damage, or possible bodily harm, and could void the warranty for the system.

This appendix provides information to help users integrate third-party VME boards into the Challenge and POWER Challenge deskside systems.

The following information is divided into three major sections:

- "VMEbus Architecture and Interface" provides a detailed discussion of the VMEbus architecture in the Challenge system. This section also briefly describes the overall bus structure, VME interrupt generation, and address mapping.
- "Hardware Considerations"discusses pertinent physical and electrical requirements and issues such as the required board dimensions, available power, airflow, VME pins assignments, the VME slots, and VME backplane jumpering.
- "VMEbus Boards Design Considerations" provides third-party VME board design considerations and guidelines.

Note: This appendix primarily provides VMEbus hardware-related information. For software-related information on VMEbus implementation, consult the *IRIX Device Driver Programmer's Guide* (P/N 007-0911-*xxx*).

VMEbus Architecture and Interface

The VMEbus interface circuitry for the Challenge and POWER Challenge systems resides on a mezzanine board called the VMEbus Channel Adapter Module (VCAM) board. The VCAM board is standard in every system and mounts directly on top of the IO4 board in the system card cage (see Figure E-1). The VCAM is located on the master IO4 (in slot 3).

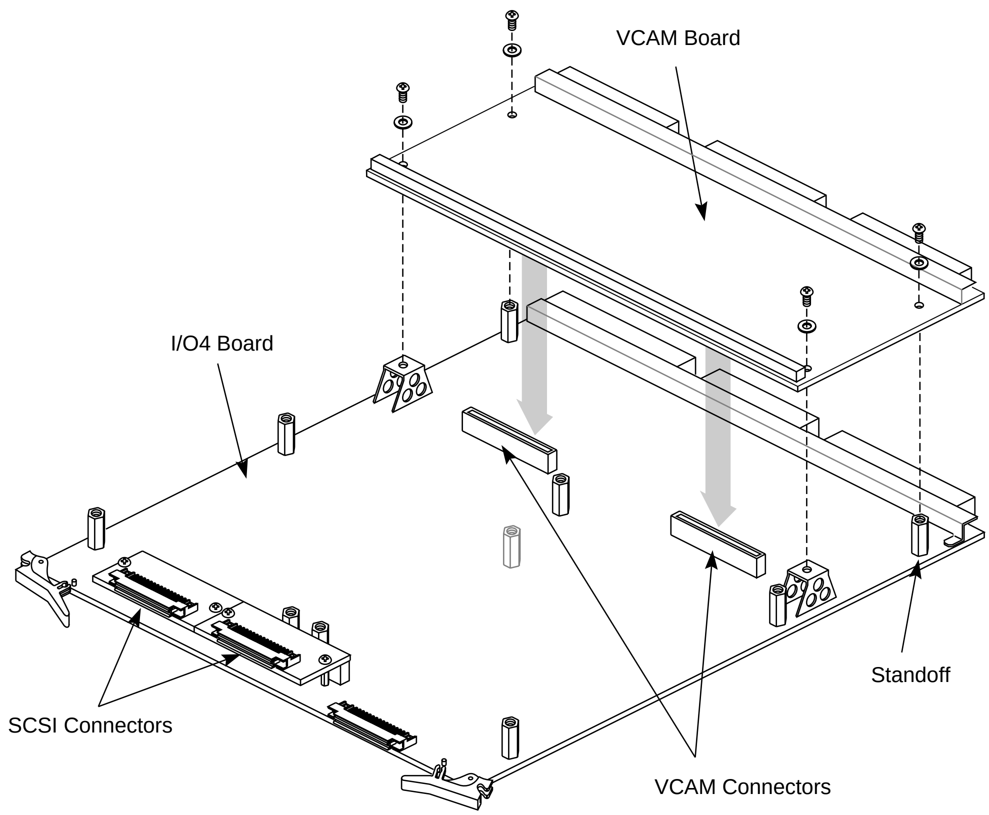

Figure E-1 Placement of the VCAM Board on the IO4 Board

The IO4 board is the heart of the I/O subsystem. It supplies the system with a basic set of I/O controllers and system boot and configuration devices such as serial and parallel ports, and Ethernet.

In addition, the IO4 board provides these interfaces:

- two Flat Cable Interconnects (FCIs) for VME connection
- two SCSI-2 cable connections
- two Ibus connections

See Figure E-2 for a functional block diagram of the IO4 board.

System Bus Architecture

This section describes the bus structure of the system.

Main System Bus

The main set of buses in the Challenge/Onyx system architecture is the Everest address and data buses (Ebus for short). The Ebus provides a 256-bit data bus and a 40-bit address bus that can sustain a bandwidth of 1.2 GB per second.

The 256-bit data bus provides the data transfer capability to support a large number of high-performance RISC CPUs. The 40-bit address bus is also wide enough to support 16 GB of contiguous memory in addition to an 8 GB I/O address space.

Ibus

The 64-bit Ibus (also known as the HIO bus) is the main internal bus of the I/O subsystem and interfaces to the high-power Ebus through a group of bus adapters.The Ibus has a bandwidth of 320 MB per second that can sufficiently support a graphics subsystem, a VME64 bus, and as many as eight SCSI channels operating simultaneously.

Bus Interfacing

Communication with the VME and SCSI buses, the installed set or sets of graphics boards, and Ethernet takes place through the 64-bit Ibus (see Figure E-2). The Ibus interfaces to the main system bus, the 256-bit Ebus, through a set of interface control devices, an I address (IA) and, four I data

(ID) ASICs. The ID ASICs latch the data, and the IA ASIC clocks the data from each ID to the flat cable interface (FCI) through the F controller (or F chip).

Two FCI controllers (or F controllers) help handle the data transfers to and from an internal graphics board set (if applicable) and any VMEbus boards in optional CC3 applications. The SCSI-2 (S1) controller serves as an interface to the various SCSI-2 buses. The Everest peripheral controller (EPC) device manages the data movement to and from the Ethernet, a parallel port, and various types of on-board PROMs and RAM.

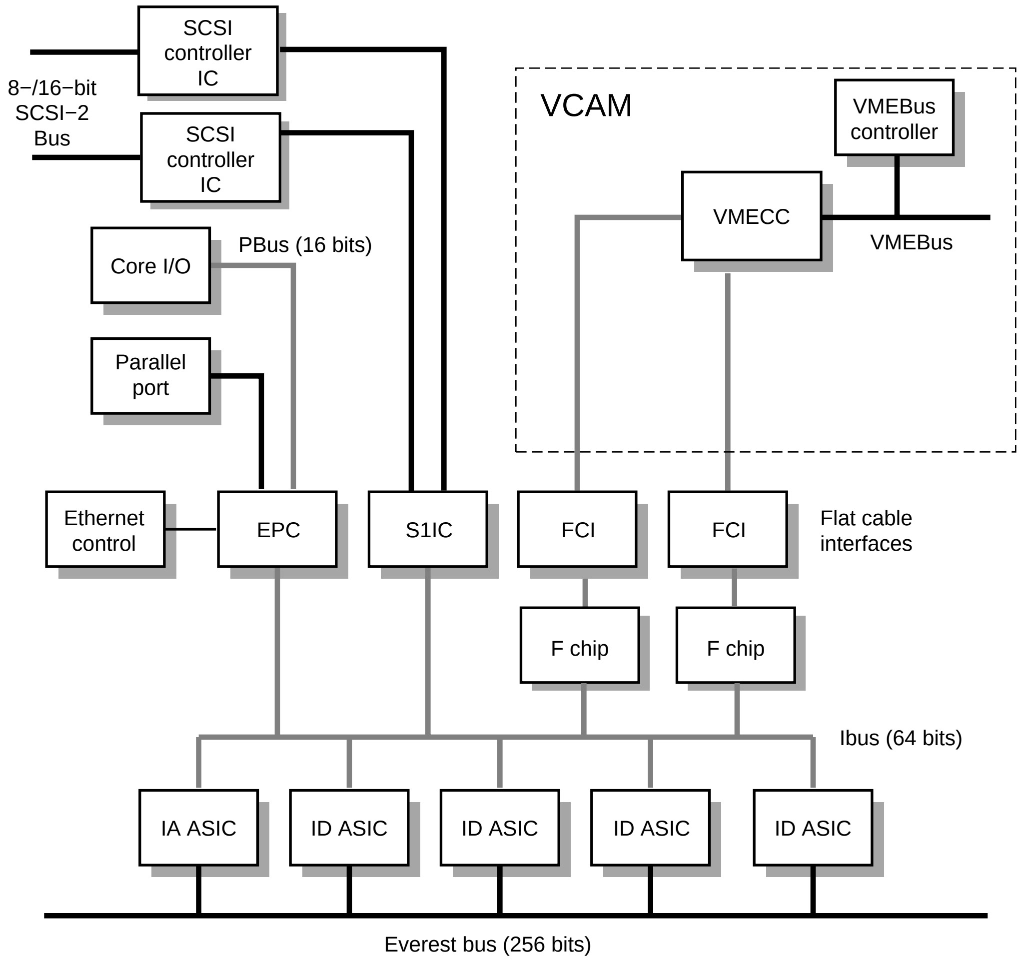

Figure E-2 IO4 Base Board Functional Block Diagram

VMEbus Channel Adapter Module (VCAM) Board

The VCAM board provides the interface between the Ebus and the VMEbus and manages the signal-level conversion between the two buses. The VCAM also provides a pass-through connection that ties the graphics subsystem to the Ebus.

The VCAM can operate as either a master or a slave. It supports DMA-to-memory transactions on the Ebus and programmed I/O (PIO) operations from the system bus to addresses on the VMEbus. In addition, the VCAM provides virtual address translation capability and a DMA engine that increases the performance of non-DMA VME boards.

VMECC

The VMECC (VME cache controller) gate array is the major active device on the VCAM. The VMECC interfaces and translates host CPU operations to VMEbus operations (see Figure E-3). The VMECC also decodes VMEbus operations to translate them to the host side.

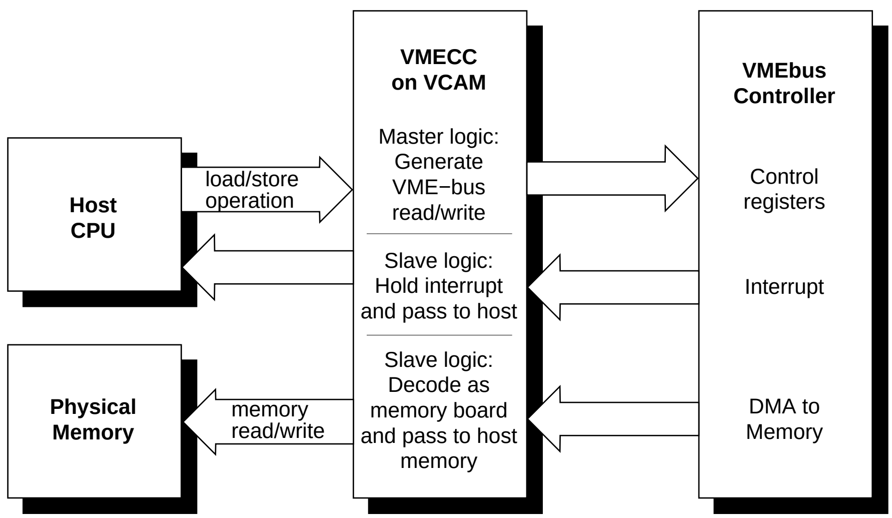

Figure E-3 VMECC, the VMEbus Adapter

The VMECC provides the following features:

- an internal DMA engine to speed copies between physical memory and VME space

  Note: For information on DMA memory mapping, see “DMA Multiple Address Mapping” on page 143.

- a 16-entry deep PIO FIFO to smooth writing to the VME bus from the host CPUs

- a built-in VME interrupt handler and built-in VME bus arbiter
- an explicit internal delay register to aid in spacing PIOs for VME controller boards that cannot accept back-to-back operations
- A16, A24, A32, and A64 addressing modes (see Table E-1) that can be issued as a bus master with PIOs
- single item transfers (D8, D16, D32, and D64) that can be issued as a bus master with PIOs
- A24, A32, and A64 addressing modes that can be responded to as a memory slave to provide access to the Ebus
- single item transfers (D8, D16, and D32) that can be responded to as a memory slave to provide access to the Ebus
- block-item transfers (D8, D16, D32, and D64—see Table E-1) that can be responded to as a memory slave

Table E-1 Supported Address and Data Sizes

Size	Term
A16 and D8 modes	Short
A24 and D16 modes	Standard
A32 and D32 modes	Extended
A64 and D64 modes	Long

The VMECC also provides four levels of VMEbus request grants, 0-3 (3 has the highest priority) for DMA arbitration. Do not confuse these *bus request levels* with the interrupt priorities described in “VMEbus Interrupts.” Bus requests prioritize the use of the physical lines representing the bus and are normally set by means of jumpers on the interface board.

F Controller ASIC

Data transfers between VME controller boards and the host CPU(s) takes place through the VMECC on the VCAM board, then through a flat cable interface (FCI), and onto the F controller ASIC.

The F controller acts as an interface between the Ibus and the Flat Cable Interfaces (FCIs). This device is primarily composed of FIFO registers and synchronizers that provide protocol conversion and buffer transactions in both directions and translate 34-bit I/O addresses into 40-bit system addresses.

Two configurations of the F controller are used on the IO4 board; the difference between them is the instruction set they contain. One version is programmed with a set of instructions designed to communicate with the GFXCC (for graphics); the other version has instructions designed for the VMECC. All communication with the GFXCC or VMECC ICs is done over the FCI, where the F controller is always the slave.

Both versions of the F controller ASICs have I/O error-detection and handling capabilities. Data errors that occur on either the Ibus or the FCI are recorded by the F controller and sent to the VMECC or GFXCC.

ICs must report the error to the appropriate CPU and log any specific information about the operation in progress. FCI errors are recorded in the error status register. This register provides the status of the first error that occurred, as well as the cause of the most recent FCI reset.

VMEbus Interface Overview

The Challenge and POWER Challenge VMEbus interface supports all protocols defined in Revision C of the VME specification plus the A64 and D64 modes defined in Revision D. The D64 mode allows DMA bandwidths of up to 60 MB. This bus also supports the following features:

- seven levels of prioritized processor interrupts
- 16-bit, 24-bit, and 32-bit data addresses and 64-bit memory addresses
- 16-bit and 32-bit accesses (and 64-bit accesses in MIPS III mode)
- 8-bit, 16-bit, 32-bit, and 64-bit data transfer
- DMA to and from main memory

The VME bus does not distinguish between I/O and memory space, and it supports multiple address spaces. This feature allows you to put 16-bit devices in the 16-bit space, 24-bit devices in the 24-bit space, 32-bit devices in the 32-bit space, and 64-bit devices in 64-bit space.[1]

VMEbus Address Space

The VME bus provides 32 address bits and six address-modifier bits. It supports four address sizes: 16-bit, 24-bit, 32-bit, and 64-bits (A16, A24, A32, and A64). The VME bus allows the master to broadcast addresses at any of these sizes. The VME bus supports data transfer sizes of 8, 16, 32, or 64 bits.

Note: To best understand the VMEbus addressing and address space, think of the device as consisting of two halves, master and slave. When the CPU accesses the address space of a device, the device acts as a VME slave. When the VME device accesses main memory through direct memory access operations, the VME device acts as a VME master.

DMA Multiple Address Mapping

In the Challenge and POWER Challenge systems, a DMA address from a VME controller goes through a two-level translation to generate an acceptable physical address. This requires two levels of mapping. The first level of mapping is done through the map RAM on the IO4 board. The second level is done through the map tables in system memory. This mapping is shown in Figure E-4.

R4400 and R8000 Mapping

The second level mapping requires system memory to be reserved for the mapping tables. The current limit on the number of pages that is allocated for map tables is 16 pages and the maximum memory allotted for the map tables is 64 KB. The R4400 provides a 4 KB page size for 16 pages (4 KB * 16 pages = 64 KB). The R8000 provides an 8 KB page size for 8 pages (8 KB * 8 pages = 64 KB).

[1] 64-bit data transfers, accesses, and memory addresses do not depend on a 64-bit IRIX kernel, so they can be mapped to all MIPS R4000 and R8000 series platforms.

The R4400 pointer size is 4 bytes and the R8000 pointer size is 8 bytes. There are 1K mapping entries for the R4400 for each page and 8K mapping entries in the R8000. In the R4400, if you divide the amount of memory allocated for the map tables (64 KB) by the pointer size (4 B) and then multiply it by the page size (4 KB), you derive 64 MB of VME DMA mapping. This is the maximum allowed by IRIX. The 64 MB address space applies to the R8000, as well.

R10000 Virtual Address Translation

In the R10000 processor, the size of each page may be selected from a range between 4 KB to 16 MB inclusive, in powers of 4 (that is, 4 KB, 16 KB, 64 KB, etc.). The virtual address bit that select a page (and thus are translated) are called the page address.

Page size is defined in each TLB entry's PageMask field. This field is loaded or read using the PageMask register (see the *R10000 Microprocessor User's Manual* from MIPS Technology for additional information). Translations are maintained by the operating system, using page tables in memory. A subset of these translations is loaded into a hardware buffer called the translation lookaside buffer or TLB.

The contents of this buffer are maintained by the operating system; if an instruction needs a translation which is not already in the buffer, an exception is taken so the operating system can compute and load the needed translation. If all the necessary translations are present, the program is executed without any delays.

VME Physical Address Generation

Referring to the top of Figure E-4, bits 32 and 33 from the IBus address come from the VMECC. These two bits determine a unique VMEbus number for systems with multiple VMEbusses. Of the remaining 32 bits (31 to 0), 12 are reserved for an offset in physical memory, and the other 20 bits are used to select up to 2^{20} or 1 million pages into the main memory table. However, as stated earlier, only 64 KB is allocated for map tables.

As shown in Figure E-4, 13 bits go to the static RAM table. Recall that two of the thirteen bits are from the VMECC to identify the VMEbus number. The static RAM table then generates a 29-bit identifier into the main memory table. These 29 bits select a table in the main memory table. An additional nine bits select an entry or element within the table. Two zeros are appended to form a 40-bit address into the main memory table.

The main memory table then generates 28-bit address which is then appended to the 12-bit offset of the IBus to form the final 40-bit physical address.

Note: Address conflicts with other boards in the system should not be a problem as long as the drivers and the VME controllers adhere to the semantics for DMA mapping defined in the *IRIX Device Driver Programmer's Guide* (p/n 007-0911-*xxx*).

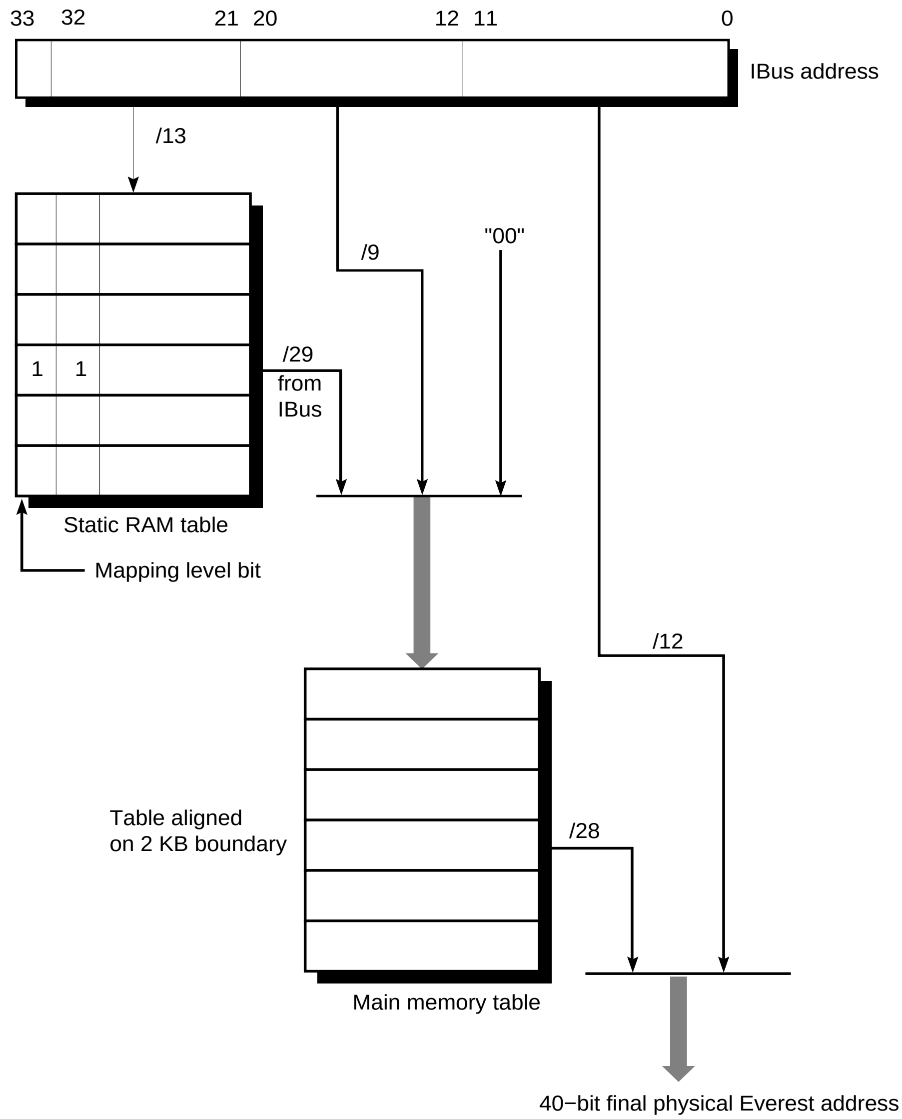

Figure E-4 I/O Address to System Address Mapping

VMEbus Cycles Operation

This section describes the VMEbus operation for the following address and data cycles:

- write (non-block)
- read (non-block)
- read-modify-write (issued only by the VMECC)

Word Length Conventions

Table E-2 shows the word length conventions used in this document.

Table E-2 Word Length Conventions

Parameter	Number of Bits
Byte	8 bits
Half-word	16 bits
Word	32 bits
Double or long word	64 bits

Write Cycle

The write cycle begins when the master gets the bus and asserts WRITE*. The master places the address on the address bus (A01 to A31) and also places the address modifier on the bus (AM0 through AM5) to indicate the type of access and address space (for example A16, A24, A32, or A64). The address strobe (AS*) is then asserted to indicate a stable address.

The master then places the data on the data bus (D00 through D31) and asserts the data strobes DS0* AND DS1* and LWORD*. This combination determines the data size (for example, D32, D16, or D8).

The slave takes the data and responds by asserting the DTACK* line. When the master releases the data strobes, (DS0* and DS1*), the slave releases DTACK* and the cycle is completed, as the AS* signal is released. If a mismatch in the data transfer size or other errors occur, the slave asserts BERR* and the bus error terminates the cycle.

Read Cycle

The read cycle is the same as the write cycle except that the slave places the data on the data bus (D00 through D31) in response to data strobes and long word combinations (DS0, DS1, and LWORD) from the host CPU. The slave asserts DTACK* when the data is driven and the master reads it. The master then releases the strobe and the slave releases DTACK* and AS, and the cycle is completed.

VME-bus Read-Modify-Write Cycle

The read-modify-write (or RMW) allows a master to read data, modify it, and write it back without releasing the bus. This bus cycle allows users to read and change the contents of a device register or memory location in a single atomic operation. Although this feature is typically used to implement synchronization primitives on VME memory, you may occasionally find this feature useful for certain devices.

Note: Silicon Graphics products do not support VME read-modify-write operations initiated by a VME master to host memory.

VMEbus Interrupts

The VME bus supports seven levels of prioritized interrupts, 1 through 7 (where 7 has the highest priority). The VMECC has a register associated with each level. When the system responds to the VMEbus interrupt, it services all devices identified in the interrupt vector register in order of their VMEbus priority (highest number first). The operating system then determines which interrupt routine to use, based on the interrupt level and the interrupt vector value.

Note: On systems equipped with multiple VME buses, adapter 0 has the highest priority; other adapters are prioritized in ascending order (after 0).

No device can interrupt the VME bus at the same level as an interrupt currently being serviced by the CPU because the register associated with that level is busy. A device that tries to post a VMEbus interrupt at the same VMEbus priority level as the interrupt being serviced must wait until the current interrupt is processed.

Note: All VME interrupt levels map into one CPU interrupt level through IRIX.

VMEbus Interrupt Generation

The following and Figure E-5 outline how a VMEbus interrupt is generated.

1. A VME controller board asserts a VME interrupt.
2. The built-in interrupt handler in the VMECC chip checks if the interrupt level is presently enabled by an internal interrupt mask.
3. The interrupt handler in the VMECC issues a bussed IACK (interrupt acknowledge) response and acquires the vector from the device. The 3-bit response identifies one of the seven VME address.

   Note: Once an interrupt is asserted and the bus is granted to the handler, a 3-bit code that identifies the interrupt level being acknowledged is placed on address bits 1 to 3, and IACK* and AS* are asserted.
4. If multiple VME boards are present, the bussed IACK signal is sent to the first VME controller as an IACKIN. As shown in Figure E-5, since the first controller is not the requesting master, it passes the IACKIN signal to the next board (in the daisy chain) as IACKOUT.

   Note: Each board compares the interrupt level with the interrupt level it may or may not have asserted. If the board did not generate an interrupt, or if the interrupt level does not match its own level, the board passes on the IACKOUT signal to the next board.

   In addition, the board closest to the master IO4 normally wins access to the bus.
5. The requesting board responds by issuing a DTACK* (data acknowledge signal), blocking the IACKOUT signal to the next board in line (if present), and placing an 8-bit status word on the data bus.
6. After acceptance and completion through the VMECC, the interrupt signal is sent over the FCI interface to the F-chip and is queued awaiting completion of other F-chip tasks.

7. The F-chip (or F controller ASIC) requests the I-bus and sends the interrupt to the IA chip.
8. The IA chip requests the Ebus and sends the interrupt over the Ebus to the CC chip on the IP19/IP21 board.

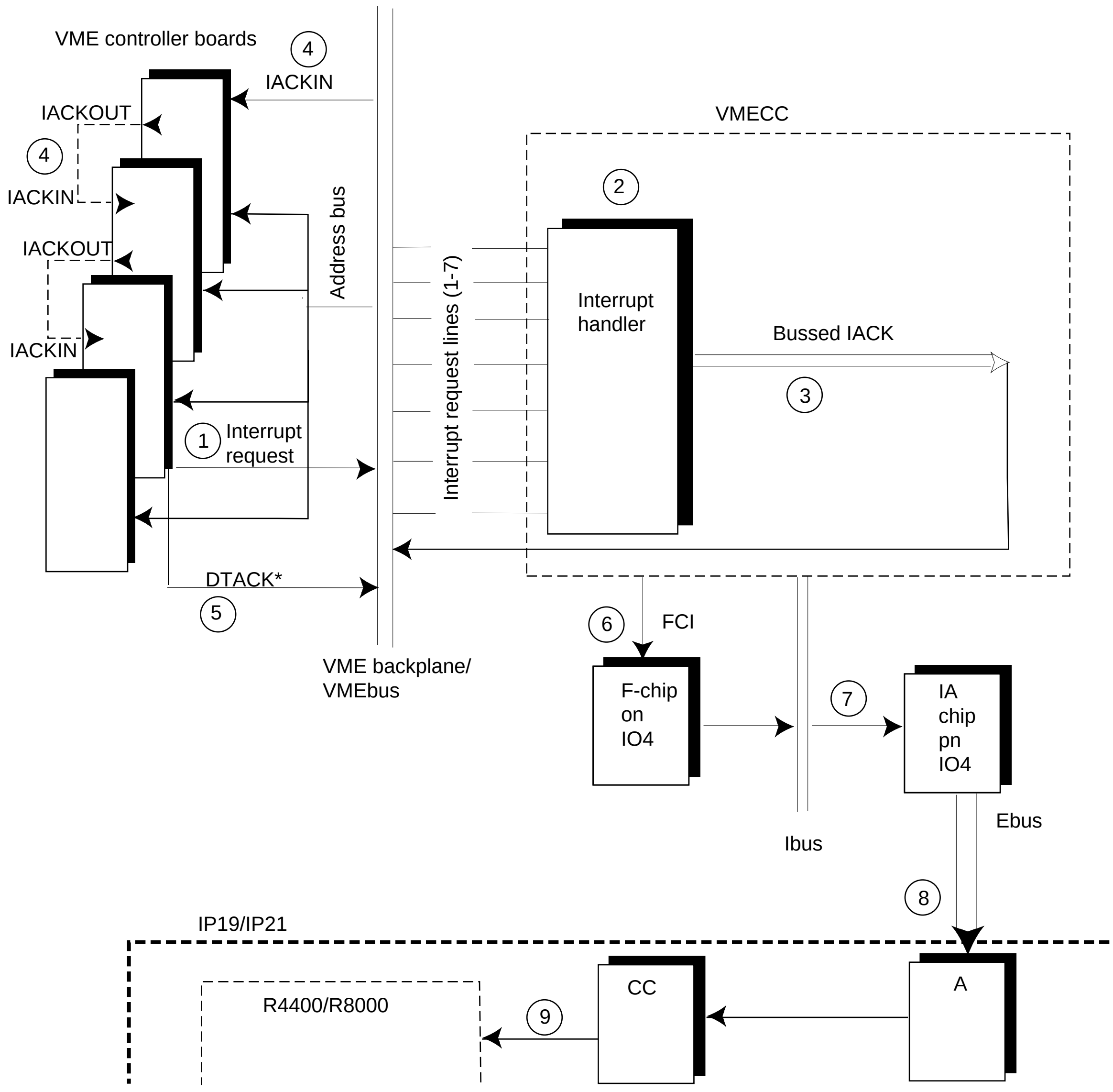

Figure E-5 VMEbus Interrupt Generation

9. The CC chip interrupts the R4400/R8000, provided that the interrupt level is not masked.

   While the interrupt handler is executing, it prevents another interrupt at an equal or lower level from being serviced. Furthermore, all pending interrupts that are equal to or higher than the priority of a new interrupt must complete execution before the new interrupt is serviced.

The time for this to complete is normally less than 3 microseconds, but will be queued to await completion of other VME activities.

VME Interrupt Acknowledgments

VME boards have two methods of interrupt acknowledge:

- release on acknowledge of interrupt
- release on register acknowledge of interrupt

The first release policy is where the interrupting device removes the IRQ request once the VMECC acknowledges the interrupt. In other words, the VME board assertion of the IRQ line is dropped when the board transfers its interrupt vector to the VMECC.

The second release policy occurs when the interrupting VME board does not drop the IRQ line the until a register on the board has been accessed or modified. Therefore, after the interrupt vector has been transferred, the device still asserts IRQ.

Potential VME Interrupt Problems

The following outlines VME interrupt problems that could result in VME interrupt error messages, such as: `WARNING: stray VME interrupt, vector=0xff.`

- Noise occurs on one of the IRQ lines. If the noise pulse (signal) is wider than 20 ns, then the VMECC attempts to issue an IACK cycle. If the signal is just noise and not an actual interrupt, no expectant response to the IACK takes place. This lack of a response from a VME board results in a timeout, causing the VMECC to issue an error message.
- A VME board accidentally asserts an IRQ line and doesn't respond.

- One of the boards in front of the requesting board improperly blocks the IACKIN signal and doesn't respond.

Ignoring Interrupts

The VMECC responds only to those interrupt levels that it is configured to recognize. You can therefore prevent the VMECC from responding to particular interrupt levels. For example, if the kernel is configured to have two VME devices configured at ipl=3 and 4, then the VMECC responds to interrupt levels 3 and 4 only. The VMECC does not respond to any other interrupt levels, thereafter.

Bus Arbitration

The VMEbus supports two arbitration schemes priority and round robin. The VMECC designates the highest priority to its internal bus masters, the interrupt handler, and the PIO master. These two bus masters have a higher priority than the four backplane request levels (BRQ3 through BRQ0). BRQ3 has the highest priority level. BRQ2 through BRQ0 use round-robin arbitration.

The master relinquishes the bus based on an internal policy of release on request or release when done. Most VME masters can set their arbitration scheme through jumper selectors or by software.

In round-robin scheduling, the arbitration keeps track of the history of the bus grants to different levels. The last bus request level to have the bus becomes the lowest priority. For example, if the bus current request level is 1, all bus request level 1s are pushed back to the end of the queue, after a bus grant. The bus request level that is adjacent to the lowest priority then becomes the highest priority.

As an example, at a given time, say that level 3 is currently the highest priority. After a bus grant takes place, level 3 then becomes the lowest priority, and level 2 (since it was previously adjacent to level 3) is now the highest bus-level priority.

Hardware Considerations

This section defines physical and electrical parameters for implementing VMEbus boards and also provides VMEbus slot-specific information for the Challenge and POWER Challenge systems.

VME Board Dimensions

The Challenge board slots have a 9U (vertical) form factor and measure 15.75 inches (400 mm) horizontally. The board edges *must* also be less than or equal to 0.062 inches (1.57 mm). If the board is thicker, the edge of the board must be milled to fit into the card guide. In addition, the center-to-center board spacing is 0.8 inch (20.3 mm).

Note: If you wish to install a 6U form-factor VMEbus board into the system, you need to obtain a 6U-to-9U converter board from Silicon Graphics. See "Using a 6U to 9U Converter Board" on page 165 for further information.

Deskside VME Power and Cooling

The deskside Challenge provides five 9U VME slots and receives 600 watts of 5 VDC power (see Table E-3) from the system. Approximately 200 watts of the 5 VDC power are reserved for the VME boards. Nominally, 40 watts are allowed per VME slot. However, it is possible to exceed this power rating. See "Exceeding the Nominal VME Power Rating Per Slot" on page 158 for further information.

The deskside chassis circulates approximately 150 to 250 linear feet per minute (LFM) of air flow through the chassis (depending on the ambient temperature).

The IO4, VCAM, and mezzanine boards all draw their power from the same source as the VME cards. The CPU boards (such as the IP19) and the MC3 memory boards draw 48-V power directly from the OLSs, and do not compete for power directly with the IO4, VCAM, mezzanine, and VME boards.

Table E-3 Power Specifications for the Challenge Deskside System

Category	Parameter
Total 5 V power available	600 watts
Total 12 V power available	200 watts
Each IO4 draws	64 watts (5 V); 20 watts (12 V)
VCAM	35 watts (5 V); 24 watts (12 V)
Backplane requirement	50 watts (5 V)

Determining the System Power Budget

Use the information in Table E-3 and Table E-4 to help determine the power budget for your system. With this information, you should be able to calculate the power available for VME cards in your particular configuration, as required.

Table E-4 5 VDC Power Consumption Chart for Various System Boards

Board Type	Power Consumption at 5 VDC
Master IO4 board and VCAM	130 watts
Slave IO4 board	47 watts
S1 mezzanine board	20 watts
SCIP mezzanine board	20 watts
F-chip mezzanine board	35 watts
FDDI mezzanine board	25 watts
ATM board	37 watts
HIPPI board	75 watts

Challenge Slot Assignments

Table E-5 and Figure E-6 show the board slot locations for the Challenge deskside system.

Table E-5 Challenge Deskside Slot Assignments

Slot Number	Description
1	First MC3
2	First CPU
3	Second or third CPU or second or third MC3 or second or third IO4
4	Second or third CPU or second or third MC3 or second or third IO4
5	IO4 Board (Note: An IO4 board must reside in slot 5.)
6	VCAM Board
7	VME
8	VME
9	VME
10	VME
11	VME

Caution: Because of less air flow coming into slot 1 and the heat generated by the CPU board, the cooler-operating MC3 must be in the first slot.

Note: The VCAM mezzanine board connects to both the IO4 board and the backplane.

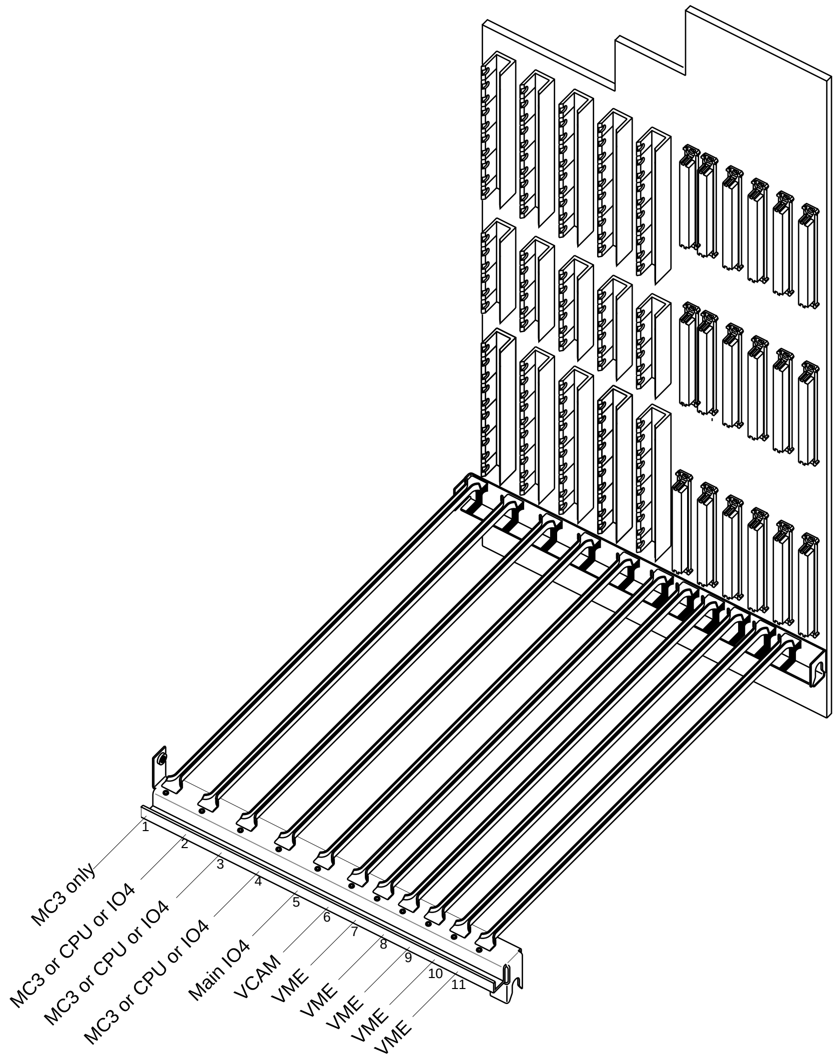

Figure E-6 Deskside Server System Slot Assignments

Exceeding the Nominal VME Power Rating Per Slot

If a VME board requires more than the nominal slot power allotment (approximately 40 watts of +5-V power per slot) the board still can be used providing that the following cooling and power guidelines are met.

Cooling Guidelines

The user needs to ensure that the board has the proper air flow (for cooling purposes) and sufficient available power. To help maintain proper cooling (according to manufacturer's specifications), the board may need special custom baffles or a set of non-component enclosure boards to surround the VME board with sufficient air flow.

Note: These custom air flow devices must be supplied by the customer.

VME Power Guidelines

To use a third-party VME board that requires more than the normal VME slot power, be sure to observe these guidelines:

- The board does not draw more than the amount of power allocated for VME board use.
- The board does not exceed the power rating for the VME pins (approximately 200 watts).
- The board uses all three "P" connectors on the system backplane: the P1, P2, *and* P3. (See Table E-6 through Table E-8 for pinout information.)

If these guidelines are followed along with the proper cooling requirements, a single VME board can draw as much as 150 watts of +5-V power.

Note: See also "Determining the System Power Budget" on page 155 for additional reference information.

You can install two 75-watt VME boards (providing the boards are sufficiently cooled). However, as a result, you cannot install any additional VME boards, since the VME power allotment would already be saturated. It is also possible to use a single 150-watt VMEbus board, providing the remaining VME slots are also not used.

VME Pin Information

Table E-6 through Table E-8 list the pin assignments of the VME P1, P2, and P3 connectors. Table E-9 describes the pin signals.

Note: No connections are made to rows A and C of connector P2. These lines are not bussed across the backplane. The P3 connector uses the Sun power convention. In addition, the Challenge system does not generate ACFAIL* or SYSFAIL*. The SERCLK and SERDAT* are also unused.

The Challenge system supplies the defined voltages to the bus, also asserts SYSREST*, and drives SYSCLK (SYSCLK is driven at 16 MHz).

On the Challenge backplanes, the unused VME pins are *no connects*.

Caution: The Challenge system does not support VSBbus boards.

Table E-6 P1 VME Pin Assignments

Pin	Row A	Row B	Row C
1	D00	BBSY*	D08
2	D01	BCLR*	D09
3	D02	ACFAIL	D10
4	D03	BG01N*	D11
5	D04	BG0OUT*	D12
6	D05	BG1IN*	D13
7	D06	BG1OUT*	D14
8	D07	BG2IN*	D15
9	GND	BG2OUT*	GND
10	SYSCLK	BG3IN*	SYSFAIL*
11	GND	BG3OUT*	BERR*
12	DS1	BR0*	SYSRESET*
13	DS0	BR1	LWORD*

Table E-6 (continued) P1 VME Pin Assignments

Pin	Row A	Row B	Row C
14	WRITE*	BR2*	AM5
15	GND	BR3*	A23
16	DTACK*	AM0	A22
17	GND	AM1	A21
18	AS*	AM2	A20
19	GND	AM3	A19
20	IACK*	GND	A18
21	IACKIN*	SERCLK	A17
22	IACKOUT*	SERDAT*	A16
23	AM4	GND	A15
24	A07	IRQ7*	A14
25	A06	IRQ6*	A13
26	A05	IRQ5*	A12
27	A04	IRQ4*	A11
28	A03	IRQ3*	A10
29	A02	IRQ2*	A09
30	A01	IRQ1*	A08
31	-12V	+5VSTDBY	+12V
32	+5V	+5V	+5V

Table E-7 P2 VME Pin Assignments

Pin	Row A[1]	Row B	Row C[1]
1		+5V	
2		GND	
3		RESERVED	
4		A24	
5		A25	
6		A26	
7		A27	
8		A28	
9		A29	
10		A30	
11		A31	
12		GND	
13		+5V	
14		D16	
15		D17	
16		D18	
17		D19	
18		D20	
19		D21	
20		D22	
21		D23	
22		GND	
23		D24	

Table E-7 (continued) P2 VME Pin Assignments

Pin	Row A[1]	Row B	Row C[1]
24		D25	
25		D26	
26		D27	
27		D28	
28		D29	
29		D30	
30		D31	
31		GND	
32		+5V	

[1] Rows A and C in Table E-7 are user-defined.

Table E-8 P3 VME Pin Assignments

Pin	Row A	Row B	Row C
1 through 25	+5 V	Not connected	GND
26, 27	+12 V	Not connected	+12 V
28, 29	-12 V	Not connected	-12 V
30 through 32	-5 V	Not connected	-5 V

Note: In the Challenge VME backplanes, P3B is used for Silicon Graphics purposes.

Table E-9 Signal Definitions

Signal Name	Definition
D00 through D31	Data lines. These lines are tri-stated and are not defined until the data strobes (DS0* and DS1*) are asserted by the MASTER.
A00 through A31	Address lines. These lines are tri-stated and are not defined until the address strobe (AS*) is asserted by the MASTER.
AM0 through AM5	Address modifier lines. Asserted by the MASTER and indicate the type of data transfer to take place. VME SLAVEs look at the lines to determine if they will respond and what type of response to make.
DS0, DS1	Data Strobe lines. Asserted by the MASTER and indicate stable data on the data bus.
AS	Address strobe. Asserted by the MASTER and indicates a stable address is present on the address lines.
BR0 through BR3	Bus request lines. MASTER request a busy bus via these prioritized levels.
BG0IN through BG3IN	Bus grant in (daisy-chained).
BG0OUT through BG3OUT	Bus grant out (daisy-chained).
BBSY	Bus busy.
BCLR	Bus clear. (Hint to bus master: VME MASTERs are not required to comply.)
IRQ1 - IRQ7	Interrupt request lines.
IACK	Interrupt acknowledge. Asserted by MASTER to indicate the VME interrupt level to be serviced.
IACKIN	Interrupt acknowledge in (daisy-chained).
IACKOUT	Interrupt acknowledge out (daisy-chained).

Table E-9 (continued) Signal Definitions

Signal Name	Definition
DTACK	Data transfer acknowledge. Asserted by SLAVE to indicate a successful bus transfer.
WRITE	Write not or read.
LWORD	Indicates long word transfer (D32).
SYSCLK	16 MHz system clock. (Does not control bus timing.)
SERCLK	Serial data clock.
SERDAT	Serial data line.
BERR	Bus error line.
SYSFAIL	Indicates a board has failed.
ACFAIL	AC power failure notify line.
SYSRESET	Reset signal for VME bus.

Skipping a VME Slot

Skipping a slot is occasionally required to fit oversized VME boards or to improve air flow. A slot can be skipped if jumper blocks are placed on the appropriate VME jumper block pins.

Note: If you install the VME boards in order (from left to right), then no jumpering is required. In addition, if you have no VME boards installed, you do not need to install any jumpers.

The general guideline is to have jumpers in the jumper banks correspond to the VME slot number that you are skipping, as follows:

- If you are skipping the first VME slot (slot 7 in a Challenge deskside) to use the second, you must place five jumpers in the jumper bank, designated as slot 1 (see Figure E-7).
- If you are skipping the first two VME slots and wish to use the third, you must place jumpers in jumper banks 1 and 2.

- If you wish to skip over VME slots—for example, from the first VME slot over to the third—you must place jumpers in bank 2.

Using a 6U to 9U Converter Board

Some third-party VMEbus boards have a 6U form factor and require a Silicon Graphics 6U to 9U converter (or extender) board assembly to be used in the Challenge or POWER Challenge system (see Figure E-8).

Note: Contact your Silicon Graphics sales office to obtain a 6U converter board (p/n 030-0519-001).

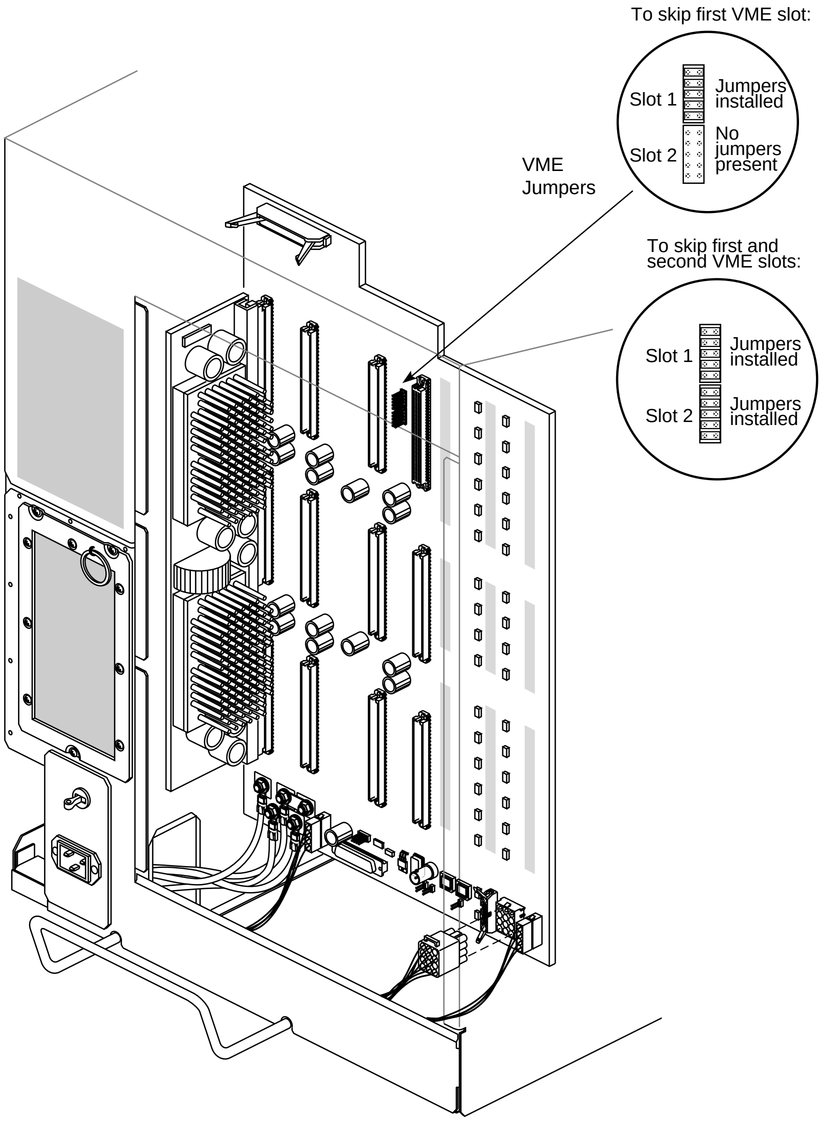

Figure E-7 VMEbus Midplane Jumpers

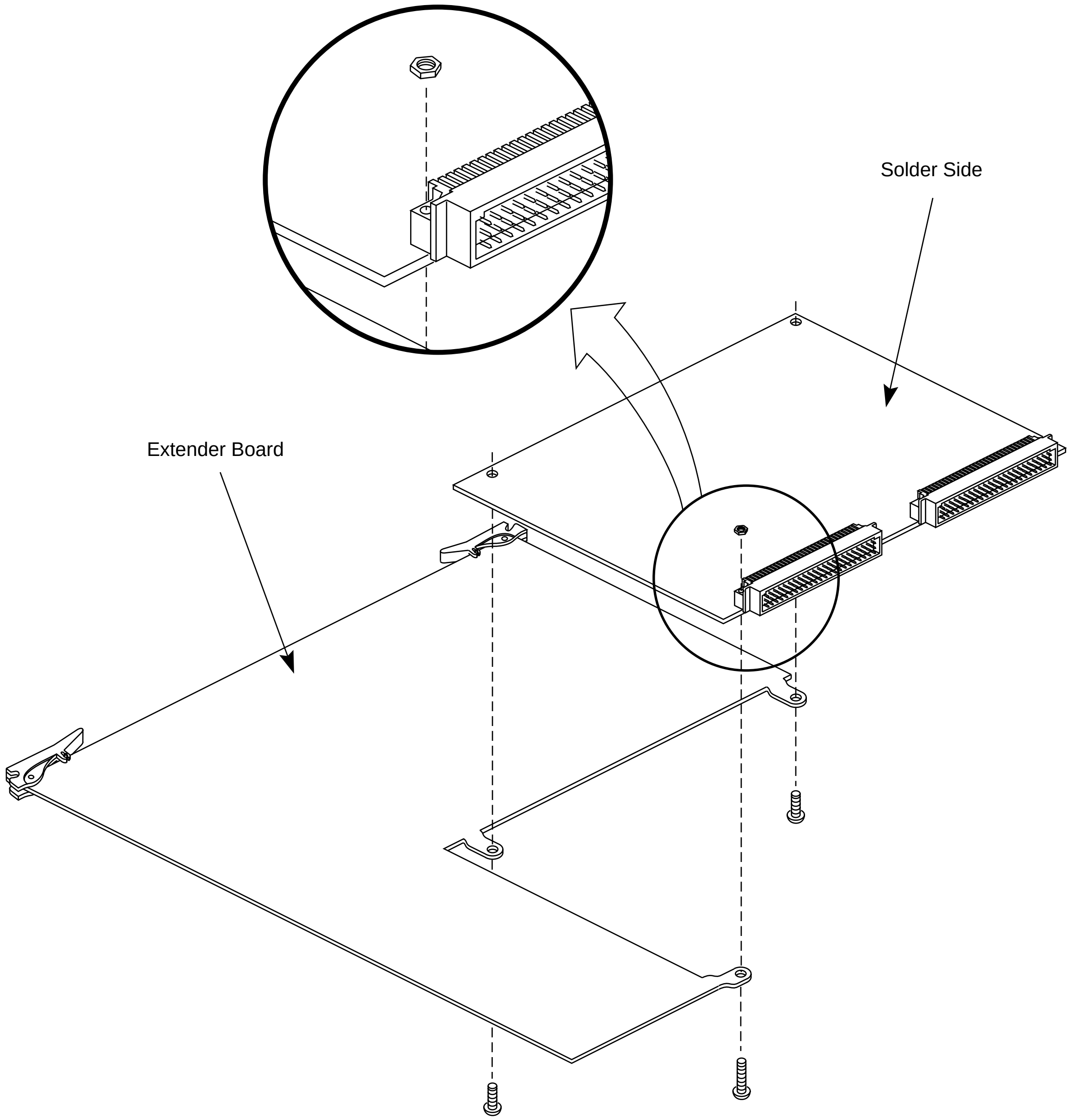

Figure E-8 A Silicon Graphics 6U Converter Board

VMEbus Boards Design Considerations

This section provides design guidelines for implementing third-party VME boards. Be sure to observe these general rules to avoid possible damage to the VMEbus and system.

- Devices should require 8-bit interrupt vectors *only*. This is the only interrupt vector size that is recognized by the IRIX kernel.
- Devices must not require UAT (unaligned transfers or tri-byte) access from the Challenge system.
- Devices in Slave mode must not require address modifiers, other than Supervisory/Nonprivileged data access.
- While in VME Master mode, devices must access only the system memory, using Nonprivileged data access or Nonprivileged block transfers.
- Devices must have the ability to be configured so that their address range does not conflict with those used by the Challenge system. The device should also be able to respond to addresses generated by the system. See the */var/sysgen/system/irix.sm* file for acceptable ranges.
- The Challenge system does not support VSBbus boards. In addition, there are no pins on the back of the VME backplane. This area is inaccessible for cables or boards.
- Be sure to place boards starting in the first VME slot, or jumper the daisy-chained signals across the empty slots to maintain proper interrupt acknowledge and bus arbitration.
- Metal face plates or front panels on VME boards may need to be removed. The plate could prevent the I/O door from properly closing and possibly damage I/O bulkhead.

  Note: In some VME enclosures, these plates supply the required additional EMI shielding. However, the Challenge chassis already provides sufficient shielding for boards inside the chassis, so these plates are not necessary.

Design Guidelines

This section presents basic timing numbers to aid in designing a VME bus master for the Challenge and POWER Challenge systems.

The first word of a read is delivered to the master in 3 to 8 µsec. In addition, the first word of a write is retrieved from the master in 1 - 3 µsec.

The VME spec has a burst length of

- 265 bytes in D08, D16, and D32 modes
- 2 KB in D64

The Challenge hardware has a 20- bit counter for a burst length of 2 MB in all sizes. The burst length occurs in bytes and not transfer cycles.

VME Handshake

Figure E-9 illustrates the VME handshake.

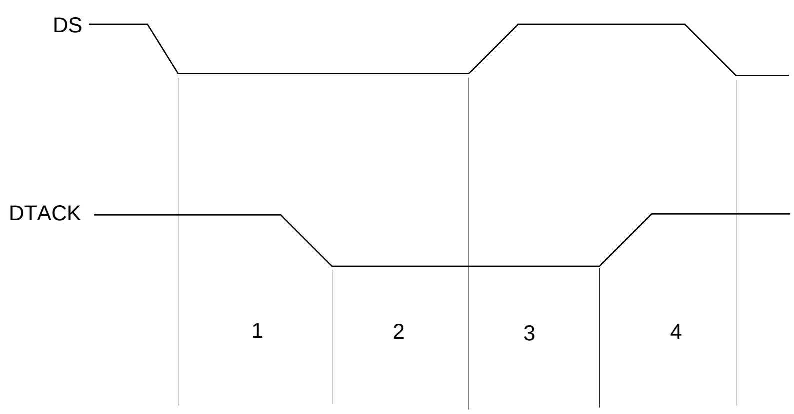

Figure E-9 VME Handshake

Parts 1 and 3 are controlled by the slave (the Challenge and POWER Challenge hardware).

Parts 2 and 4 are controlled by the master (the VME controller board).

Note: Part 1 is about 40 ns and Part 3 is about 20 to 25 ns. The total Challenge and POWER Challenge contribution is about 60 to 65 ns.

F Controller ASIC Address Mapping

The F controller does the mapping from A32 mode into system memory and automatically crosses the page boundaries. You do not have to have AS go high and then low on 4 KB boundaries.

If you use A64 addressing, then you may have to change the address on the 4 KB boundaries and cause a transition on AS low to high, and then back to low. This incurs the delays mentioned at the beginning of this section, “Design Guidelines” on page 169.

Note: The delays are averages and may occasionally be longer. The system design does not have any guaranteed latency. For this reason, longer transfers are better than shorter ones. If you decide to exceed the VME bus specifications, it is recommended that you place a field in a control register on your VME board that enables/disables this feature. This allows you to put the board in standard mode so it can be used on other VME systems.

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