ftServer 6600
Technical Service Guide

1/29/04

<u>***Revision History***</u>

8/29/03 – Updated Section 7.
9/5/03 – Made several changes throughout the document based on reviewers' comments.
1/29/04 - Updated Sections 1, 6, and 7 to include the 3.0-GHz (with 4-MB cache), 2.2-GHz (with 2-MB cache), and 2-MB memory information.

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Manual Name: *ftServer 6600 Technical Service Guide*

Services Technical Communications Department

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Preface

The *ftServer 6600 Technical Service Guide* contains technical information pertinent to ftServer systems operating under Microsoft Windows 2000 Advanced Server (Y2K) or Windows Server 2003 Enterprise Edition (Y2K3).

This document is organized as follows:

Section 1 - Introduction

Section 2 -Operation and Troubleshooting Procedures

Section 3 - CRU Removal Procedures

Section 4 – FRU Removal Procedures

Section 5 – DRU Removal Procedures

Section 6 - Part Numbers

Section 7 - Theory of Operation

Audience

This guide is intended for authorized service personnel who install and maintain Stratus systems, and who have completed Stratus field-service training courses.

1. Introduction

This section describes the requirements, components, configurations, and specifications for the Stratus ftServer 6600 system. It covers the following topics:

- Overview
- Operating system requirements
- Hardware components
- System configurations
- System specifications

1.1 Overview

tServer 6600 systems are distributed servers on a fault-tolerant hardware architecture. Stratus customizes the software, providing fault-hardened device drivers, enhancements to the operating system, and application reliability and availability, to promote fault tolerance.

The ftServer 6600 uses the Intel Xeon MP processor in a 2-way or 4-way configuration. The processor operates at 2.8 GHz (with 2 MB iL3 cache), 2.0 GHz (with 1 MB iL3 cache), 3.0 GHz with 4 MB iL3 cache), or 2.2 GHz (with 2 M iL3 cache)**.**

12 DIMM slots allow memory configurations from 2 GB to 12 GB. The front side bus operates at 400 MHz.

The ftServer 6600 configurations consist of a 10U rack-mounted chassis with two core I/O enclosures (each 1U in height), two expansion I/O enclosures (each 1U in height), and either two dual modular redundancy (DMR) or three triple modular redundancy (TMR) CPU enclosures (each 2U in height). Systems can be mounted in a Stratus cabinet or a customer-supplied cabinet.

The diagram below shows the slot allocation of the system components in the 6600 chassis.
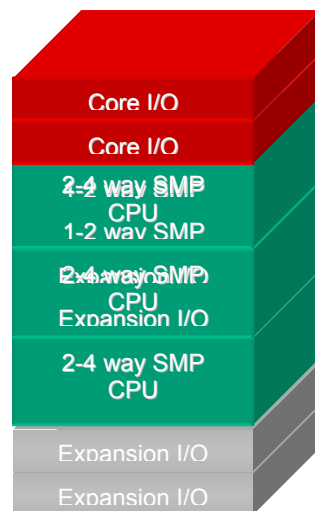
The CPU and I/O enclosures are installed from the front of the chassis and connect to a backplane located at the rear of the chassis. The clock card, power inlets, VGA, USB, serial ports, and connections to the installed PCI adapters are also located at the rear of the chassis.

To enable connectivity to the Stratus ActiveService Network (ASN), which allows the CAC or an authorized Stratus service representative to remotely manage the system, the system is configured with two duplexed ftServer Access Adapters. These adapters connect to the ASN over an internal modem and provide ASN connectivity even when the operating system is not operational. The adapter allows internal administrators to remotely service the system over an IP network, regardless of the state of the operating system.

1.2 Operating System Requirements

The ftServer 6600 system is currently supported by the following operating systems:

- Microsoft Windows 2000 Advanced Server (W2K)

- Windows Server 2003 Enterprise Edition (W2K3)

1.3 Hardware Components

The main hardware components in the ftServer 6600 system are the following:

- 2 or 3 CPU Enclosures
2 Core I/O Enclosures

2 Expansion I/O Enclosures

- 10U Backplane

1.3.1 CPU Enclosure

Each ftServer 6600 CPU contains two or four processors operating at 2.8 GHz (with 2 MB iL3 cache), 2.0 GHz (with 1 MB iL3 cache), 3.0 GHz with 4 MB iL3 cache), or 2.2 GHz (with 2 M iL3 cache)**.**

The configurations are 2-way or 4-way (one or two processors per CPU, respectively) symmetric multiprocessing (SMP).

The ftServer 6600 uses DDR (Dual Data Rate) Dual Inline Memory Module (DIMM) memory in 512-MB and 1-GB configurations.

Up to 12 DIMMs can be housed in each CPU enclosure, providing memory configurations from 2 GB to 12 GB (8 GB maximum limit for W2K and 12 GB maximum limit for W2K3)

Both CPU enclosures must be configured with identical total memory size. DIMMs of different capacities and from different manufacturers can be mixed within a CPU enclosure, but not within a single memory bank. DIMMs of identical capacity must be mounted in the corresponding memory slot in each CPU enclosure.

Due to the interleaving requirements of the ftServer 6600, the DIMMs must be installed in groups of four. All DIMMs within each group of four must be of the same capacity.

The following table lists the memory modules currently supported in ftServer 6600 systems.

Model Number	Description	Minimum # per CPU Enclosure	Maximum # per CPU Enclosure
M867	512-MB DDR DIMM	4	12
M229	1-GB DDR DIMM	8	12
M230	2-GB DDR DIMM	?	12

The following table shows the possible memory configurations.

Total Memory in CPU Enclosure	Number of Memory Modules in CPU Enclosure
2 GB	Four 512-MB modules
4 GB	Eight 512-MB modules
6 GB	Twelve 512-MB modules
8 GB	Eight 1-GB modules
10 GB	Four 512-MB modules and eight 1-GB modules
12 GB	Twelve 1-GB modules
24 GB	Twelve 2-GB modules

The following table shows the possible configurations of the modules in the DIMM slots.

Memory Size	CPU DIMM Slots											
	0	2	4	6	8	10	11	9	7	5	3	1
2 GB					512-MB	512-MB	512-MB	512-MB				
4 GB			512-MB	512-MB	512-MB	512-MB	512-MB	512-MB	512-MB	512-MB		
6 GB	512-MB	512-MB	512-MB	512-MB	512-MB	512-MB	512-MB	512-MB	512-MB	512-MB	512-MB	512-MB
8 GB			1-GB	1-GB	1-GB	1-GB	1-GB	1-GB	1-GB	1-GB		

10 GB	1-GB	1-GB	512-MB	512-MB	1-GB	1-GB	1-GB	1-GB	512-MB	512-MB	1-GB	1-GB
12 GB	1-GB	1-GB	1-GB	1-GB	1-GB	1-GB	1-GB	1-GB	1-GB	1-GB	1-GB	1-GB
12 GB	1-GB	1-GB	1-GB	1-GB	1-GB	1-GB	1-GB	1-GB	1-GB	1-GB	1-GB	1-GB
24 GB	2-GB	2-GB	2-GB	2-GB	2-GB	2-GB	2-GB	2-GB	2-GB	2-GB	2-GB	2-GB

■ Memory bank 1   ■ Memory bank 2   ■ Memory bank 3

1.3.2 I/O Enclosures

1.3.2.1 Core I/O Enclosure

Each IO enclosure contains:

- One CD-ROM drive
- One 10/100 Ethernet port
- One 10/100/1000 Ethernet port
- Three single-initiated internal SCSI disk slots
- One external SCSI port for tape drive
- One 32-bit 33-MHz PCI slot (reserved for ftSAA or VGA Adapter)
- Two 64-bit 33-MHz PCI slots (customer-configurable)

The following table lists the SCSI disk drives supported in the Core I/O enclosures.

Model	Description
D531	36-GB disk drive (10K RPM)
D532	73-GB disk drive (10K RPM)
D533	18-GB disk drive (15K RPM)

NOTE: A resister cable must be configured in slots not occupied by disk drives.

1.3.2.2 Expansion I/O Enclosure

Each expansion I/O enclosure contains three customer-configurable 64-bit 33/66-MHz PCI slots.

1.3.2.3 PCI Adapters

The following table lists the PCI adapters supported on ftServer 6600 systems.

Model	Description	Min. #	Max. #
U462	ftServer Access Adapter (ftSAA)	2	2
U486	8-port Asynchronous Adapter	0	8
U515	1-port 10/100BaseTx Ethernet Adapter	0	8
U521	Ultra 160 2-port SCSI HBA Adapter	0	4
U525	EMC SAN Fibre Channel Adapter	0	2
U526	EMC Direct Fibre Channel Adapter	0	2
U570	1-port 1000BaseSx Ethernet Adapter	0	8
U571	1-port 10/100/1000Base-T Ethernet Adapter	0	8

PCI Slot Assignments

The default configuration for the PCI adapters is shown in the following table.

Core I/O Enclosure				Expansion I/O Enclosure			
Adapter	Slot 1	Slot 2	Slot 3	Adapter	Slot 1	Slot 2	Slot 3
U462	Req	NA	NA	U462	NA	NA	NA
U486	NA	0	0	U486	0	0	0
U515	NA	0	0	U515	0	Rec	Rec
U521	NA	Rec	0	U521	Rec	0	0
AA-U52500	NA	0	0	AA-U52500	0	Rec	Rec
AA-U52600	NA	0	0	AA-U52600	0	Rec	Rec
U570/1	NA	0	0	U570/1	0	Rec	Rec

Key:
Req   The corresponding PCI adapter must be installed in this slot.
0   The corresponding PCI adapter has the option to be installed in this slot.
Rec   Recommended to be installed in this slot.
NA   The corresponding PCI adapter cannot be installed in this slot.

1.3.3 Ultra 160 SCSI Storage Enclosure

An ftServer 6600 system supports one or two optional Ultra160 SCSI storage enclosures configured in split-bus or straight-bus (joined) mode.

Each Ultra160 SCSI storage enclosure houses the following components:

- 2-14 hot-pluggable 3.5"disk drives
- 1 enclosure LED module
- 2 advanced cooling modules (ACMs)
- 2 power supply modules (PSMs)
- 2 Cluster Services Modules (CSMs)

Each Ultra160 SCSI storage enclosure occupies 3U of vertical height in the rack mount. It supports a mix of drive capacities and any combination of disk drives, but only similar disk models can mirror each other.

A pair of U521 Ultra 160 2-port SCSI host bus adapters (HBA) is required for fault tolerant operation.

The Ultra160 enclosure may contain the system boot disks.

The following table lists the disk drives supported in Ultra160 SCSI storage enclosures.

Model	Description
D522	36-GB disk drive (10K RPM)
D523	73-GB disk drive (10K RPM)
D524	18-GB disk drive (15K RPM)

1.3.4 Backplane

The ftServer 6600 system contains a 10U backplane through which the CPU and I/O enclosures interconnect.

The backplane contains:

- VHDM connectors for CPU and expansion enclosures
- System clock card (and optional spare clock card)
- Two IDPROMs
- Connector I/O card (contains the serial, USB, and VGA ports)
- AC distribution unit

The AC distribution unit splits the input power to provide fault tolerance in the event of power loss on one input source.

1.3.5 Optional Components

Optional components of an ftServer 6600 system include:

- EMC Attachment HBA Kit
- Tape drives
- Keyboard, mouse, and monitor
- External USB Floppy Disk Drive
- Power Distribution Unit (PDU)
- KVM Switch

1.3.5.1 EMC Attachment HBA Kit for EMC/Symmetrix/Clariion Storage Systems

The EMC Symmetrix/Clariion Storage System is a full Fibre Channel networked storage system. The ftServer 6600 system supports two types of Fibre Channel (FC) PCI adapters for connections to the storage system.

The U525 Optical Fibre Channel PCI Adapter provides a 2-gigabit (Gb) attachment to the storage system through a Storage Area Network (SAN) or switch.

The U526 Optical Fibre Channel PCI Adapter provides a 2-Gb direct attachment to the storage system.

Each FC PCI adapter is a 64-bit host bus adapter (HBA) that supports both 66 megahertz (MHz) PCI and 2-Gb FC I/O technologies.

1.3.5.2 Tape Drives

ftServer 6600 systems support DLT 8000 and DDS-4 tabletop tape drives. No tape drives are mounted in the storage enclosure. They are all external to the cabinet.

Each core I/O enclosure can support up to two daisy-chained tape drives or a single non-daisy-chained tape drive. The first tape drive connects to the external SCSI port on the core I/O enclosure.

> **CAUTION**: Each tape drive must have a unique SCSI ID assigned to it. Failure to do so will create SCSI bus conflicts.

The following table lists the tape drives supported on ftServer 6600 systems.

Model	Description
T511	HP-DDS-4 DAT tape drive
T512	HP-DDS-4 DAT tape drive with autoloader
T513	Quantum DLT 8000 tape drive

1.3.5.3 Keyboard/Monitor/Mouse

The keyboard and mouse connect to the system by the USB port on the connector I/O board.

The following table lists the keyboard, monitor, and mouse types.

Model	Description
V122	External 17" Color VGA Monitor
V125	ftServer 15" Rack Mount LCD with Keyboard Drawer.
V115	ftServer USB Keyboard/Mouse

1.3.5.4 External Floppy Disk Drive

The ftServer 330 system does not support an internal floppy disk drive. An optional external USB floppy drive (AK438}can be connected via a USB port on the ftServer.

1.3.5.5 Power Distribution Unit (PDU)

PDUs provide an optional way of managing power in the ftServer 6600 system. However, PDUs are required if more than one ftServer 6600 system is installed in a Stratus cabinet and for any system configured in a 38U Stratus cabinet. PDUs are also required for all systems installed in Japan.

The PDUs are installed at the bottom rear of the rack and may be used in either a Stratus-supplied rack or a customer-supplied rack. PDUs are configured in pairs with one PDU supplying A-side power and the second PDU supplying B-side power. The system A-side power is connected to PDU A and the B-side power is connected to PDU B. Hardware options, such as monitors, KVM switches and tape devices, generally have only a single power connection. These devices are connected to the A-side PDU, except for the rack-mount tape enclosure, which connects to the B-side PDU. The A-side PDU is always the one connected to a UPS.

The A-side must be capable of still functioning if power to the B-side is lost. The A-side wattage is always equal to or greater than the B-side wattage.

The PDU has eight IEC C13 outlets and supports a maximum of 15 amps.. The maximum outlet current is 8 Amps. The PDU has an IEC C20 (20-Amp) inlet connector and a 16-Amp circuit breaker to provide protection.

1.3.5.6 KVM Switch

1.4 Storage Configurations

The ftServer 6600 has an 18-GB to 73-GB disk drive capacity that can be configured as follows:

- Up to 6 internal disk drives may be configured in the core I/O enclosures.

- The system/boot disk is supported in the external Ultra160 SCSI enclosure or in a Core I/O enclosure.

- Maximum of two Ultra160 SCSI enclosures, configured in split mode (joined mode not supported).

- No boot disks are supported in the EMC storage system.

The following table lists the supported disk configurations in the ftServer 6600 system.

Configuration	Core I/O Enclosure	Ultra160 Enclosure	EMC Attach
1	Yes	Yes	No
2	No	Yes	Yes
3	Yes	Yes	Yes
4	No	Yes	No
5	Yes	No	Yes
6	Yes	No	No

1.5 System Configurations

Marketing ID	P3701-2D	P3701-4D	P3701-2T	P3701-4T	P3702-2D	P3702-4D
Processor	DMR	DMR	TMR	TMR	DMR	DMR
SMP	2-way	4-way	2-way	4-way	2-way	4-way
Processor speed	2.8 GHz	2.8 GHz	2.8 GHz	2.8 GHz	2.0 GHz	2.0 GHz
Cache size	2 MB iL3	2 MB iL3	2 MB iL3	2 MB iL3	1 MB iL3	1 MB iL3
DIMM size	512-MB, 1-GB	512-MB, 1-GB	512-MB, 1-GB	512-MB, 1-GB	512-MB, 1-GB	512-MB, 1-GB
Min/Max Memory	2 GB/ 12 GB	2 GB/ 12 GB	2 GB/ 12 GB	2 GB/ 12 GB	2 GB/ 12 GB	2 GB/ 12 GB
# CPU Enclosures	2	2	3	3	2	2
Total # Physical Processors in System	4	8	6	12	4	8

Marketing ID				
Processor	DMR	DMR	TMR	TMR
SMP	2-way	4-way	2-way	4-way
Processor speed	2.2GHz	3.0 GHz	2.8 GHz	2.8 GHz
Cache size	2 MB iL3	2 MB iL3	2 MB iL3	2 MB iL3
DIMM size	512-MB, 1-GB, 2-GB	512-MB, 1-GB, 2-GB	512-MB, 1-GB, 2-GB	512-MB, 1-GB, 2-GB
Min/Max Memory	2 GB/ 24 GB	2 GB/ 24 GB	2 GB/ 24 GB	2 GB/ 24 GB
# CPU Enclosures	2	2	3	3
Total # Physical Processors in System	4	8	6	12

1.5 System Specifications

1.5.1 10U Rack-Mount

Physical	
Height	**in. (cm) (10U)**
Width	**17.75 in. (45 cm)**
Depth	**29.23 in. (75 cm)**
System Weight	**lb (kg) to lb (kg)**
Environmental	
Operating temperature	**41°F to 95°F (5°C to 35°C)**
Maximum rate of temperature change during operation	**12°C/hr**
Relative humidity during operation	**10% to 80% (non-condensing)**
Relative humidity during storage	**To 95%**
Acoustic sound pressure limits	**55-65 dBA**
Heat dissipation	**6826 BTUs per hour**
Electrical	
Input voltage	**180–256 VAC; 50/60 Hz**
Output wattage	**2000 W (AC)**

1.5.2 V125 1U Monitor

Physical	
Height	1.75 in. (4.45 cm) (1U)
Width	19 in. (48.3 cm)
Depth	27 in. (68.6 cm)
Heat dissipation	153.5 BTUs per hour
Electrical	
Input voltage	100–240 VAC; 50/60 Hz
Output wattage	45 W (AC)

1.5.3 V122 17-inch Color VGA Monitor

Physical	
Height	16 in. (41 cm)
Width	16 in. (41 cm)
Depth	16.5 in. (40.8 cm)
Weight	30 lb (13.61 kg)
Heat dissipation	341.2 BTUs per hour
Electrical	
Input voltage	100–240 VAC; 50/60 Hz
Output wattage	100 W (AC)

1.5.4 D527 Ultra160 SCSI Storage Enclosure

Physical	
Height	5.22 inches (13.3 cm) (3U)
Width	17.5 inches (44.5 cm)
Depth	20 inches (50.8 cm)
Weight without disk drives	33 lb (15.9 kg)
Weight fully configured	75 lb (34 kg)
Environmental	
Operating temperature	32°F to 113°F (0°C to 45°C) Drives can operate at this temperature but should not be cold-started below 5°C.
Storage Temperature	-40°F to 158°F (-40°C to +70°C)
Maximum rate of temperature change	68°F (20°C) per hour
Relative humidity during operation	10% to 80% (noncondensing)
Relative humidity during storage	10% to 95% (noncondensing)
Operating altitude	-200 to 10,000 feet
Storage altitude	-200 to 40,000 feet
Heat dissipation	2296 to 2911 BTUs per Hour
Electrical	
Input voltage	85–264 VAC; 47/63 Hz
Output wattage	400 W (AC)

1.5.5 P41104 Power Distribution Unit (PDU)

Physical	
Height	1.75 in. (4.45 cm)
Width	19.1 in. (48.51 cm)
Depth	6.75 in. (17.15 cm)
Environmental	
Operating temperature	
-200 to 6,000 ft	40° F to 95° F (4.5° C to 35° C)
6,000 to 8,000 ft	40° F to 86° F (4.5° C to 30° C)
8,000 to 10,000 ft	40° F to 77° F (4.5° C to 25° C)
Storage Temperature (to 40,000ft.)	-38° F to 158° F (-40° C to 70° C Unvented) -38° F to 140° F (-40° C C to 60° C Vented)
Relative humidity during operation	10% to 80% non-condensing
Relative humidity during storage	To 95%
Heat dissipation	6 BTUs per Hour
Electrical	
Input voltage	200–240 VAC; 50/60 Hz

2. Operation and Troubleshooting Procedures

This section describes procedures related to ftServer 6600 system operation and solving problems with the hardware components. It covers various topics, including the following:

- System Startup
- System Shutdown
- Device IDs
- Troubleshooting Hardware Components
- Taking a Component Offline
- Bringing a Component Online

2.1 System Startup

Whenever the system is plugged into live AC outlets, low-level power is present in the ftServer system. This standby power enables the Baseboard Management Controller (BMC) to monitor the status of the system components, even when system power is off.

If the Windows operating system is not running, starting, or stopping, you can initiate a start-up sequence that will power-up the rest of the system and start Windows.

The system power button is located on the front of the system and functions as follows:

- If the system power is **off** and standby power is **on**, pressing the system power button turns the system power on and boots Windows.
- If the system power is **on** and Windows or the system BIOS is starting, stopping, or running, pressing the system power button will turn the system off.
- If the system power is **on** and Windows is completely shut down, pressing the live power button (the one whose LED is lit) on the I/O enclosure shuts down system power. (Standby power remains on.)

To initiate the power-up sequence, perform the following steps:

1. Make sure the system power cords are plugged into live AC outlets.

2. Turn on the monitor, any attached storage enclosures, and any other peripheral devices.

3. On the core I/O enclosure whose system power-button LED is lit, press the system power button to power on the rest of the system and boot Windows.

Figure 2-1. *System Power Button*
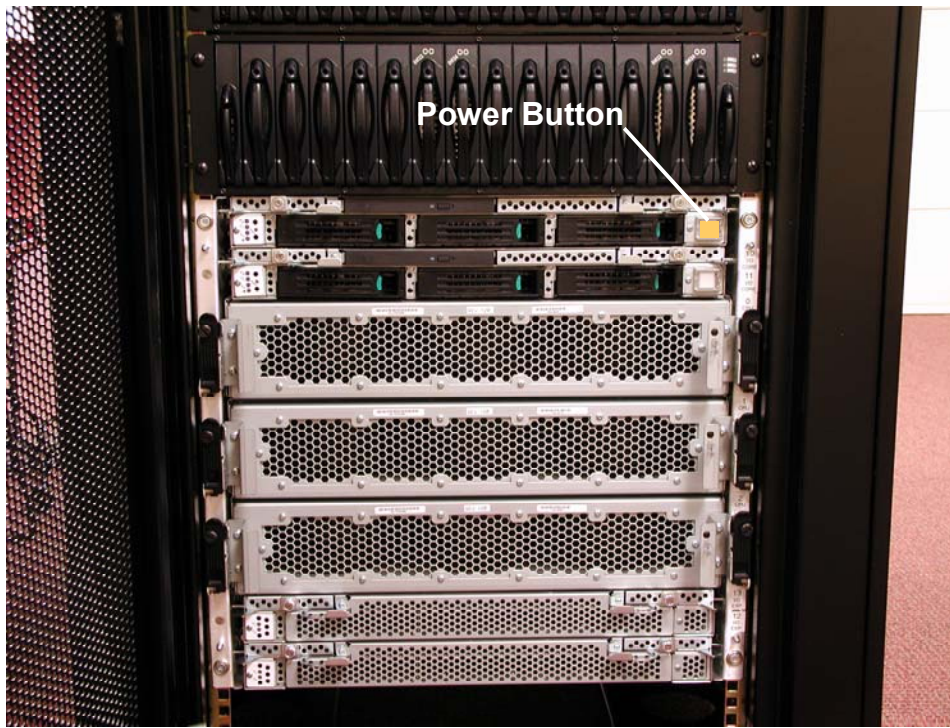
2.2 System Shutdown

Before shutting down the ftServer, warn all users that a shutdown is imminent so that they have time to save their files and exit their applications. Give users sufficient time to exit.

Perform the following procedure to gracefully shut down an ftServer system running Windows. Any Windows settings will be saved and the contents of memory are saved to disk. The operating system should always be shut down in this manner if at all possible.

1. Click the **Start** button on the Windows desktop and click **Shut Down**.

2. In the **Shut Down Windows** dialog box, select **Shut Down** and then click **OK**. A message states that your system is shutting down.

3. When the system displays the message `It is now safe to turn off your computer`, the system will turn off its power automatically.
   This removes main power from the system; however, standby power to the Baseboard Management Controller (BMC) remains on.

4. Turn off power to the monitor and any peripheral devices.

2.3 Device Ids

A device ID is an identifier used to physically locate hardware components within a Stratus system. Traditionally, Stratus Customer Service relies on the Device ID for identification of failed parts within the system cabinet. Windows provides no facility to relate a physical device location to a device driver.

A device ID is a 64-bit value divided into 8 separate bytes. Each byte represents a physical layer of hardware in the system. These bytes are also called Levels. Levels are DECIMAL values ranging from **0** through **254**, allowing for a maximum of 255 unique values. The Value **255** is reserved and represents an end marker (called a null Device ID value) for parsing the 64-bit Device ID.

Device IDs are represented in the system as a series of / separated decimal numbers without the end marker. Examples are **0**, **0/2** and **10/0/1**.

It is desirable to be able to make associations between devices. For example, a core I/O board has PCI adapters plugged into it, and if the core I/O board breaks, these PCI adapters will subsequently be non-functional. This so called 'parent to child' relationship needs to be clearly articulated within a Customer Service call by the system management software, since the failure of the parent (in this case the core I/O board) has caused child devices (the PCI adapters) to fail. In this case, the PCI adapters should not be replaced since the core I/O board is the only faulty device.

A component's address, or Device ID, is a hierarchical number where each level is used to represent different layers of the physical hardware in an ftServer system. Device IDs are derived using a top-down approach, starting with the highest layer. Each additional layer provides finer granularity and detail. Each level in the Device ID represents a replaceable unit.

The following subsections describe the device IDs.

2.3.1 Level 1 Devices

Level 1 devices fit directly into the system chassis. Level 1 devices are CPU enclosures, I/O enclosures, clock cards, and SCSI storage enclosures.

They are shown in the following table.

Level 1 Device	Range of Device IDs
CPU Enclosures	0-9
I/O Enclosures	10-19
Clock Cards	20-29
SCSI Storage Enclosure	Start at 40 and increment by 1.

2.3.2 Level 2 Devices

Level 2 devices consist of components that plug into Level 1 devices. Level 2 devices include memory modules (DIMMs), processors, PCI slots, SCSI disk slots, power supplies, and temperature sensors.

Examples of Level 2 devices are shown in the following table.

Level 2 Device	Range of Device IDs	Examples
Core/Expansion I/O Enclosure Slots	0-99	10/0, 10/1, 10/2
CPU Enclosure Processors	20-39	0/20, 0/21
CPU Enclosure Memory Modules	0-19	0/0, 1/0
Power Supplies	100-109	0/100, 2/100
Fans	110-119	40/110, 40/112
Ultra160 SCSI Enclosure Disk Drive Slots	0-99	40/1, 40/14, 41/1
Temperature Sensors	120-139	

2.3.3 Level 3 Devices

Level 3 devices include ports on SCSI PCI adapters (SCSI buses). These are assigned addresses of 1 and 2.

2.3.4 Level 4 Devices

Level-4 devices include SCSI targets on a SCSI bus connected to a specific port on a specific SCSI PCI adapter. Note that these devices are typically represented by two different Level-4 devices (one for each port connected to the bus) and may also be represented as Level-2 devices within a storage enclosure. Typically, the SCSI target device ID are NOT displayed for end users but may be used internally where appropriate.

2.4 Troubleshooting Hardware Components

ftServer systems provide hardware- and software-based methods of troubleshooting system hardware. Hardware-based troubleshooting is implemented through light-emitting diodes (LEDs). Software-based troubleshooting is accomplished by means of the **ftServer Manager**.

This section provides general information and guidelines for troubleshooting hardware failures in the ftServer system. For more information about monitoring and troubleshooting the system, refer to the *Stratus ftServer: System Administrator's Guide (R014W)*

2.4.1 Hardware-Based Troubleshooting

ftServer 6600 systems signal hardware status through LEDs, or status lights. LEDs are located on the front (only) of the CPU enclosure, and on the front and rear of the core I/O enclosure.

During the boot process, the ftServer Access Adapter (ftSAA) verifies that components of CPU and I/O enclosures, such as clock cards, are present and performing normally before the ftSAA turns that enclosure on. If a component has failed, the ftSAA removes power from that enclosure. As a result, the LEDs on an enclosure may be lit briefly and then turn off, or the LEDs may not be lit at all, indicating a failed component of the enclosure.

2.4.1.1 CPU Enclosure LEDs

Each CPU enclosure has two LEDs, a red and a green-amber. They are located at the front .

The following table describes the meaning of the status LEDs when lit and shows what action, if any, should be taken.

LED	Meaning	Action
Red	The CPU enclosure is broken.	Replace CPU enclosure.
Amber	The CPU enclosure is operating simplexed. Taking it offline will crash the system.	Return the offline CPU enclosure to service.
Red and Green	CPU enclosure is testing.	Wait.
Green	CPU enclosure is operating duplexed.	None.
Clear (unlit)	No standby power present.	Check that the enclosure is inserted correctly. Verify that AC power cords are connected or take other measures to supply AC power to the system.

2.4.1.2 Core I/O Enclosure LEDs

The LEDs on the core I/O enclosure are located on the front and rear of the enclosure.They consist of the following:

1. Baseboard Management Controller (BMC) status
2. Core I/O enclosure status
3. Disk activity/fault
4. Disk power, read/write
5. System power button and LED
6. Core I/O enclosure status
7. PCI adapter slot status
8. Ethernet port LEDs
9. 10/1000 Ethernet port
10. 10/100 Ethernet port

Baseboard Management Controller (BMC) LED

The BMC LED indicates the status of the BMC and the ftServer 6600 system as a whole.

Each core I/O enclosure has a BMC LED. The primary BMC LED is the one on the I/O enclosure whose power button is lit (the primary enclosure). The secondary BMC LED is the one on the other I/O enclosure (the secondary enclosure). When a system is running in duplex with no error, only the primary BMC LED lights. This is the power button that powers the system on and off. The secondary BMC assumes operation and control of the system if the primary BMC goes offline.

The BMC LED is a single bicolor LED that either lights green, red, or amber (green and red together), or goes unlit to signify the states described in the following table.

NOTE: The LED states defined in the following table are signaled only by the BMC LED on the primary I/O enclosure, except where noted.

LED	Meaning	Action
Red	The BMC is not ready.	Wait.
Blinking red	BMCs are synchronizing, or the BMC firmware versions are incompatible.	Wait for synchronization to end. If condition continues indefinitely, install compatible BMC firmware versions.
Green	The system is operating normally	None.
Blinking green	System is operating simplexed. Taking it offline will crash the system.	Restore offline enclosure to service.
Amber	The system has a critical condition (e.g., over-temperature condition).	Refer to system administration documentation to identify the critical condition and take actions to correct it.
Blinking Amber	On a single core I/O enclosure: The system has a noncritical warning condition (e.g., a secondary BMC failure).	Refer to system administration documentation to identify the critical condition and take actions to correct it.
	On both core I/O enclosures: the system clock card has failed.	Shut down system and replace the clock card.
Clear (unlit	Power to the primary I/O enclosure, and therefore to the system is off. (The secondary BMC is off when the primary I/O enclosure is operating.)	Check that the enclosure is inserted correctly. Verify that AC power cords are connected, or take other measures to supply AC power.

Core I/O (and Expansion) Enclosure Status LEDs

Each core and expansion I/O enclosure includes two pairs of LEDs to describe the status of the enclosure: one in the front and one in the back of each enclosure. Each pair consists of one red LED and one green-yellow LED.

The following table describes the core and expansion I/O enclosure LED states.

LED	Meaning	Action
Red	Enclosure is broken.	Replace I/O enclosure.
Red and Green	Testing.	Wait.
Green	Enclosure is running duplexed.	None.
Amber	Enclosure is running simplexed. Taking it offline will crash the system.	Restore offline I/O enclosure to service.
Clear (unlit)	Standby power is off.	Verify that AC power cords are connected, or take other measures to supply AC power to the system.

Disk Activity LED

A single red-green LED indicates the status of disk activity of all of the disks within that core I/O enclosure. This LED is different from the LEDs on the individual SCSI disk drives.

The following table describes the Disk Activity LED states.

LED	Meaning	Action
Blinking Green	Disk activity in one or more SCSI disk.	None.
Amber	Disk fault in one or more SCSI disk.	Determine which disk has the fault. Verify that it is properly installed. If necessary, replace the disk.

SCSI Disk-Drive LEDs

Each core I/O enclosure supports three SCSI disks. Each SCSI disk has a single green-amber LED on its front side.

The following table explains the SCSI disk LED states.

LED	Meaning	Action
Green	Disk and power are present.	None
Blinking green	Disk activity.	None.
Amber	Disk error.	Verify that the disk is properly installed. If necessary, replace the disk.

PCI Slot Status LEDs

The core I/O enclosure contains three, single, bicolor (red-amber) LEDs to describe the status of each of the three PCI slots within that enclosure. The three LEDs are only at the rear of the enclosure.

The following table describes the PCI slot status LEDs.

LED	Meaning	Action
Red	The PCI adapter is broken.	Replace the PCI adapter.
Amber	The PCI adapter is operating simplexed. Taking it offline will result in lost connectivity.	Insert identical adapter in corresponding slot in the other I/O enclosure.
Clear (unlit)	The PCI slot is operating duplexed, or is empty.	if the PCI slot is operating duplexed, take no action.

Ethernet LEDs

Each core I/O enclosure contains two Ethernet ports: a 10/100 Mbit port and a 100/1000 Mbit port. Each of these ports has two integrated LEDs: a green and an amber. The Ethernet ports and their LEDs are located at the rear of the enclosure. The 10/100 Mbit port is on the right; the 100/1000 Mbit port is on the left.

The following table describes the ethernet LEDs.

LED	Meaning	Action
Green	**Connection or activity taking place**	**None**
Blinking green	**Receiving or transmitting data.**	**None.**
Amber	**10/100 Mb port: 100 Mb connection speed.** **100/1000 Mb port: 1000 Mb connection speed.** **Connection or activity.**	**None.**

2.4.1.3 Ultra160 SCSI Enclosure

The Ultra160 SCSI storage enclosure and its associated, integrated subsystems (Cluster Services Module (CSM),Advanced Cooling Module (ACM), and power supplies) include a number of LEDs that supply status information.

LED Module LEDs

The Ultra160 SCSI enclosure's LED module has three LEDs labeled P, S, and F that report the status.

The LEDs are described in the following table.

LED	Meaning
P LED, Power On (Green)	**On when power is applied to the enclosure. Off when power is not applied.**
S LED, Split-Bus (Green)	**On when bus is in split-bus mode.**
F LED, Fault (Amber)	**Off when enclosure has no fault; on when it has a fault.**

Disk Drive LEDs

Each disk drive contains two status LEDs, which are visible from the front of the Ultra160 SCSI enclosure.

The LEDs are described in the following table.

Name	Color	Description	Safe to Remove Disk Drive?
Disk Drive State LED (located on the right)	**Solid green**	**Illuminates when the disk drive is initialized (contains at least one volume or partition) and mirrored, or when the disk drive is uninitialized.**	**Yes**
	Solid amber	**Illuminates when the disk drive is initialized but not mirrored.**	**No**
	Blinking amber	**Illuminates when a fault occurs within the disk drive.**	**Yes**
	Slow blinking green	**lluminates when the storage enclosure is first powered on (in its initial state) or when the disk drive is offline.**	**No, if the storage enclosure has just been powered on.** **Yes, if the disk drive is offline**
	Fast blinking green	**Illuminates when the disk drive is being identified (when you select the disk drive through ftSMC for identification).**	**No**
Disk Activity LED (located on the left)	**Solid green**	**Illuminates when the disk drive is active (performing read/write operations).**	**No**

ACMs and Power Supply LEDs

The Ultra160 SCSI enclosure ACMs and power supplies include the status-reporting LEDs. The audible alarm button shown is permanently disabled through firmware, although it beeps once upon successful completion of the CCM power-on self-test (POST).

1. ACM fan 1 LED

2. ACM fan 2 LED

3. Power supply fault LED

4. Power on LED

5. Audible alarm button

The Ultra160 SCSI enclosure ACM and power supply status-reporting LEDs are described in the following table.

Component	LED	Meaning
ACM LEDs and Alarm Button	**Fan 1 LED (Amber)** **Fan 2 LED (Amber)**	**These light only when the CSM detects a fan fault.**
	Audible alarm button	**The alarm is disabled by ftServer software.**
Power Supply LEDs	**Power On (Green)**	**Lights when the power supply is on and operating normally.**
	Fault LED (Amber)	**Lights steadily when the CSM detects a power-supply fault.**

CSM LEDs

The CSM controls and monitors a number of the storage enclosure's operations.

In split-bus mode, the two Bus A LEDs on the left CSM and the two Bus B LEDs on the right CSM (as seen from the rear) are steadily lit green.

The ES activity LED is on when the CSM's ES module is active. It is off when the ES is in standby mode.

2.4.1.4 SCSI Disk Drive and CD-ROM Drive Problems and Solutions

System Disk Drives

The following table lists some possible problems that the system disk drives may encounter, as well as some corrections.

Problem	Action
Disk Fault LED is illuminated.	A fault has occurred within the disk drive. Replace disk drive.
System will not boot from system disk.	Ensure that the disk drive boot is enabled through the BIOS setup program. For more information, see the Windows Help system.
	Try to boot from the system disk's mirrored partner. To do so, unlatch the suspected faulty system disk.
Cannot access data.	Some files may contain viruses. Run a virus-scan utility on the disk drive.
	Some files may be corrupted. Use the Emergency Repair Disk (ERD) to help repair problems with system files. For more information, see the Windows Help system.
Slow response time	The disk drive may be full. Ideally, at least 15 percent of the disk drive should be free. Delete unnecessary files, or move files to another disk drive.
	The disk drive may need to be defragmented. To defragment a disk, use the Disk Defragmenter tool of Windows. For more information, see the Windows Help system.
	Mirror regeneration may be occurring. Try to schedule mirror regeneration for a time when the system is not heavily used. However, if the disk contains business-critical data, you should regenerate the mirrors as soon as possible.
	The disk drive may be reading a compressed file. In the future, avoid compressing files that are heavily used.
	Many read or write operations may be queued to the disk drive. If the ftServer Software Availability Manager indicates an unusually high number of disk requests outstanding, you should examine how your applications are using the disks. For more information about the ftServer Software Availability Manager, see the *Stratus ftServer Software Availability Manager User's Guide* (R007W).
	Errors may be occurring on the drive. Check the system event log.

CD-ROM Drives

The CD-ROM drive has a single LED (the Busy Indicator) that indicates whether the drive is busy. It does not have an LED that indicates whether a fault has occurred.

The following table lists some possible problems that the CD-ROM drive could encounter, as well as some corrections.

Problem	Action
CD-ROM drive is not working properly	**Ensure that the disc has been inserted correctly.**
	Check for environmental problems that can damage disc media and drive heads. Environmental problems can result from airborne contaminants (smoke, steam, dust, and ashes) or radiated interference (hand-held receivers, communications and radar installations, and radio/television broadcast transmitters).
	Check that no paper or plastic label, or any residue, is attached to the surface of the disc that is in use.
	Ensure that the correct drivers are installed.
System cannot read disc	**Ensure that the disc is clean and does not contain any scratches.**
CD-ROM drawer will not open	**Insert a straightened paper clip into the emergency eject hole.**
System will not boot from CD-ROM drive	**Ensure that the CD-ROM boot is enabled through the BIOS setup program. For more information, see the Windows Help system.**

2.4.2 Software-Based Troubleshooting

When a fault or some other event occurs at a hardware device, for example, a PCI card failure or an environmental monitor exceeding a threshold, the device driver notifies the **ftServer Manager (ftSM)**. If **ftSM** determines that the event is significant, as defined by the ftServer's Policy Service, it forwards the event notification to the Alarm Service for processing. The Alarm Service then forwards the notification as follows:

- Event information is recorded in the Windows Event Log.

- The user is notified by email or pager, depending on user configuration of the ftServer Manager.

Hardware errors are detected by the system hardware and evaluated by the maintenance and diagnostics software. After a hardware error, the software directs the affected device to self-test. If the device fails the test, the error is called a *hard error* and the device is taken out of service. If the device passes the test, the error is called a *soft error*.

The system takes the device out of service and places it in the *Broken* state under the following circumstances:

- The error is a hard error.
- The error is a soft error and the MTBF (Mean Time Between Failures) threshold for the device has been reached.

If the error is a hard error and the MTBF threshold has not been reached, the system attempts to enable the device and return it to service.

In addition, **ftSM** continuously copies the ftServer Windows Event Log to the ftServer Access Host Log on both ftServer Access adapters so that support personnel can retrieve the log in the event of a failure of the ftServer system.

Information about hardware failures can be viewed from various sources:

- Windows Event Log
- ftServer Access Logs
- System Inventory from the ftServer Management Console

Windows Event Log

The Windows Event Viewer can access three log files:

- Application log - records events about system applications.
- Security log - records events about system security.
- System log - records events about general system activity.

Hardware failure information is contained in the system log. These logs are accessed through the Windows **Administrative Tools**, using the **Event Viewer** option.

To access the **Event Viewer** go to

Start → Programs → Administrative Tools → Event Viewer

For more information about these logs, what they contain, and how to access them, refer to the the *Stratus ftServer: System Administrator's Guide (R014W)*

ftServer Access Logs

The **ftServer Access Console (ftSAC)** displays two logs: the **Host log** and the **ftSA log**. The **Host log** contains messages related to events occurring on the ftServer system. The **ftSA log** contains messages related to events occurring on the **ftSA**. These logs are accessed through the **Logs** tab of the **ftSAC** user interface. For more information about these logs, what they contain, and how to access them, refer to the *Stratus ftServer Access User's Guide (R003W)*

To connect to ftServer Access

1. In a Web browser, specify the IP address of one of the ftServer Access Adapters, followed by a forward slash (/), as the Address or Location. For example:

2. Log on to the ftServer Access Console.

To examine entries from the host log

1. On the **Logs** tab, scroll down to the box labeled **Host Log**.

2. To select the number of entries you want to see, click the **View Log Entries** list above the **Host Log** box and click a setting.

3. Click **Refresh** to update the log entries with the most recent entries.

To examine entries from the ftServer ftSA log

1. On the **Logs** tab, scroll down to the box labeled **ftSA Log**.

2. To select the number of entries you want to see, click the **View Log Entries** list above the **ftSA Log** box.

3. Click **Refresh** to update the log entries with the most recent entries.

System Inventory (Component Status)

The ftServer System Inventory, which is accessible through the **ftServer Management Console (ftSMC)**, displays a tree-list of system components. Next to each component name is an icon that indicates the status of the component. A failed component is indicated by a white X in a red circle. This condition causes a warning icon (yellow triangle with !) to appear next to all parent nodes of the failed node. The error icon appears next to the SCSI slot that failed, and the warning icon appears in the three nodes that precede the failed node.

To determine that a component failed

1. Go to **Start** ➜ **Programs** ➜ **Administrative Tools**

2. Click on **Console.msc**

3. In the Console tree, click on the ftServer node.

4. Look for **Warning** or **Error** icons. If you see a **Warning** icon, click the plus sign (+) in front of nodes that have a **Warning** icon until you see an **Error** icon indicating the component that has failed.
   For example, **Warning** icons appear in these three nodes and the **Error** icon appears beside the SCSI Slot that has a problem, as shown below.
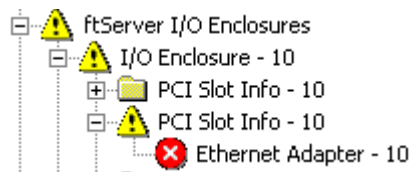
5. Click the problem node and check the MTBF: Current value in the Details pane. If it is less than the MTBF: Threshold value, the node has failed and the system takes it out of service. For example:

```
MTBF: Time of Last Fault May 30, 2001 15:07:24
MTBF: Threshold 300 seconds
MTBF: Number of Faults 2
MTBF: Current 220 second
```

For more information about System Inventory, refer to the the *Stratus ftServer: System Administrator's Guide (R014W)*

2.5 Taking a Component Offline

In the **ftSMC** Console tree, select and right-click the failed component.

From the pop-up menu, select **Initiate Bring Dow**n. This results in shutting down the component.

> **N O T E:** If the failed component is a mirrored disk, break the mirror before shutting the failed disk down.

If you are going to remove a disk, first confirm that the disk's mirror is present and functioning. If the mirror is present, go to Windows **Disk Management** and break the mirror. To break a mirror, right-click one of the disks and select **Break Mirro**r.

To determine what disks are mirrored, go to Windows **Disk Management**. The logical disks that have the same drive letter are a mirrored pair. Replace the component and bring the replaced component back online. See the next subsection.

2.6 Bringing a Component Online

In the **ftSMC** Console tree, select and right-click the new component.

From the pop-up menu, click **Initiate Bring Up**. This results in bringing the component online.

3. CRU Hardware Removal and Replacement Procedures

This section lists the Customer Replaceable Units (CRUs) in the ftServer 6600 system and describes the removal and replacement procedures for each one.

In most instances, CRUs are duplexed and can be removed and replaced without total removal of power. However, in some instances, the system must be shut down and both main power switches turned off prior to CRU removal and replacement.

3.1 List of CRUs

The following table lists the CRUs in the ftServer 6600 system.

Component	Part Number
CPU Enclosure - Large Cache (No memory or CPU)	AA-G92200
CPU Enclosure - Small Cache (No memory or CPU)	AA-G92500
Core I/O Enclosure	AA-E90100
Expansion I/O Enclosure	AA-E89900
PCI Adapter	AA-UXXX00
Core I/O Enclosure Fan Assembly	MA000569
Core I/O Enclosure CD-ROM Drive	AA-D55100
Core I/O Enclosure Disk Drive	AA-D53XX0
Core I/O Enclosure LED PCB	AA-E70600
Expansion I/O Enclosure Fan Assembly	MF-000574
Expansion I/O Enclosure LED PCB	AA-E70700
System Cage with Backplane	AA-E71700
Connector I/O PCB	AA-E71800
Clock Card	AA-E71900
Ultra160 SCSI Enclosure	AA-D52001
Ultra160 SCSI Enclosure Advanced Cooling Module (ACM)	MF000041
Ultra160 SCSI Enclosure Cluster Services Module (CSM)	AA-E52200
Ultra160 SCSI Enclosure LED Module (Right)	AA-000385
Ultra160 SCSI Enclosure LED Module (Left)	AA-000386
Ultra160 SCSI Enclosure Disk Drive	AA-D52XX0

3.2 Power Removal

If total power removal is required, the system must be shut down prior to removing power and rebooted after the replacement unit is installed.

1. To shut down the ftServer system, click the **Start** button on the Windows desktop and click **Shut Down**.

Figure 3-1.   Start Menu
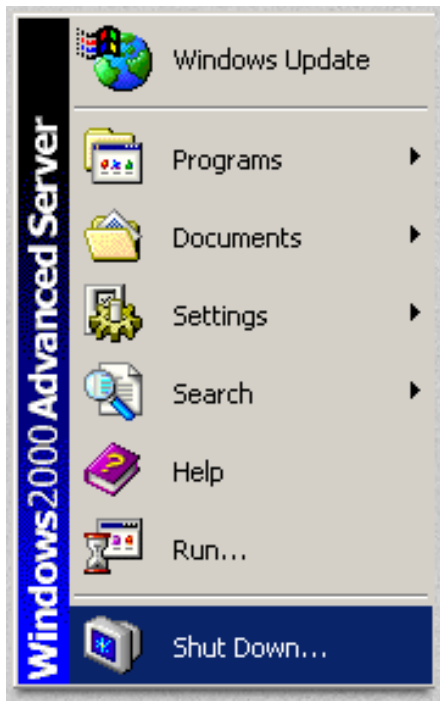
2. In the **Shut Down Windows** dialog box, select **Shut Down** and then click **OK**. A message states that your system is shutting down.

Figure 3-2.   Shut Down Window

3. When the system displays the message `It is now safe to turn off your computer`, the system will turn off its power automatically.
This removes main power from the system; however, standby power to the Baseboard Management Controller (BMC) remains on.

4. Turn off power to the monitor and any peripheral devices.

5. At the back of the system, remove the two AC power cords connected to the backplane power outlets.

Figure 3-3.   AC Power Cords
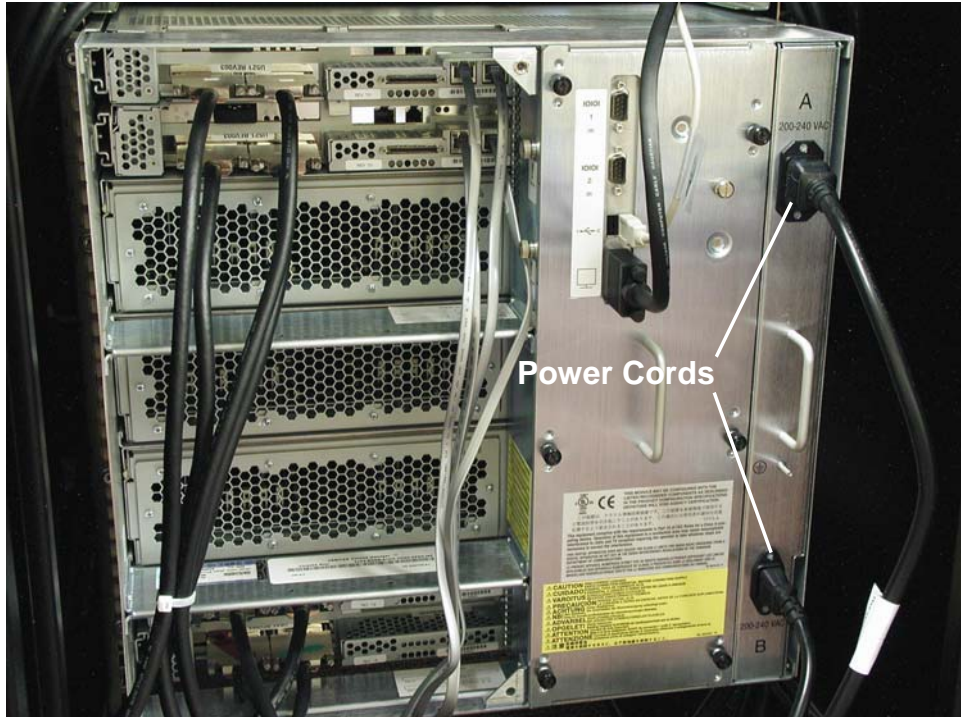
3.3 Handling ESD Sensitive Parts

Clock cards and PCI adapters are particularly sensitive to damage from electrostatic discharge (ESD) because the electronic components are exposed when the device is not fully installed.

Caution: To avoid damaging these parts during handling, always take the following precautions.

- Always store cards and adapters in their static-protective envelope until you are ready to install them in the system.

- Always hold an adapter or card by its edges.

- Always ground yourself before handling a clock card or a PCI adapter, or before removing or replacing the I/O enclosure. Ground yourself by wearing a grounding strap.

3.4 Hardware Removal Procedures

This section contains the removal procedures for the CRUs listed in the preceding table. Each of these procedures indicates any power removal requirements for the CRU.

To perform the replacement procedure for each CRU, reverse the removal procedure. If any special replacement considerations are necessary, a replacement note is included.

3.4.1 CPU Enclosure

If the CPU enclosure is still in service, take it out of service as follows:

1. On the desktop, double click the **ftServer Management Tools** icon.

Figure 3-4. *ftServer Management Tools Icon*
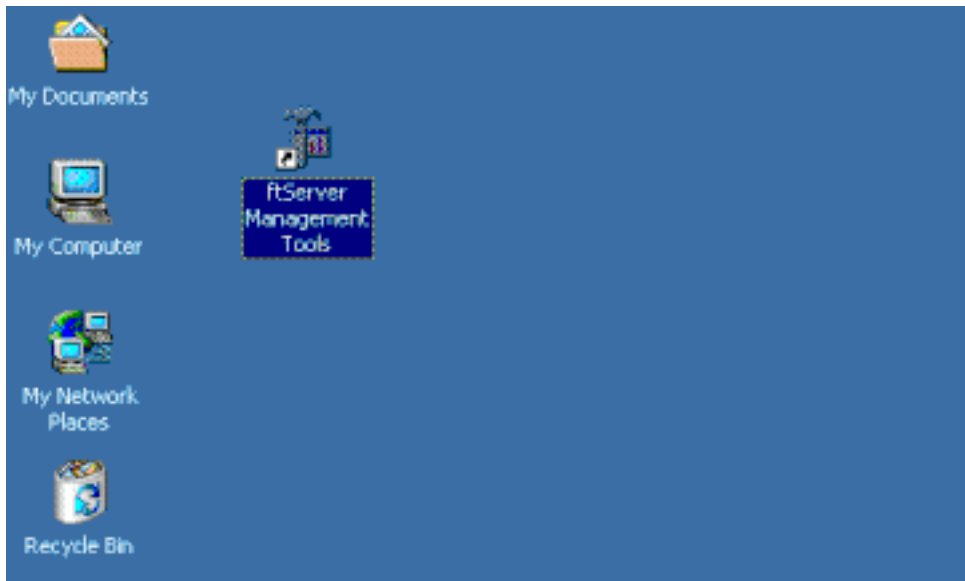
2. On the **ftServer Management [Console Root]** screen, select **Console Root**.

Figure 3-5.   ftServer Management Console Screen
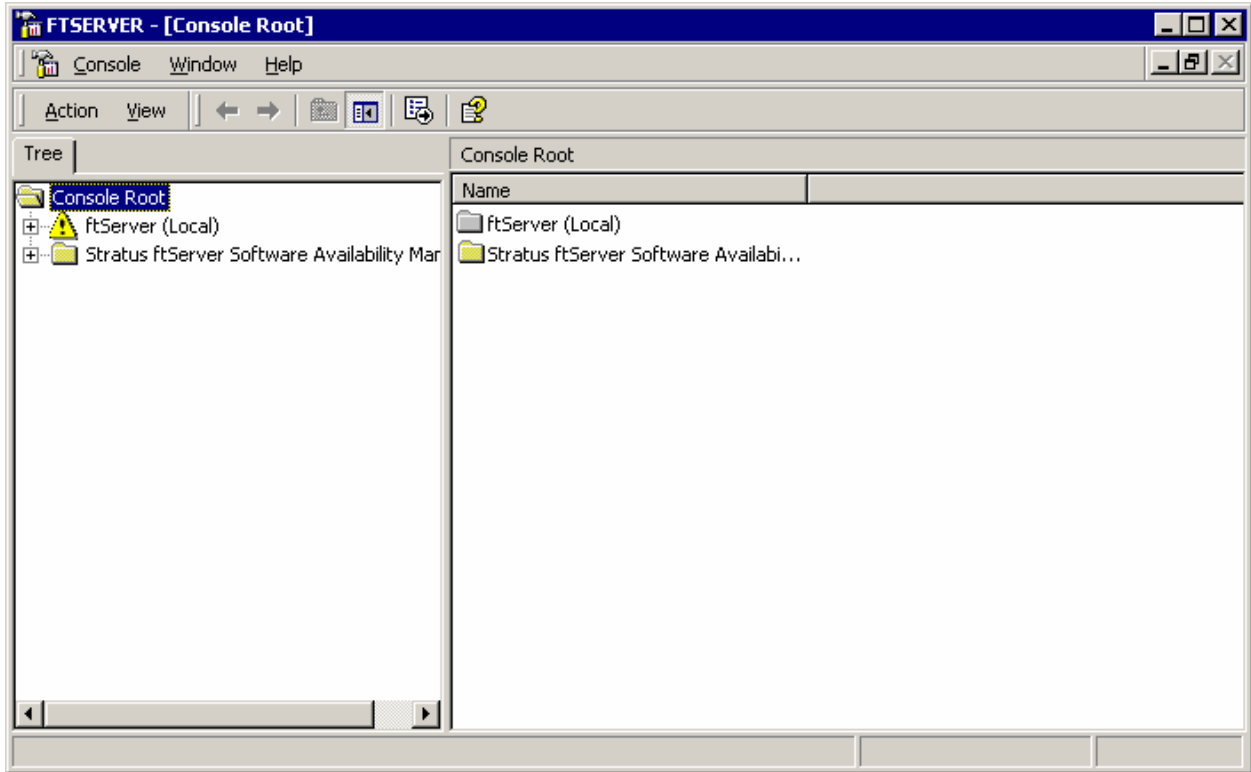
3. Select **ftServer (Local)**.

Figure 3-6.   Console Root Screen
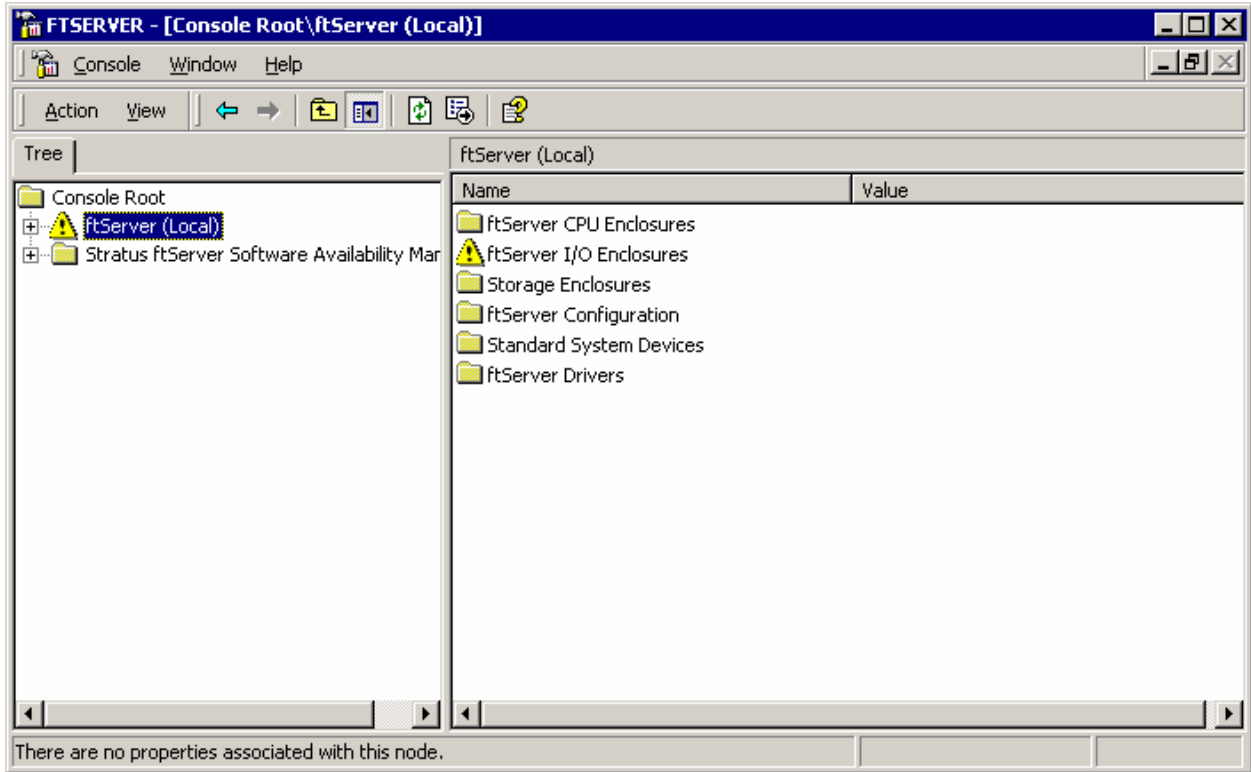
4. Select the CPU enclosure you want to remove.

Figure 3-7.   ftServer CPU Enclosures Screen
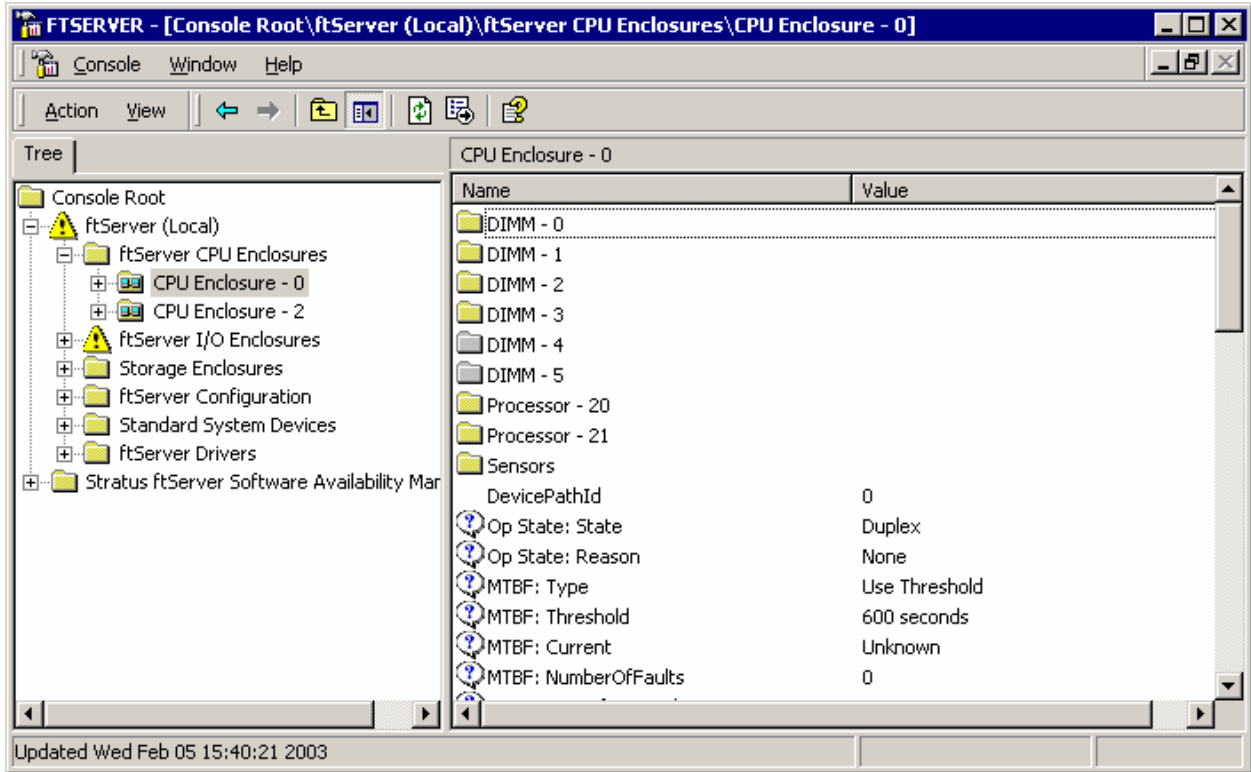
5. In the **Action** menu, click **Initiate BringDown**.

Figure 3-8.   Action Menu Screen
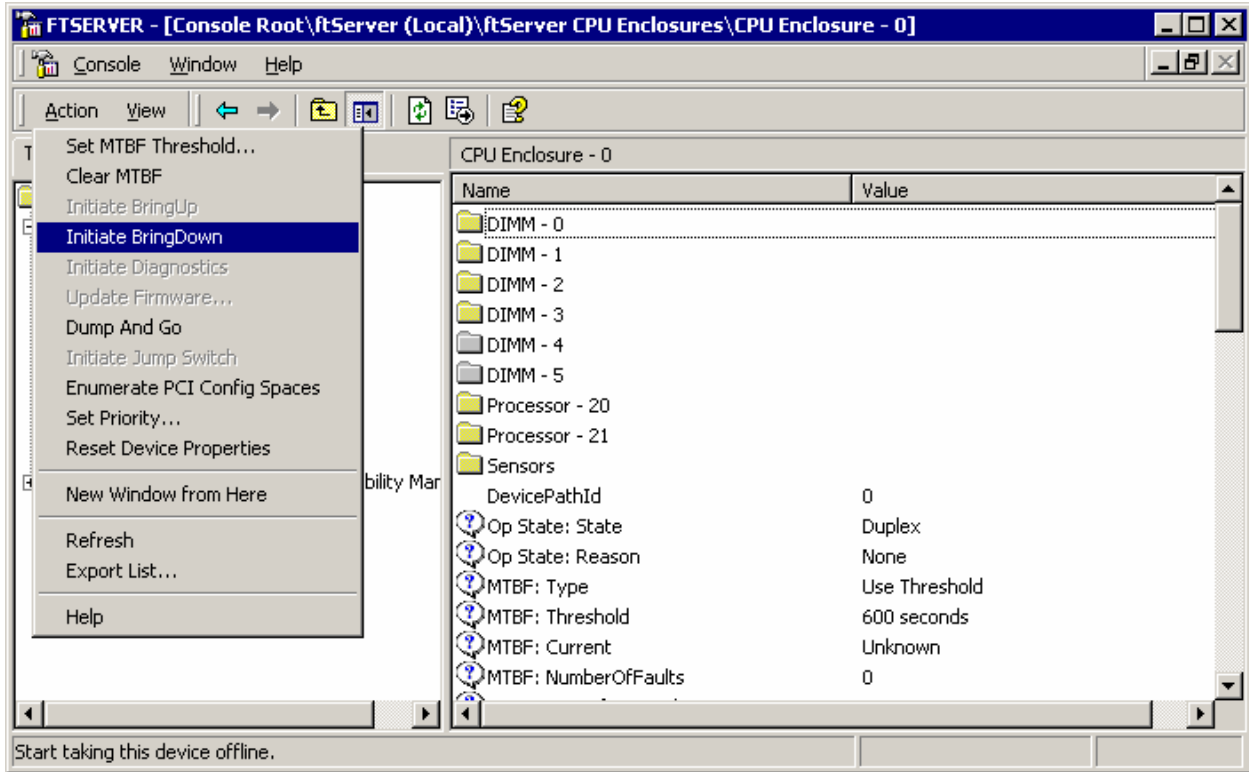
6. When the following screen appears, click on **Yes**.

Figure 3-9.   Warning Screen
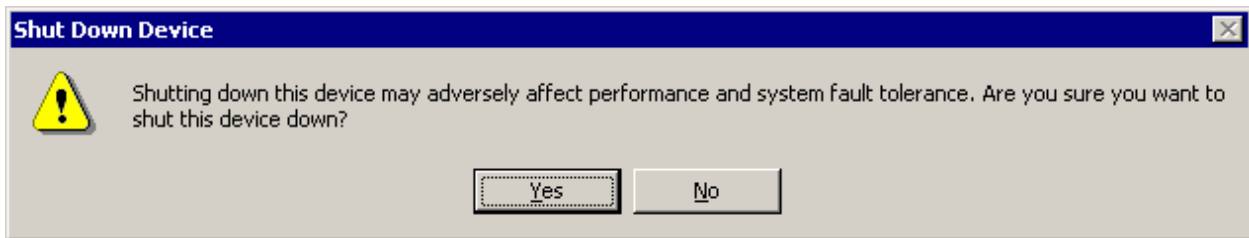
7. Monitor the status of the device to determine that it has been taken offline. Click **OK** to the message that appears.

Figure 3-10.   Message Screen
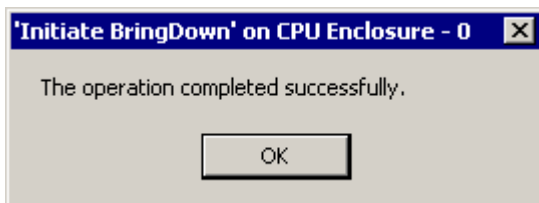
For detailed information about how to use the **ftServer Management Console**, see the *Stratus ftServer: System Administrator's Guide (R014W)*

8. At the front of the enclosure, loosen the two thumbscrews and pull the two ejector levers out.

Figure 3-11.   CPU Enclosure Thumbscrews and Ejector Levers
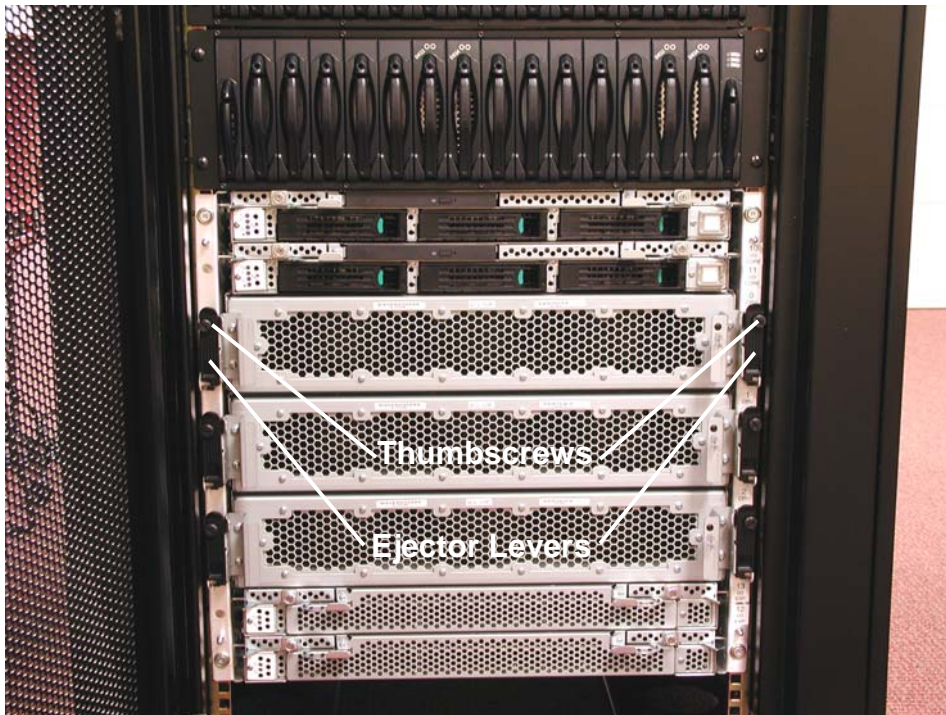
9. Carefully pull the enclosure straight out until it stops. Press down on the stop lever on the right side of the enclosure and pull the enclosure all the way out.

Figure 3-12.   CPU Enclosure Stop Lever

REPLACEMENT NOTE: When installing the enclosure make sure that the enclosure is correctly aligned with the appropriate rails on both sides. It should be perfectly level.

3.4.2 Core/Expansion I/O Enclosure

The following procedure describes the steps for removing an ftServer 6600 I/O enclosure. To perform the replacement procedure for the I/O enclosure, reverse the removal procedure.

If the I/O enclosure is still in service, take it out of service as follows:

1. On the desktop, double click the **ftServer Management Tools** icon.

Figure 3-14.   Desktop
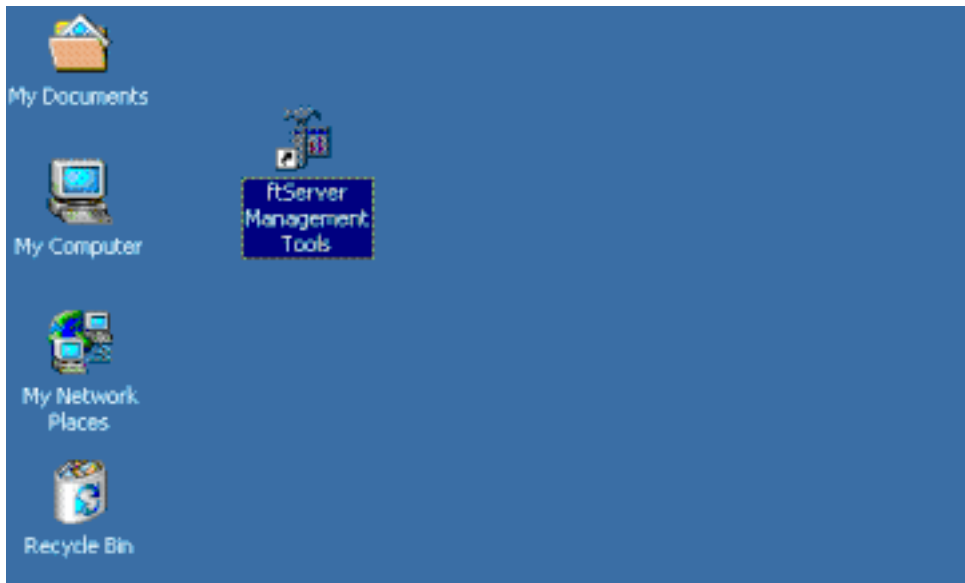
2.   On the **ftServer Management [Console Root]** screen, select **Console Root**.

Figure 3-15.   ftServer Management Console Screen
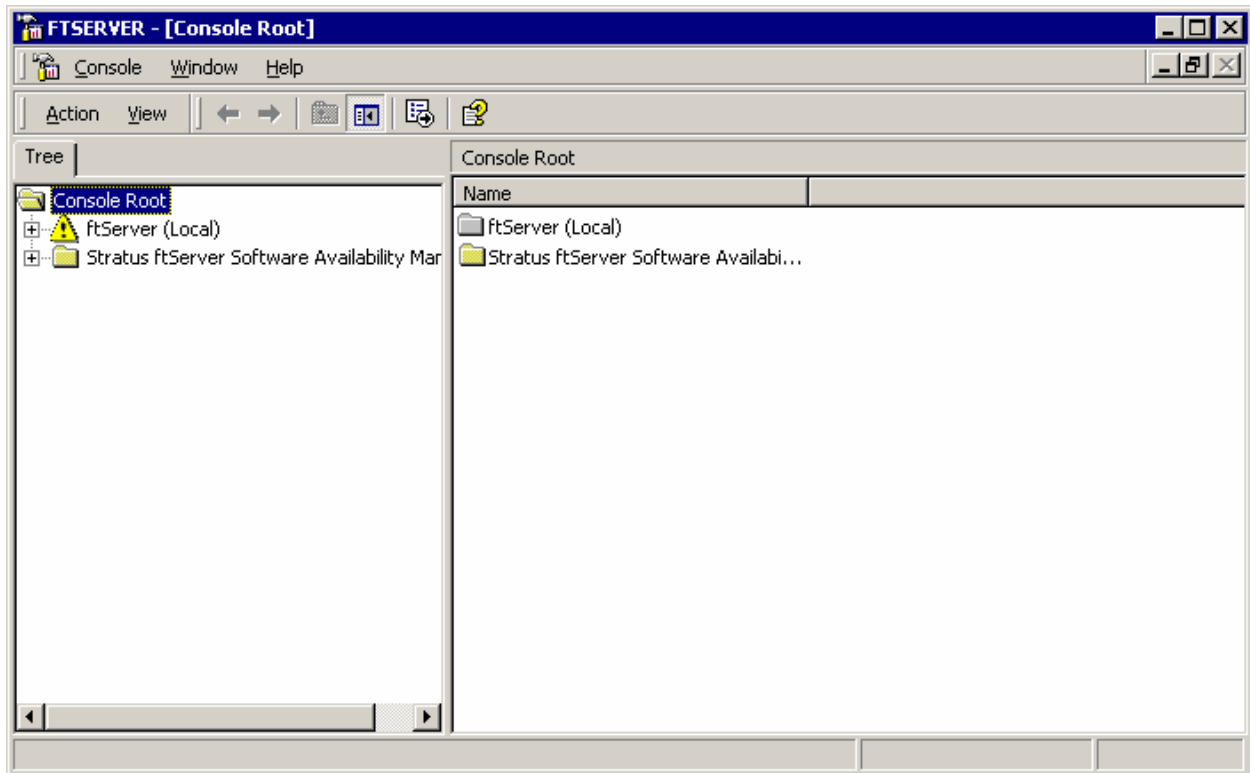
3. Select **ftServer (Local)**.

Figure 3-16.   Console Root Screen
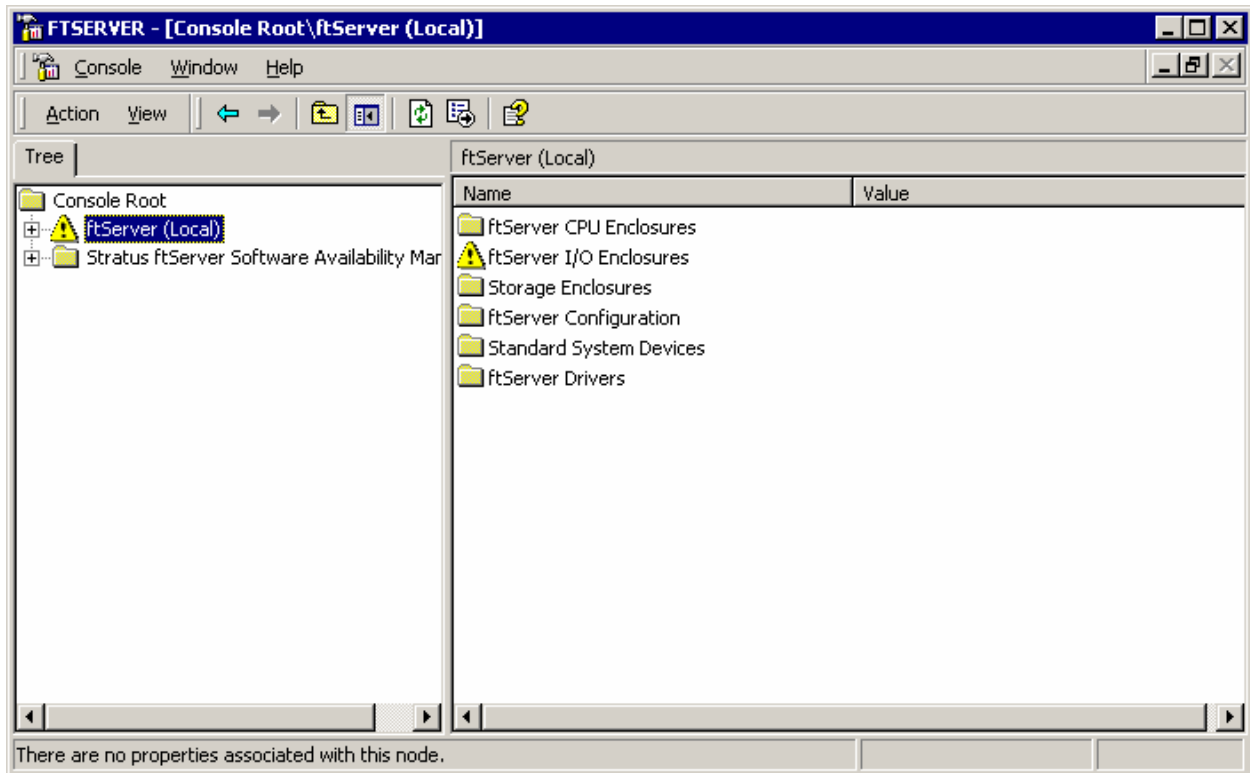
4. Select the I/O enclosure you want to remove.

Figure 3-17. ftServer I/O Enclosures Screen
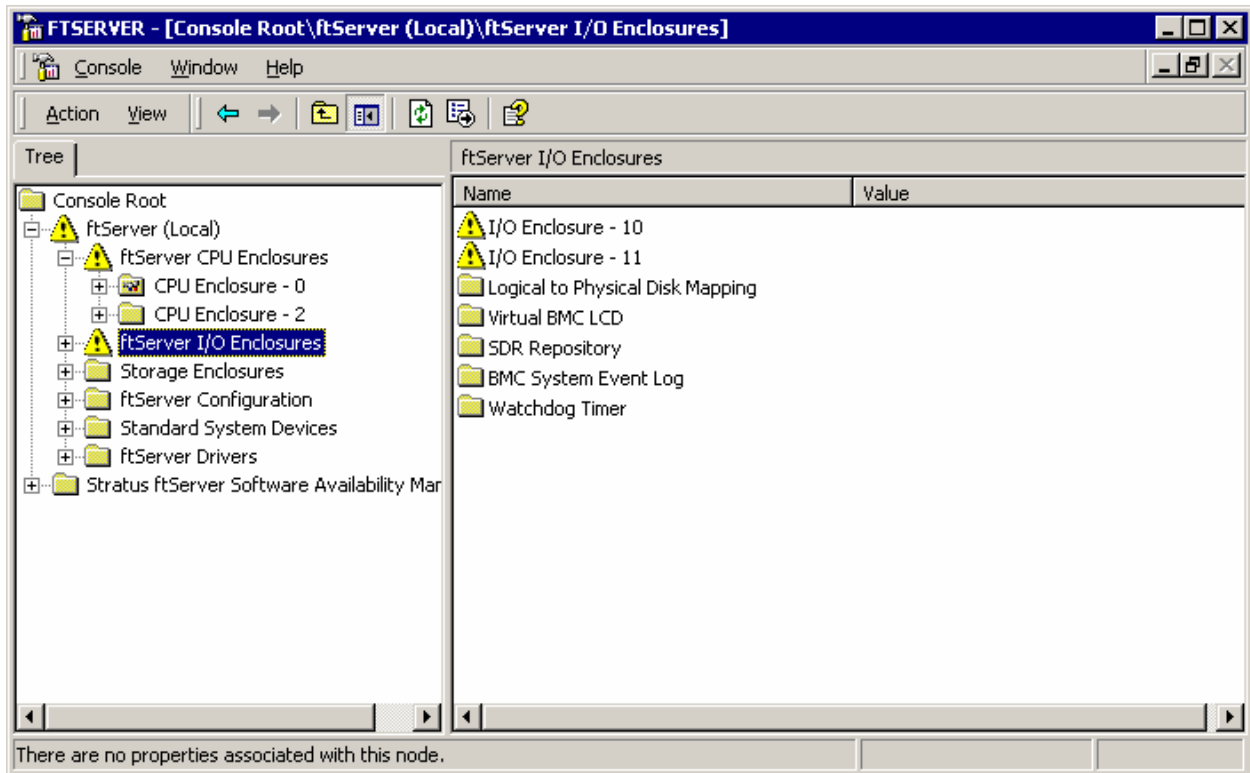
5. In the **Action** menu, click **Initiate BringDown**.

Figure 3-18.   Action Menu Screen
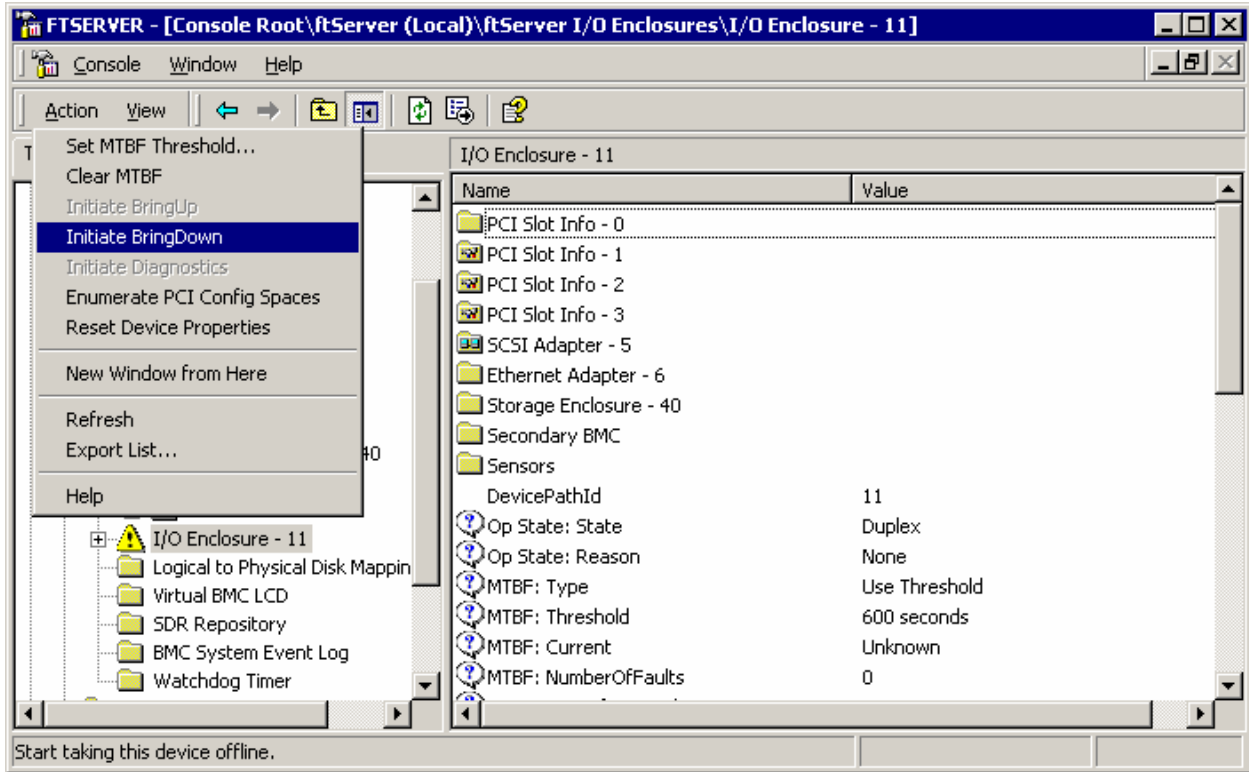
6. When the following screen appears, click on **Yes**.

Figure 3-19.   Message Screen 1
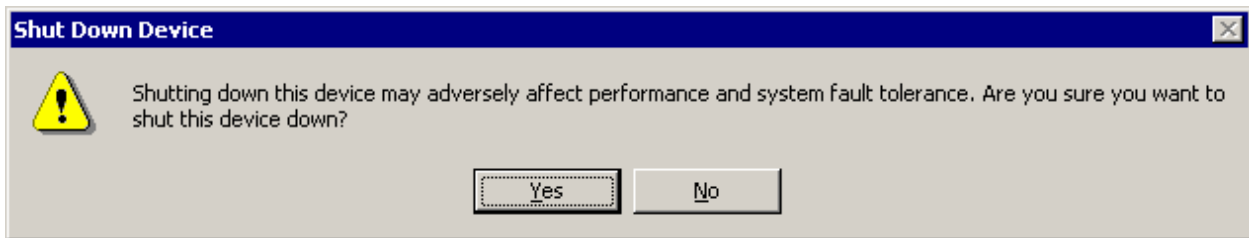
7. Monitor the status of the device to determine that it has been taken offline. Click **OK** to the message that appears.

Figure 3-20.   Message Screen 2
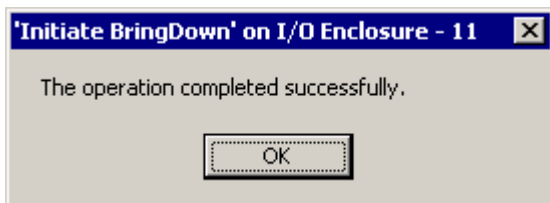
For detailed information about how to use the **ftServer Management Console**, see the *Stratus ftServer: System Administrator's Guide (R014W)*

8. Disconnect all cables from the back of the enclosure.

Figure 3-21.   I/O Enclosure Cables
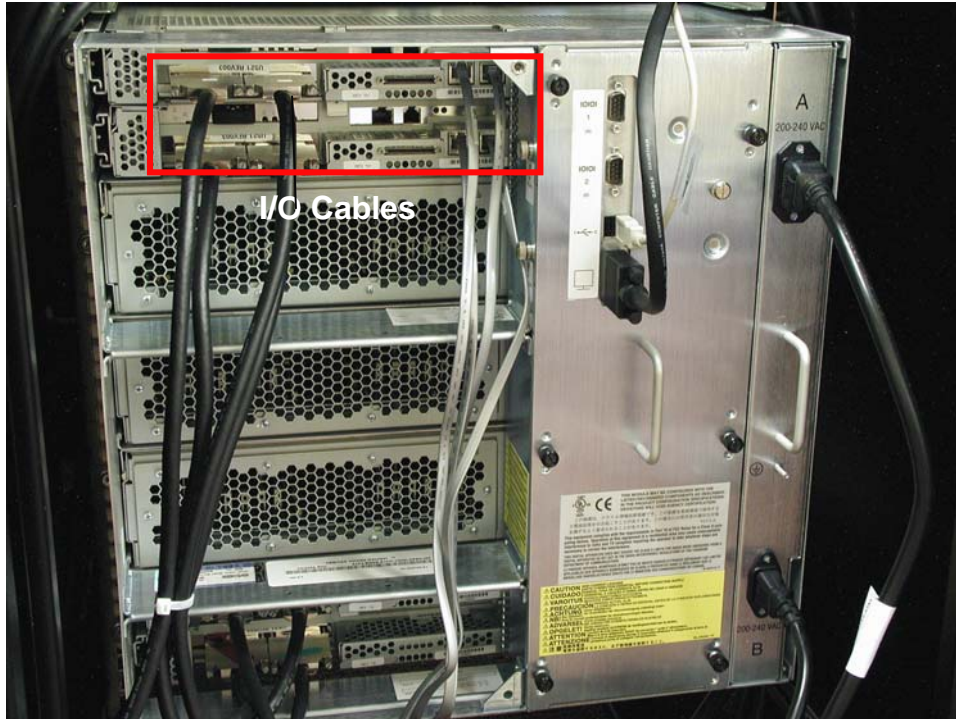
9. Loosen the two thumbscrews at the front of the enclosure and pull the two ejector levers out.

Figure 3-22.   I/O Enclosure Thumbscrews and Ejector Levers
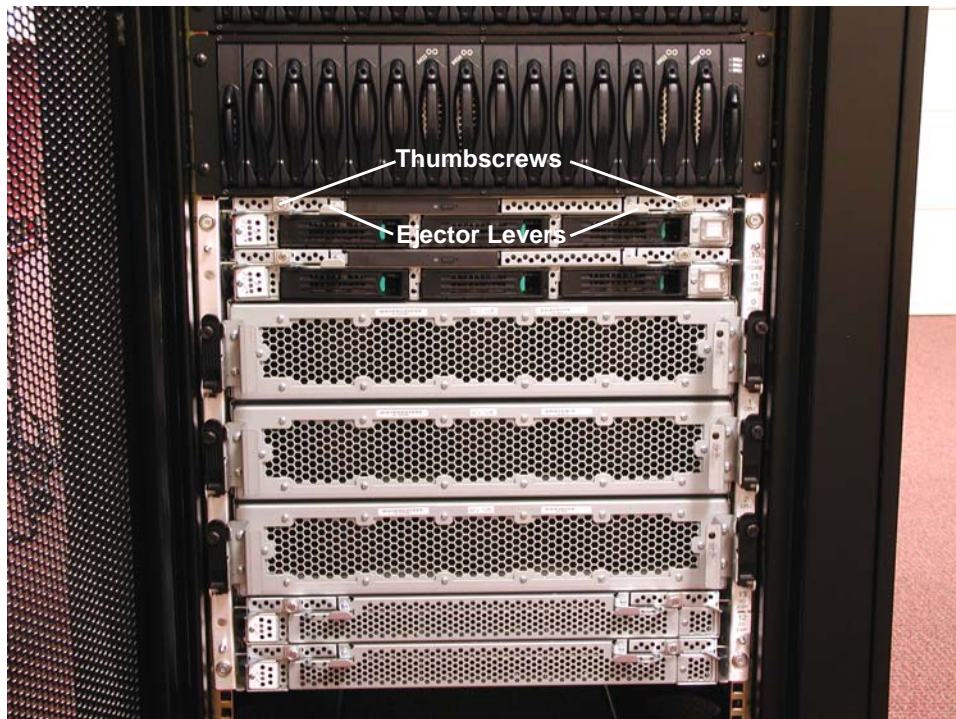
10. Carefully pull the enclosure straight out until it stops. Press down on the stop lever on the right side of the enclosure and pull the enclosure all the way out.

Figure 3-23.   I/O Enclosure Stop Lever

REPLACEMENT NOTE: The back of each core and expansion I/O enclosure is keyed to fit only into its type of I/O enclosure slot. Be sure that the enclosure is correctly aligned with the appropriate rails on both sides. It should be perfectly level.

3.4.3 I/O Enclosure Cover

1. Remove the I/O enclosure as described in Section 3.4.2.

2. Remove the three screws securing the enclosure cover.

Figure 3-24.   Enclosure Cover Screws
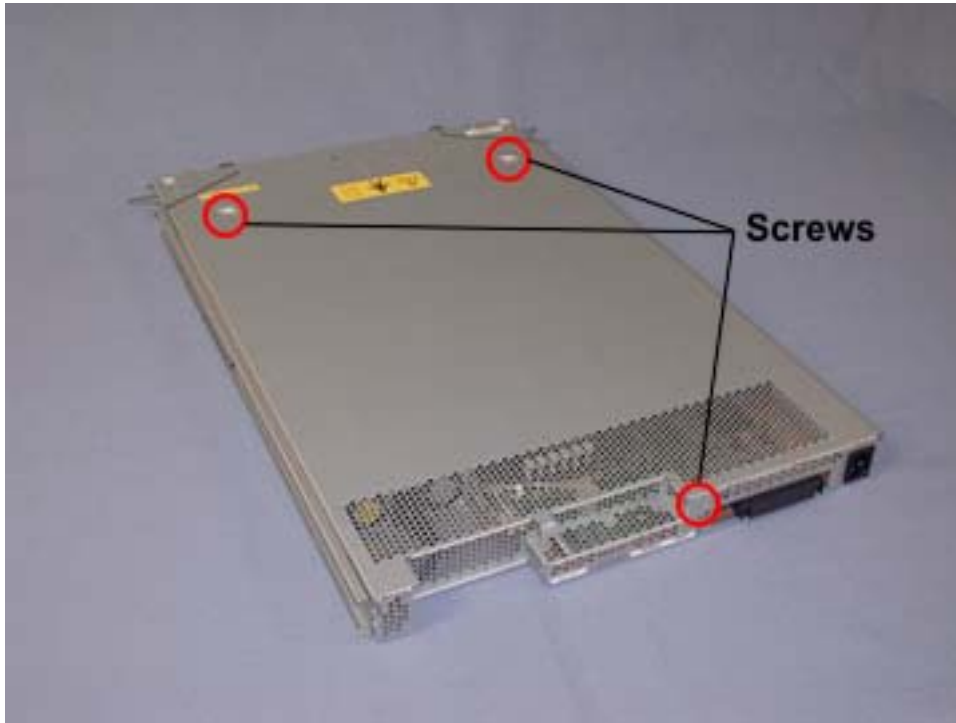
3. Slide the cover straight back towards the rear of the enclosure.

Figure 3-25.   Removing Enclosure Cover

REPLACEMENT NOTE: When sliding the cover onto the enclosure, make sure the four tabs on the back of the cover align with their holes in the back of the enclosure frame. The tapered ends of the top front portion of the cover must fit beneath the tapered ends of the enclosure front frame top.

3.4.4 PCI Adapter

1. Remove the I/O enclosure containing the PCI adapter as described in Section 3.4.2.

2. Remove the I/O enclosure cover as described in Section 3.4.3.

3. To remove the ftSAA or Video adapter in a core I/O enclosure, remove the retaining clip securing it to the chassis.

Figure 3-27.   Retaining Clip
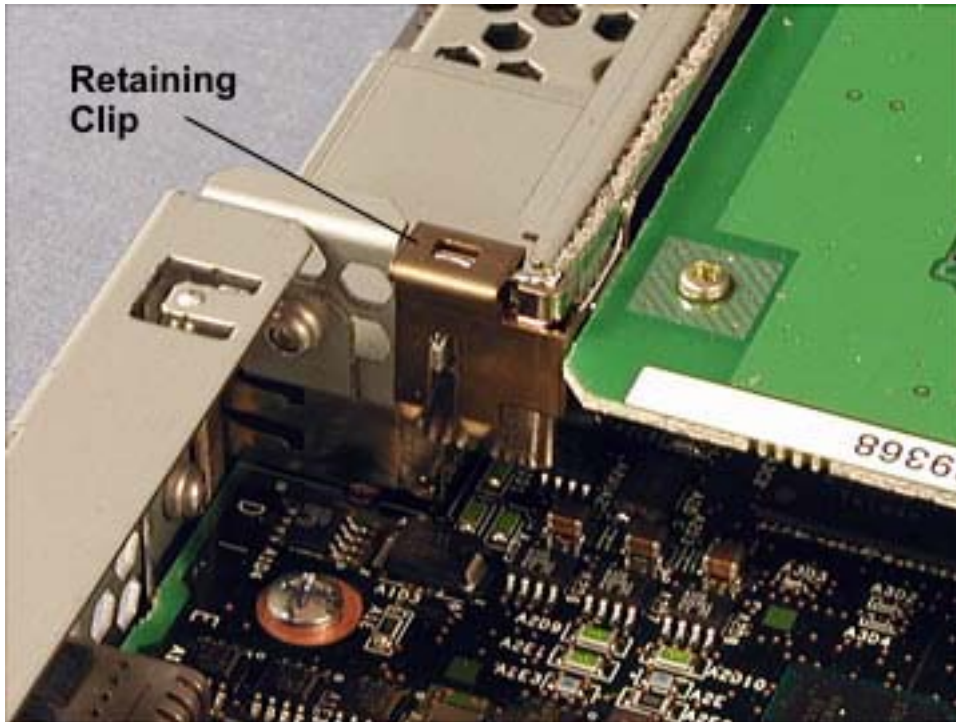
4. If this is the ftSAA, remove the screw from the stabilizing bracket and then remove the bracket.

5. To remove any of the other adapters, first remove the clip that secures the PCI adapters by pulling it straight upward.

Figure 3-28.   Retaining Clip in Core I/O Enclosure
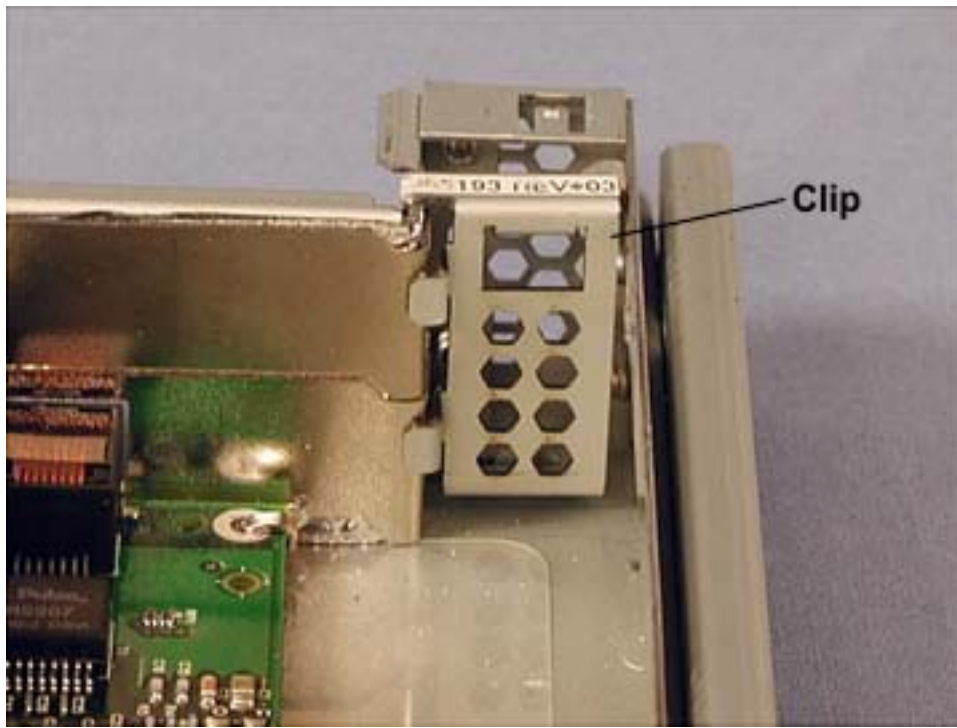
Figure 3-29.   Retaining Clip in Expansion I/O Enclosure
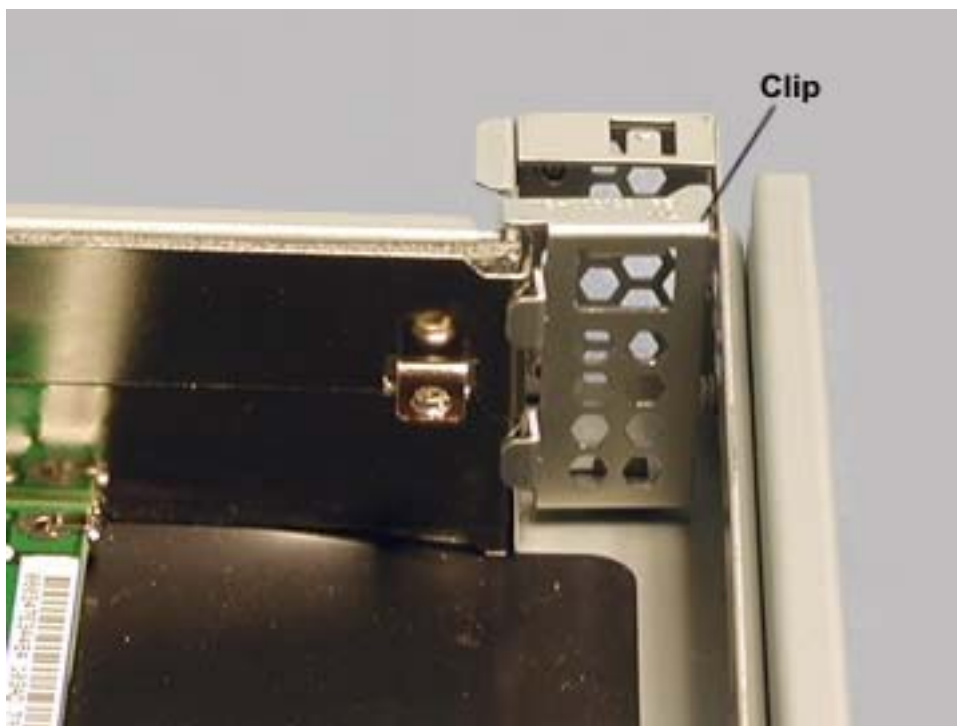
6. Pull the PCI adapter horizontally out of its connector

3.4.5 Core I/O Enclosure Fan Assembly

1. Remove the core I/O enclosure as described in Section 3.4.2.

2. Remove the I/O enclosure cover as described in Section 3.4.3.

3. Remove the three screws securing the fan assembly.

Figure 3-30.   Fan Assembly Screws
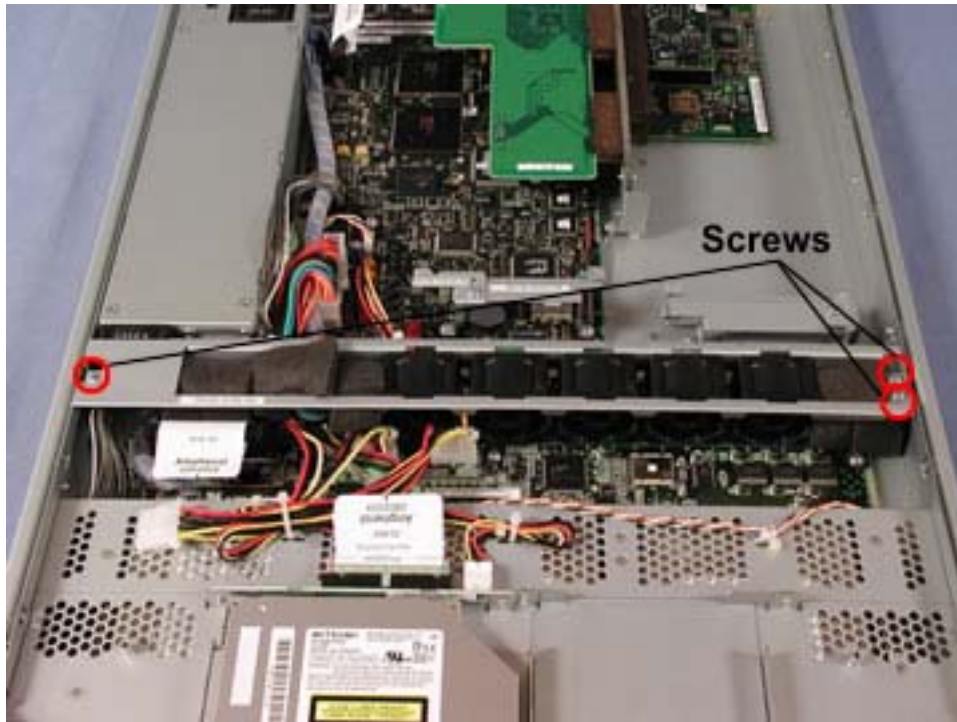
4. Disconnect the five fan assembly power cables from the core I/O board.

Figure 3-31.   Fan Assembly Power Cable Connections
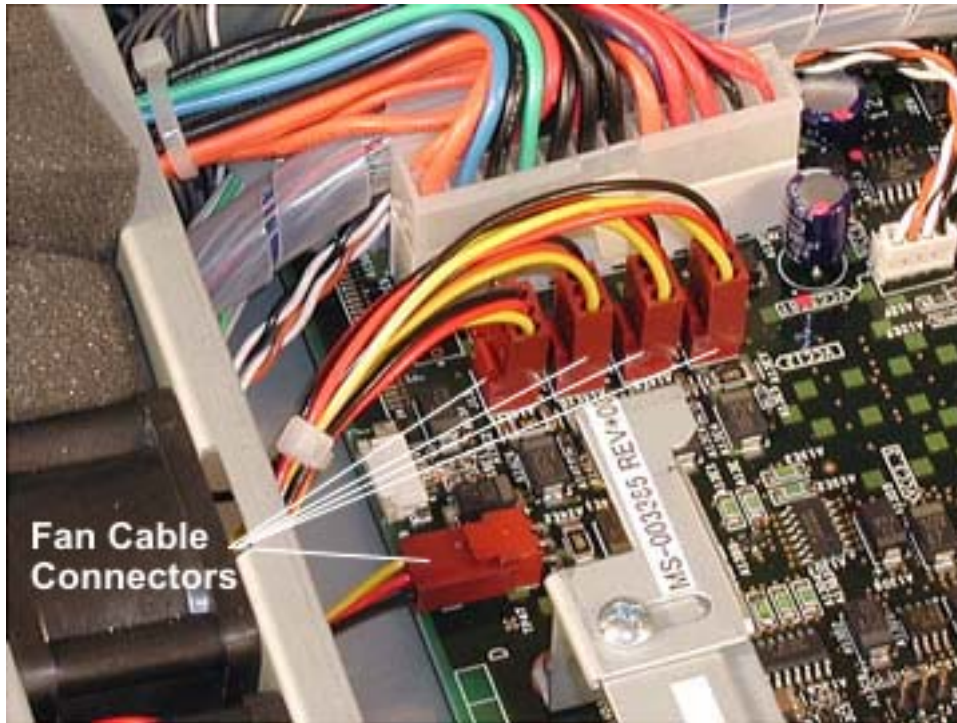
5. Lift the fan assembly straight up to remove it from the enclosure.

3.4.6 Core I/O Enclosure Disk Drive

The procedure assumes that the disk drive being removed is mirrored by another drive on the system.

> **N O T E:** Before you remove a disk drive, you should use **VERITAS Volume Manager**, **ftSMC** or **Logical Disk Manager (LDM)** to ensure that the disk has failed. If you are removing a disk drive that has **not** failed (for example, if you are upgrading a disk drive), **VERITAS Volume Manager** or **LDM** will not list the disk drive as failed. In this case, you must use **VERITAS Volume Manager** or **LDM** to remove the disk drive's mirror and to add it back after you insert the replacement disk drive.Use **VERITAS Volume Manager** to verify that all disk drives are mirrored and healthy. (For more information about configuring disk mirroring, see the *Stratus ftServer: System Administrator's Guide (R014W)* and *VERITAS Volume Manager 2.7 for Windows 2000 User's Guide* .

> **C A U T I O N:** Before you remove a mirrored disk drive, it is **critical** that you know which disk drives the disk drive is mirrored with. For information about determining which disk drives are mirrored, see the *Stratus ftServer: System Administrator's Guide (R014W)*

1. Press in the green tab at the end of the disk-drive lever and pull the lever out to its fully open position.

Figure 3-32.   Removing a SCSI Disk Drive

2. Pull the disk drive straight out of the enclosure.

3.4.7 Core I/O Enclosure CD-ROM Drive

Before removing the CD-ROM drive from the core I/O enclosure, you must remove the I/O enclosure from service.

1. Take the core I/O enclosure containing the CD-ROM drive out of service as described in steps 1-6 in Section 3.4.1. Do not remove the enclosure.

2. At the front of the enclosure loosen the two thumbscrews.

Figure 3-37.   I/O Enclosure Thumbscrews
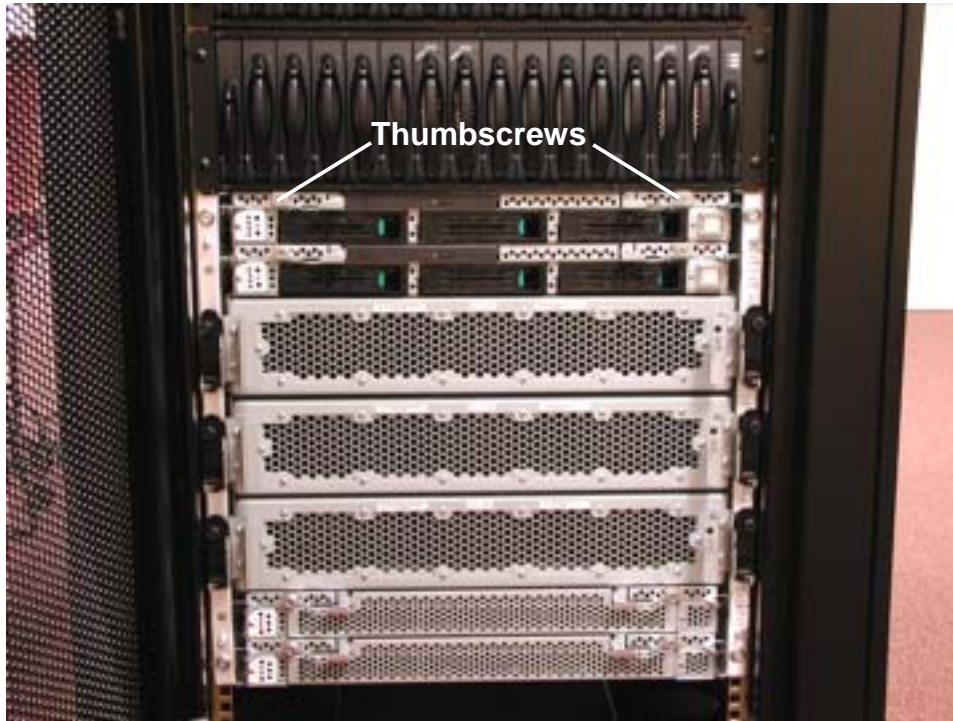
3. With the core I/O enclosure removed from service, open the enclosure's left ejector lever enough to access the screw that secures the CD-ROM drive and remove the screw at the front of the CD-ROM drive.

Figure 3-38. I/O Enclosure Ejector Lever and CD-ROM Screw
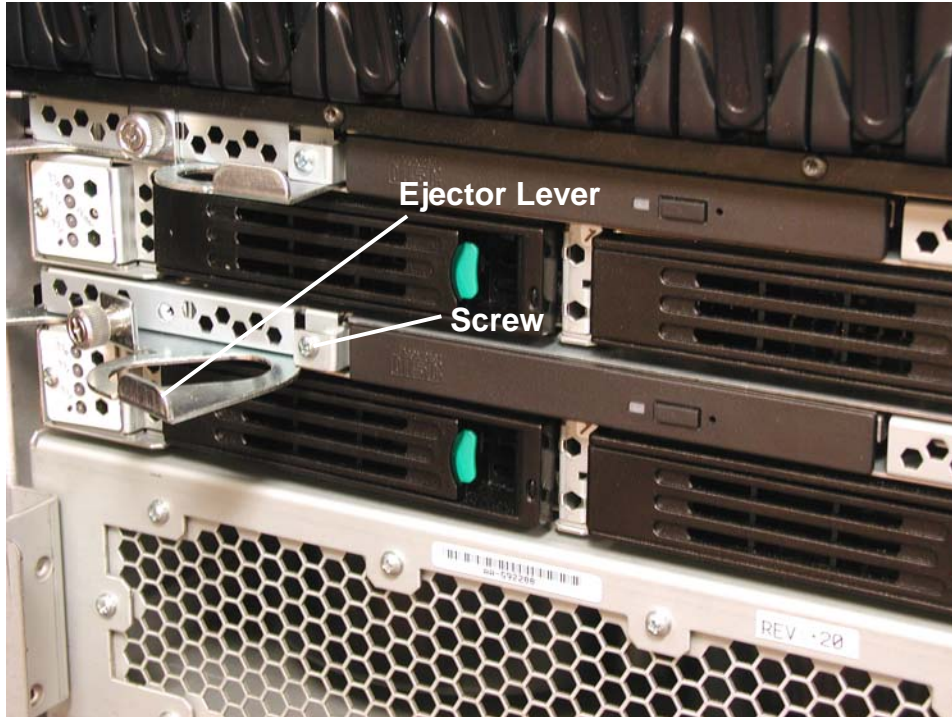
4. Hold the tab on the left side of the CD-ROM drive and pull it out of the enclosure.

Figure 3-39.   CD-ROM Tab
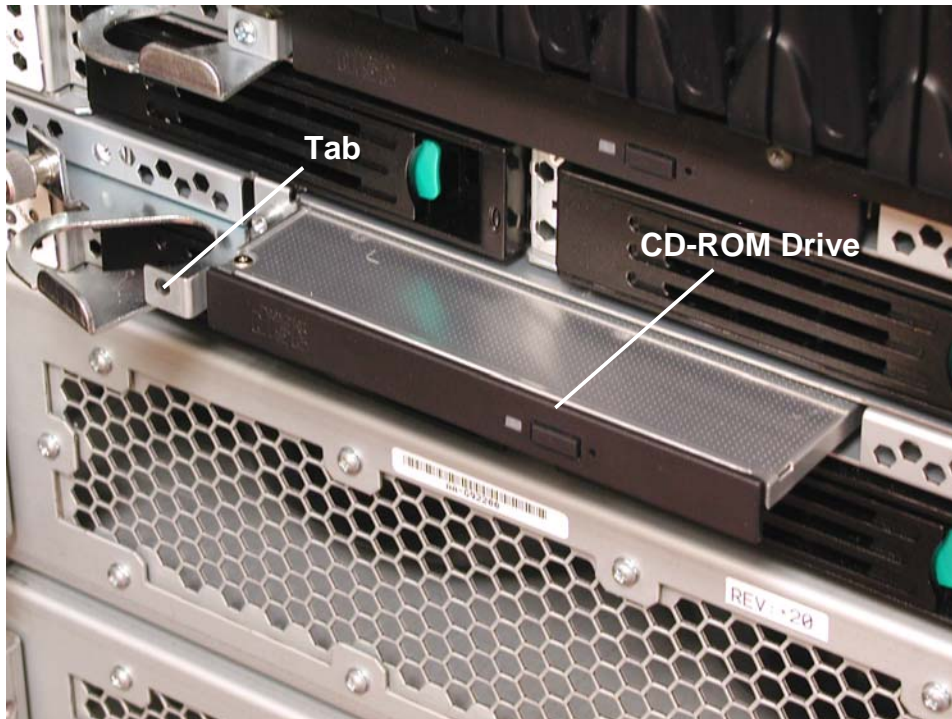
3.4.8 Expansion I/O Enclosure Fan Assembly

1. Remove the expansion I/O enclosure as described in Section 3.4.2.

2. Remove the I/O enclosure cover as described in Section 3.4.3.

3. Remove the three screws securing the fan assembly.

Figure 3-40.   Fan Assembly Screws

4. Disconnect the three fan assembly power cables from the expansion I/O board.

Figure 3-41.   Fan Assembly Power Cable Connections

5. Lift the fan assembly straight up to remove it from the enclosure.

3.4.9 Clock Card

To remove the clock card, you must shut down the system and disconnect it from power.

1. Shut down the ftServer system as described in Section 3.3.

2. At the rear of the cabinet, remove the two AC power cords and any cables connected to the connector I/O PCB.

Figure 3-42.   AC Power Cords and Connector I/O Cables
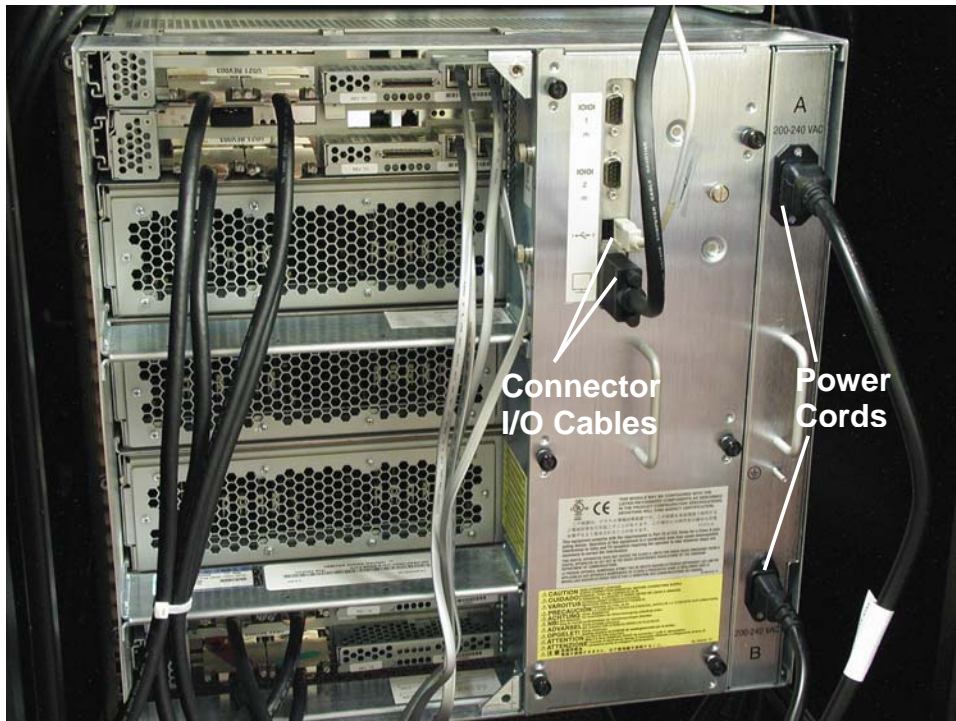
3. Unscrew the six thumbscrews on the backplane cover plate and remove the cover plate.

Figure 3-43. Backplane Cover Plate Screws
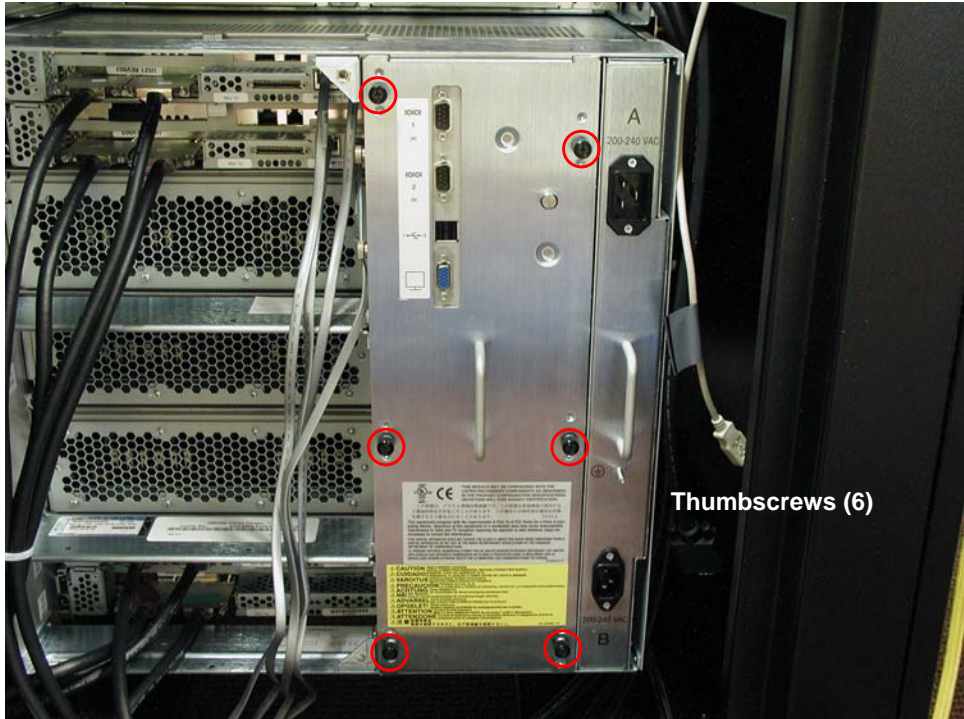
4. Unscrew the thumbscrew on the lower left side of the backplane. This screw secures the clock card in place.

Figure 3-44. Clock Card Thumbscrew
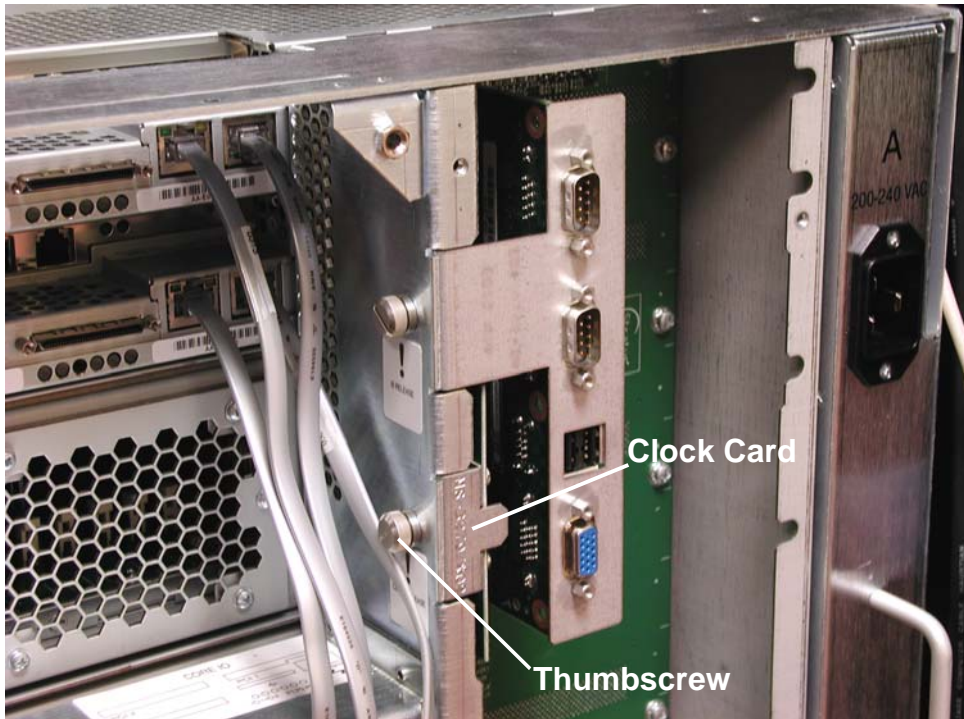
5. Pull the clock card straight out of the backplane, using the tab.

3.4.10 System Cage with Backplane

To remove the system cage with backplane, you must shut down the system and disconnect it from power.

1. Shut down the ftServer system as described in Section 3.3.

2. At the rear of the cabinet, disconnect the power cords and all the cables connected to the connector I/O PCB and the PCI adapters.

Figure 3-45.   AC Power Cords and Cables
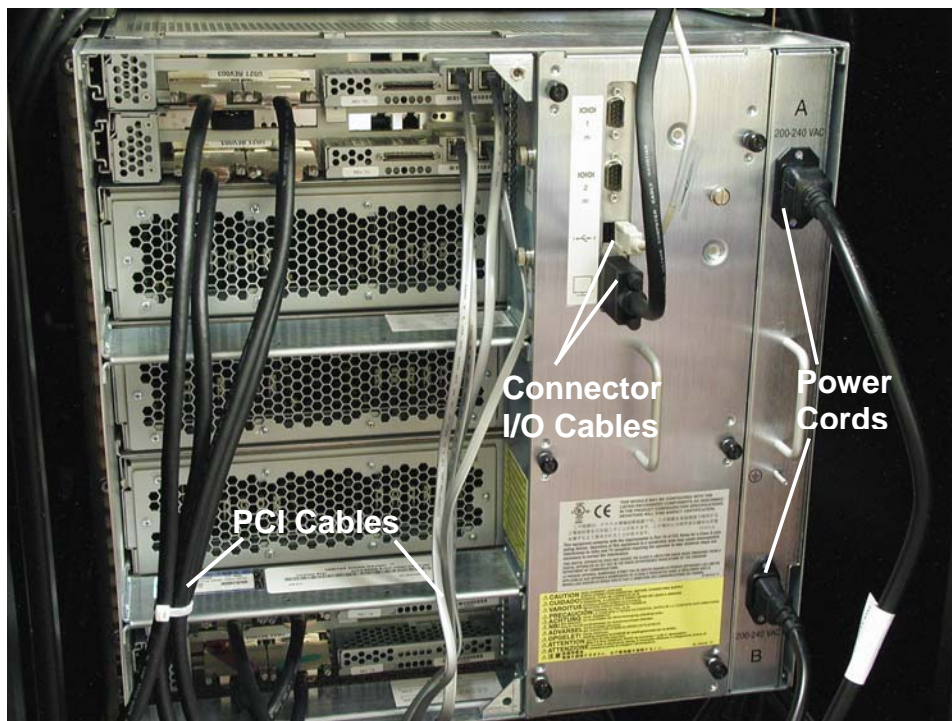
3. Remove each of the CPU and I/O enclosures as described in Sections 3.4.1 and 3.4.2.

4. Remove the 10 screws that secure the system cage to the rails at the front of the cabinet.

Figure 3-46.   System Cage Screws
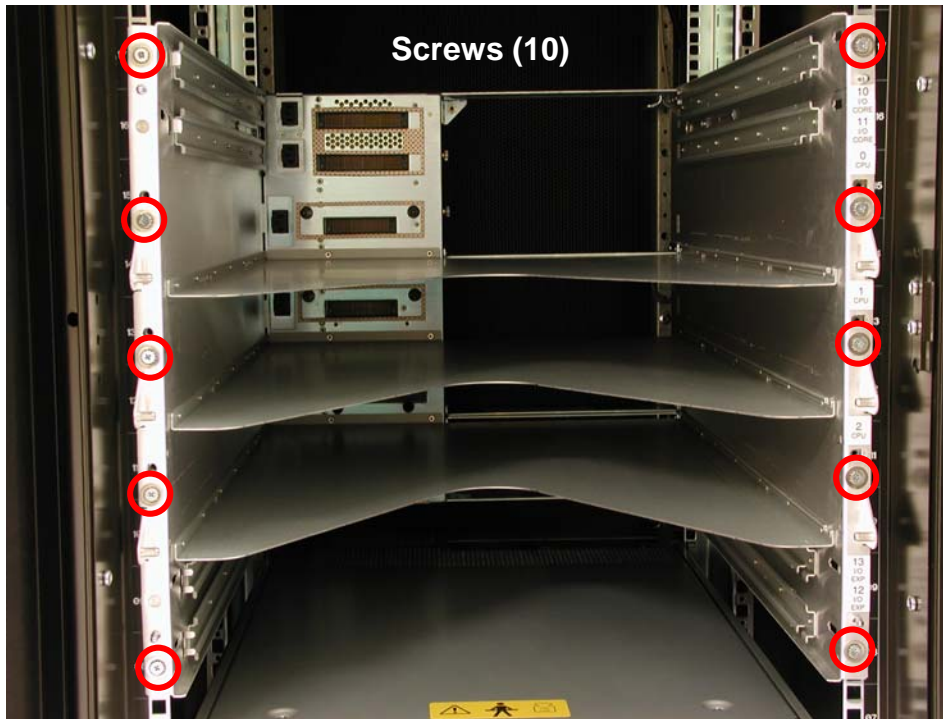
5. From inside the cage, remove the screws that secure the cage to the rear mounting rails.

Figure 3-47.   Rail Screws
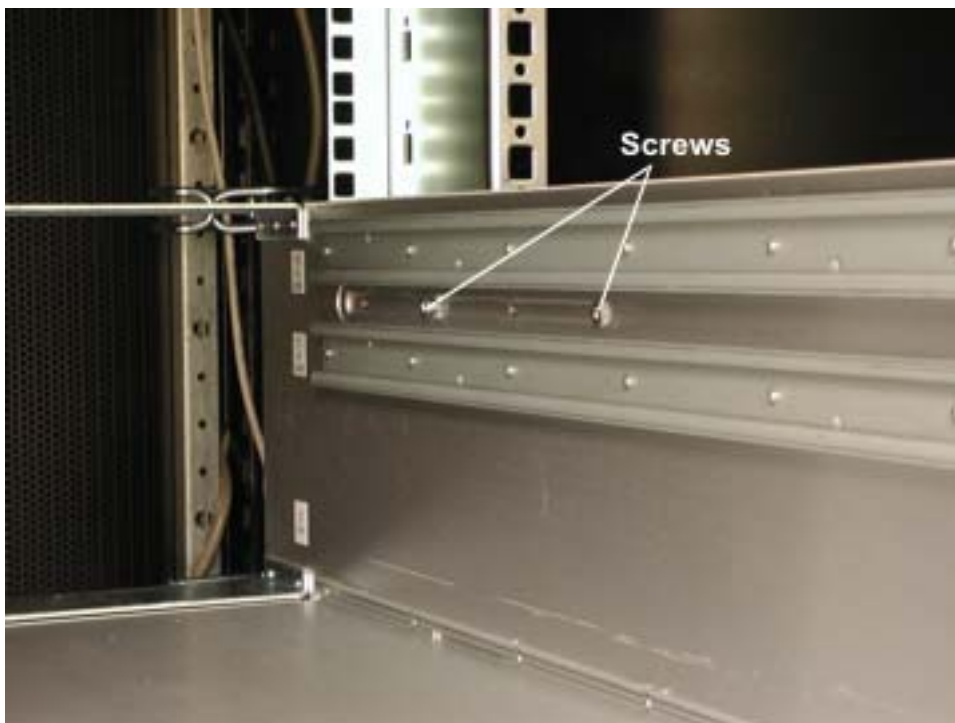
6. Pull the cage straight out the front of the cabinet.

3.4.11 Expansion I/O Enclosure PCI Adapter

1. Remove the expansion I/O enclosure as described in Section 3.4.2.

2. Remove the I/O enclosure cover as described in Section 3.4.3.

3. Remove the clip that secures the PCI adapters by pulling it straight upward.

Figure 3-48.   Retaining Clip
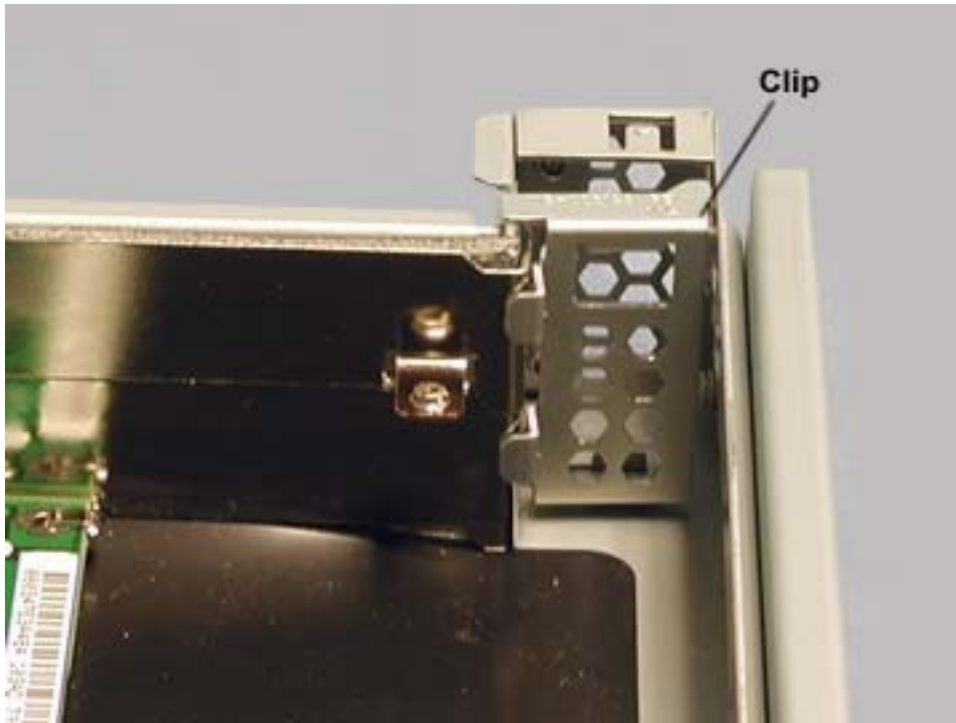
4. Pull the PCI adapter horizontally out of its connector

3.4.12 Ultra 160 SCSI Enclosure Disk Drive or LED Module

The procedure assumes that the disk drive being removed is mirrored by another drive on the system.

> **N O T E:** Before you remove a disk drive, you should use **VERITAS Volume Manager**, **ftSMC** or **Logical Disk Manager (LDM)** to ensure that the disk has failed. If you are removing a disk drive that has **not** failed (for example, if you are upgrading a disk drive), **VERITAS Volume Manager** or **LDM** will not list the disk drive as failed. In this case, you must use **VERITAS Volume Manager** or **LDM** to remove the disk drive's mirror and to add it back after you insert the replacement disk drive.

> For information about **VERITAS Volume Manager**, see the *VERITAS Volume Manager 2.7 for Windows 2000 User's Guide* . For information about **ftSMC** and about removing and adding mirrors, see the *Stratus ftServer: System Administrator's Guide (R014W)*.

> > **C A U T I O N:** Before you remove a mirrored disk drive, it is **critical** that you know which disk drives the disk drive is mirrored with. For information about determining which disk drives are mirrored, see the *Stratus ftServer: System Administrator's Guide (R014W)*

1. Squeeze the latch on the latching arm of the disk drive, and pull the latching arm down until it is fully extended.

   Caution: After you pull the latching arm down completely, all of the LEDs on the disk drive should shut off. At this point, you must wait at least 30 seconds before proceeding to step 2 to ensure that the failed drive has spun down. Otherwise, the disk drive will be damaged.

2. Press in the tab at the end of the disk drive lever.

Figure 3-49.   SCSI Disk Drive Latching Arm
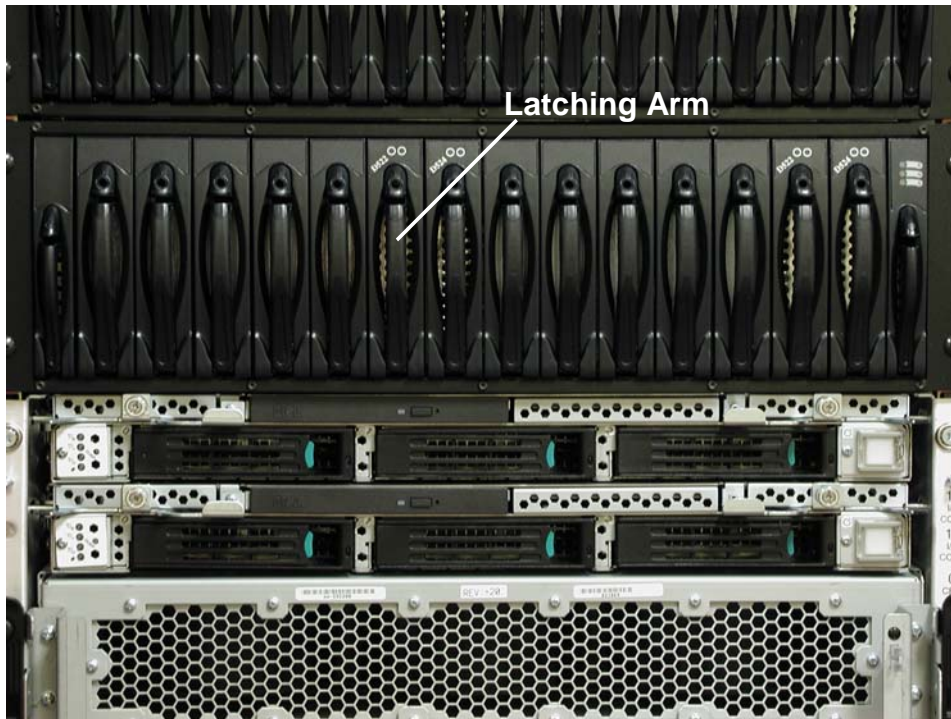
3. Grasp the handle of the disk drive and slide the disk drive out of the storage enclosure.

3.4.13 SCSI Cable

Before you remove a disk drive, you should use **VERITAS Volume Manager**, **ftSMC** or **Logical Disk Manager (LDM)** to ensure that the disk has failed. If you are removing a disk drive that has **not** failed (for example, if you are upgrading a disk drive), **VERITAS Volume Manager** or **LDM** will not list the disk drive as failed. In this case, you must use **VERITAS Volume Manager** or **LDM** to remove the disk drive's mirror and to add it back after you insert the replacement disk drive. Use **VERITAS Volume Manager** to verify that all disk drives are mirrored and healthy. (For more information about configuring disk mirroring, see the *Stratus ftServer: System Administrator's Guide (R014W)* and *VERITAS Volume Manager 2.7 for Windows 2000 User's Guide* .

1. Ensure that the SCSI devices for the affected enclosure are not in service.

2. At the rear of the Ultra160 SCSI enclosure, loosen the two captive fasteners on the SCSI cable connector and disconnect the cable from the enclosure.

Figure 3-50.   Captive Screws on SCSI Cable Connector at Enclosure
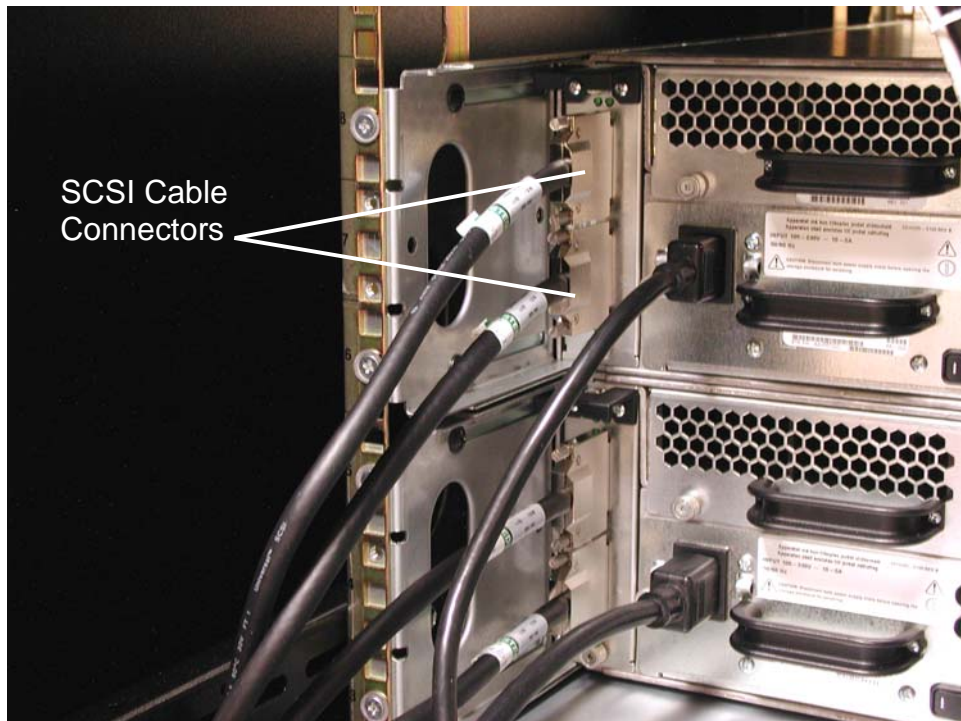
3. Disconnect the cables from the SCSI adapter (U521), noting which connector is attached to which port.

4. **NOTE:** The connectors are keyed, and will only attach one way when installing the replacement cable.

3.4.14 Ultra 160 SCSI Enclosure Advanced Cooling Module (ACM)

C A U T I O N: Perform the entire replacement procedure within five minutes to avoid overheating the Ultra160 SCSI enclosure. Removing one of the ACMs causes the fans in the other ACM to accelerate to maintain the proper operating temperature. The enclosure should not operate for more than five minutes with only one ACM installed.

1. Loosen the two captive screws on either side of the ACM.

Figure 3-51.   ACM Captive Screws

2. Pull the ACM out of the disk enclosure.

   NOTE: The fans in the installed ACM will accelerate.

3.4.15 Ultra 160 SCSI Enclosure Power Supply Module (PSM)

N O T E: In case power is lost to both sides of the Ultra160 SCSI enclosure at the same time, wait at least 15 seconds before powering up the enclosure again.

C A U T I O N: Removing a power supply disrupts the airflow within the enclosure. Therefore, when replacing a power supply, place the new power supply in the slot immediately. Do not leave the slot empty.

1. Have the new power supply ready at hand to place into the slot from which you are about to remove the old power supply.

2. At the rear of the Ultra160 SCSI enclosure, turn off the power supply switch.

Figure 3-52.   Power Supply Switch
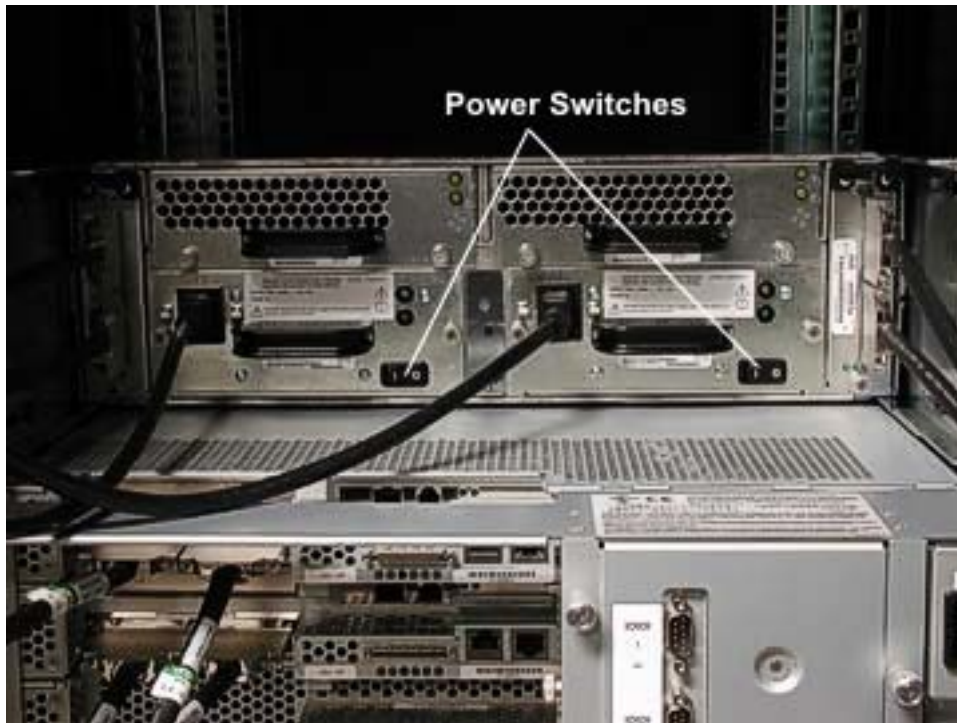
3. Disconnect the power cord from the power supply.

Figure 3-53.   Power Supply Power Cord.
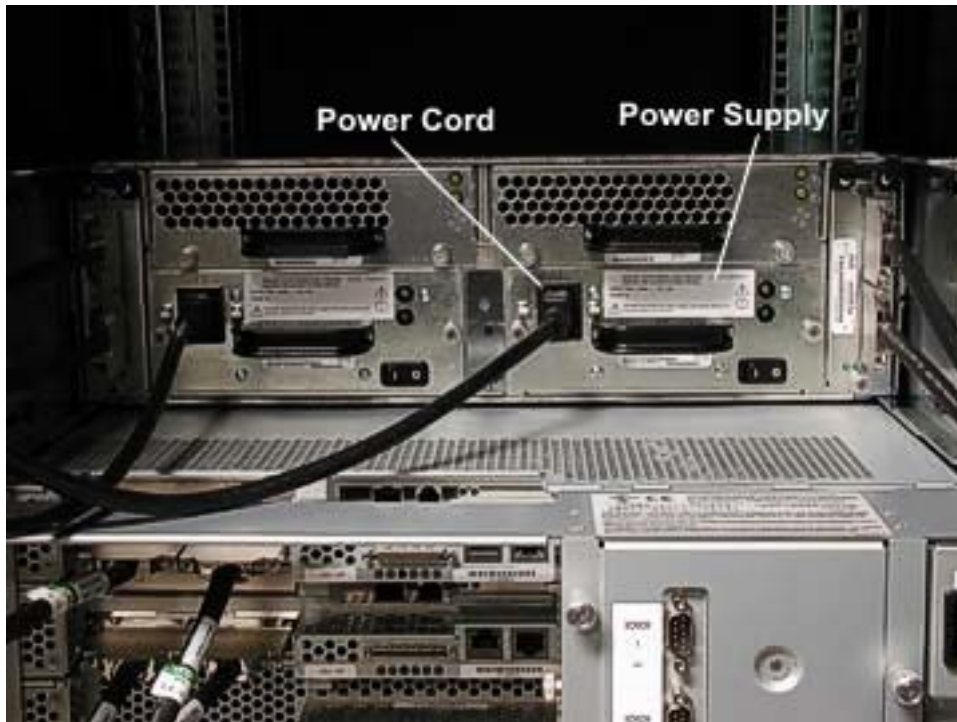
4. Loosen the two captive screws on either side of the power supply.

Figure 3-54.   Power Supply Screws.

5. Pull the power supply module out of the disk enclosure.

3.4.16 Ultra 160 SCSI Enclosure Cluster Services Module (CSM)

> **N O T E:** Performing the following procedure requires you to re-mirror the disks. See the *Stratus ftServer Software Installation and Configuration Guide* (R002W) for information about mirroring disks.

To remove a CSM, you must take the ftServer system out of service and disconnect it from power.

1. Shut down the system as described in steps 1-3 in Section 3.4.19

2. Turn off power to the monitor and any peripheral devices.

3. At the rear of the Ultra160 SCSI enclosure, turn off the switches on the power supplies.

Figure 3-55.   Power Supply Switch
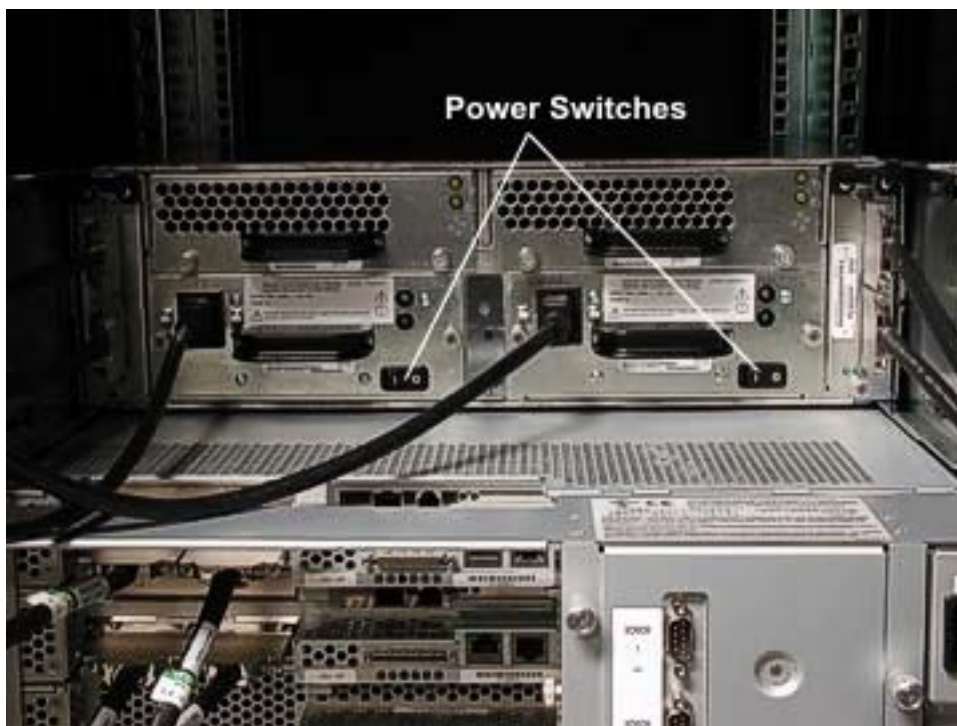
4. Remove all cables from the CSM.

Figure 3-56.   CSM Cables

5. Loosen the thumbscrews that secure the module in place.

Figure 3-57.   CSM Screws

3.4.17 Ultra160 SCSI Storage Enclosure

To remove the Ultra160 storage enclosure, you must shut down the system.

1. Shut down the ftServer system as described in Section 4.2.

All components in the Ultra160 storage enclosure must be removed before the storage enclosure is removed. The procedures are described below.

2. Turn off the power switches on the rear of the storage enclosure.

Figure 3-48.   Power Switches
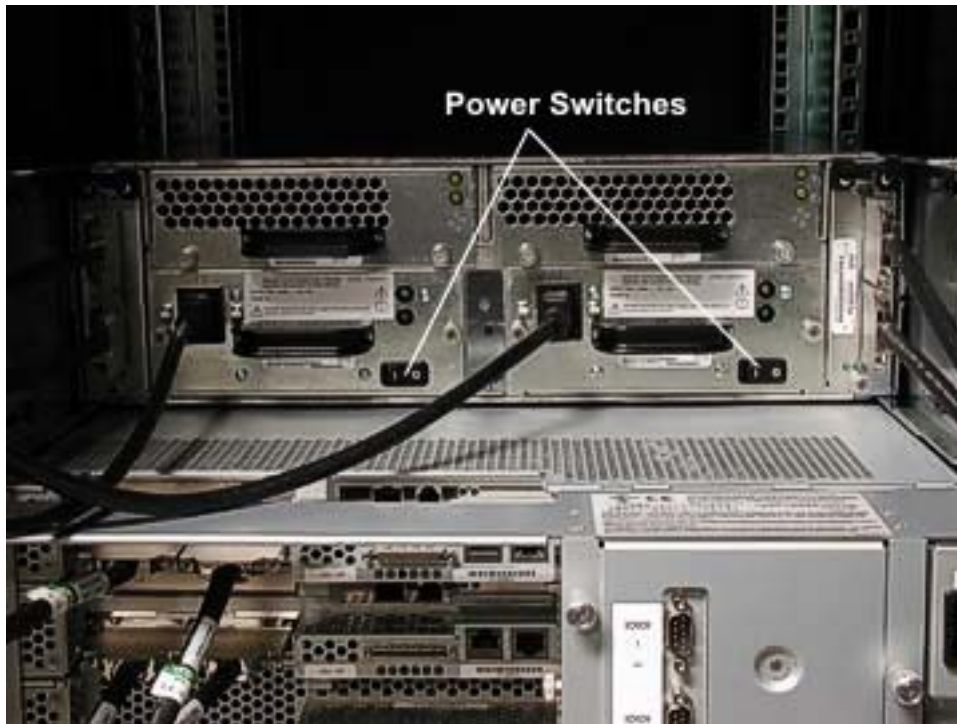
3. Disconnect the power cords from the rear of the enclosure.

Figure 3-49.   Power Cords
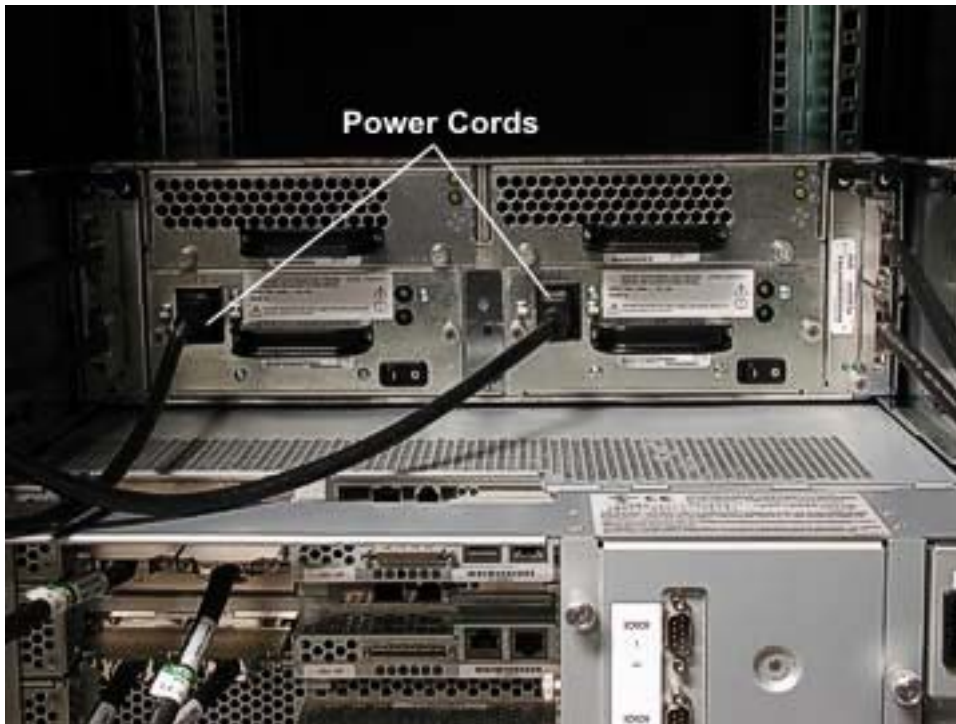
4. Disconnect all other cables at the rear of the enclosure.

5. Remove the four screws securing the enclosure at the front of the cabinet.

Figure 3-50.   Enclosure Screws

6. Carefully slide the enclosure out of the front of the cabinet.

4. FRU Hardware Removal/Replacement Procedures

This section lists the Field Replaceable Units (FRUs) in the ftServer 6600 systems and describes the removal and replacement procedures for each one.

In most instances, FRUs are duplexed and can be removed and replaced without total removal of power. However, in some instances, the system must be shut down and both main power switches turned off prior to FRU removal and replacement.

4.1 List of FRUs

The following table lists the FRUs in the ftServer 6600 system.

Component	Part Number
CPU Enclosure Fan Assembly	AA-E83800
CPU Enclosure Memory Module (DIMM)	AA-M86X00
CPU Enclosure Memory Power Board	AA-E95500
Expansion I/O Enclosure PCI Riser PCB	AA-E71400
Core/Expansion I/O Enclosure Power Supply	AA-P70100
Backplane PCB	AA-E71100
Power Strip	AA-P41103

4.2 Power Removal

If total power removal is required, the system must be shut down prior to removing power and rebooted after the replacement unit is installed.

1. To shut down the ftServer system, click the **Start** button on the Windows desktop and click **Shut Down**.

Figure 4-1.   Start Menu
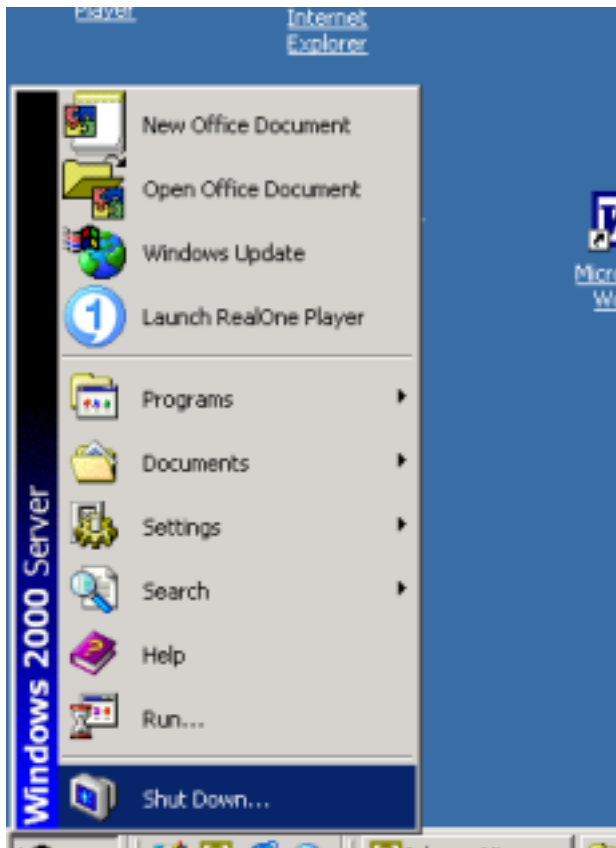
2. In the **Shut Down Windows** dialog box, select **Shut Down** and then click **OK**. A message states that your system is shutting down.

Figure 4-2.   Shut Down Menu

3. When the system displays the message It is now safe to turn off your computer, the system will turn off its power automatically.
   This removes main power from the system; however, standby power to the Baseboard Management Controller (BMC) remains on.

4. Turn off power to the monitor and any peripheral devices.

5. At the back of the system, disconnect the two AC power cords.

Figure 4-3.   AC Power Cords
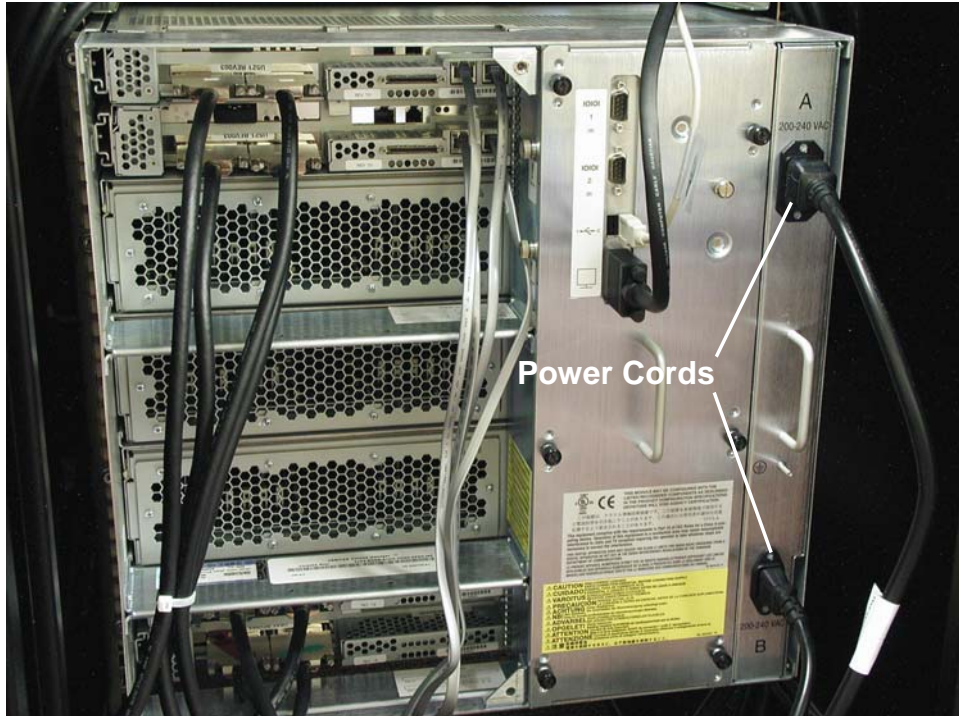
4.3 Handling ESD Sensitive Parts

Clock cards and PCI adapters are particularly sensitive to damage from electrostatic discharge (ESD) because the electronic components are exposed when the device is not fully installed.

Caution: To avoid damaging these parts during handling, always take the following precautions.

- Always store cards and adapters in their static-protective envelope until you are ready to install them in the system.

- Always hold an adapter or card by its edges.

- Always ground yourself before handling a clock card or a PCI adapter, or before removing or replacing the I/O enclosure. Ground yourself by wearing a grounding strap.

4.4 Hardware Removal Procedures

This section contains the removal procedures for the FRUs listed in the preceding table. Each of these procedures indicates any power removal requirements.

To perform the replacement procedure for each FRU, reverse the removable procedure. If any special replacement considerations are necessary, a replacement note is included.

4.4.1 CPU Enclosure Cover

1. Remove the CPU enclosure as described in Section 3.4.1.

   CAUTION: The CPU enclosure contains hazardous voltages. After removing the enclosure, wait 1 minute before removing its cover.

2. Remove the four screws securing the cover at the rear of the CPU enclosure. Slide the cover toward the rear to disengage it, and then lift it off the enclosure.

Figure 4-4.   Enclosure Cover Screws

3. Slide the cover straight back towards the rear of the enclosure.

4.4.2 Memory Module (DIMM)

The CPU enclosure can accommodate up to 12 DIMMs. See Section 1.3.1 for information on supported memory configurations and restrictions.

Perform the following procedure to remove a DIMM.

1. Remove the CPU enclosure as described in Section 3.4.1.

2. Remove the CPU enclosure cover as described in Section 4.4.1.
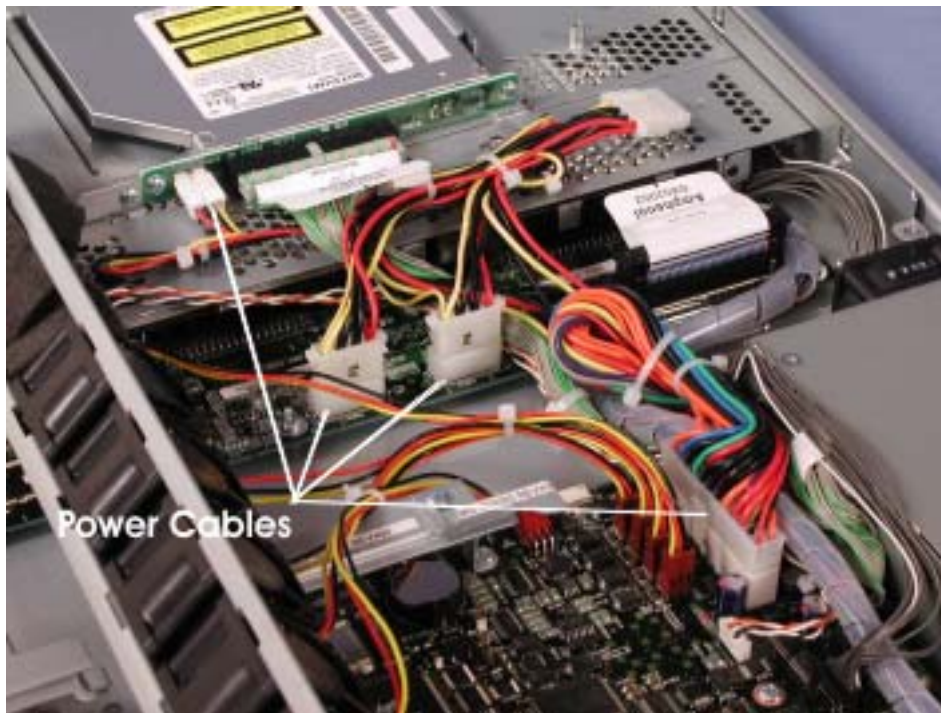
3. Remove the three screws securing the airflow cover and lift it off.

Figure 4-5.   Airflow Cover Screws
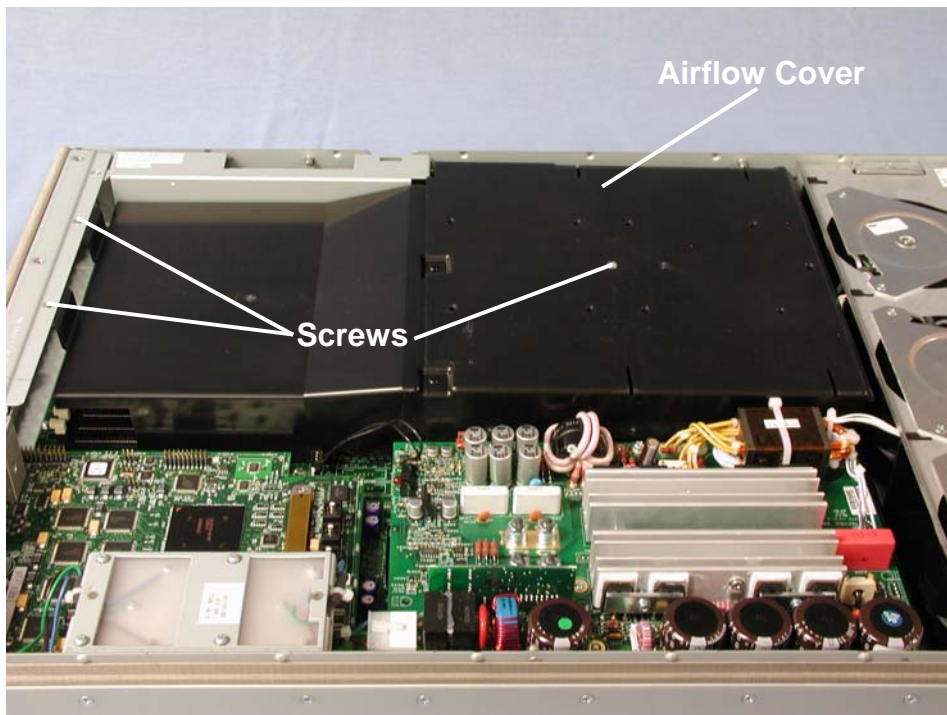
4. Push down on the two levers at the ends of the DIMM socket to release the DIMM.

Figure 4-6.   Removing a DIMM
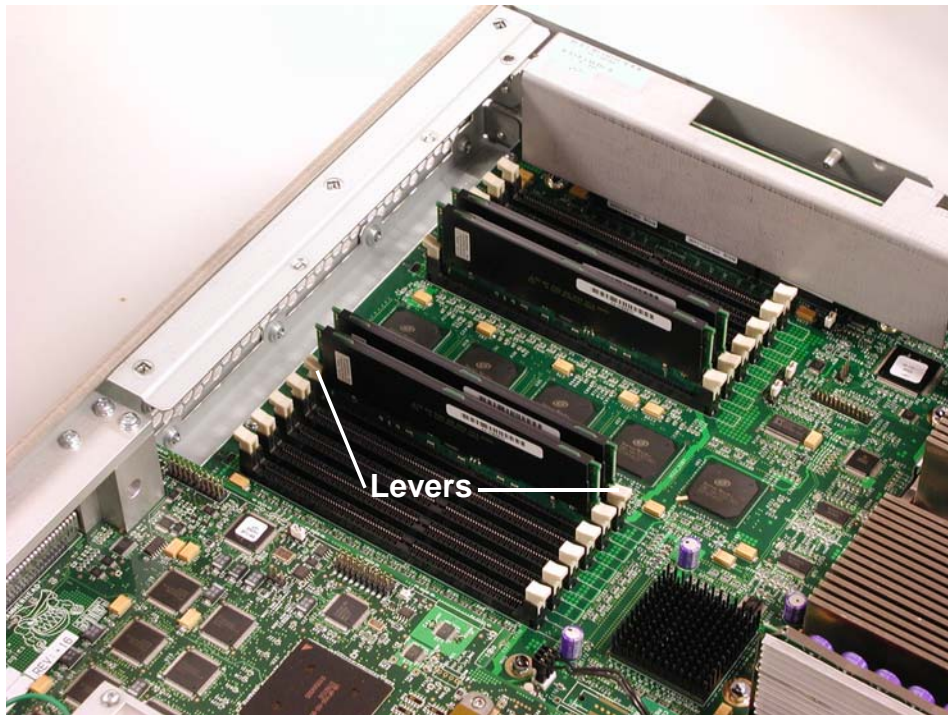
5. Pull the DIMM straight up and out of its socket.

> **REPLACEMENT NOTE:** The DIMMs are keyed to fit only in the correct position.

4.4.3 CPU Enclosure Fan Assembly

1. Remove the CPU enclosure as described in Section 3.4.1.

2. Remove the CPU enclosure cover as described in Section 4.4.1.

3. Disconnect the three fan connectors.

Figure 4-7.   Fan Connectors
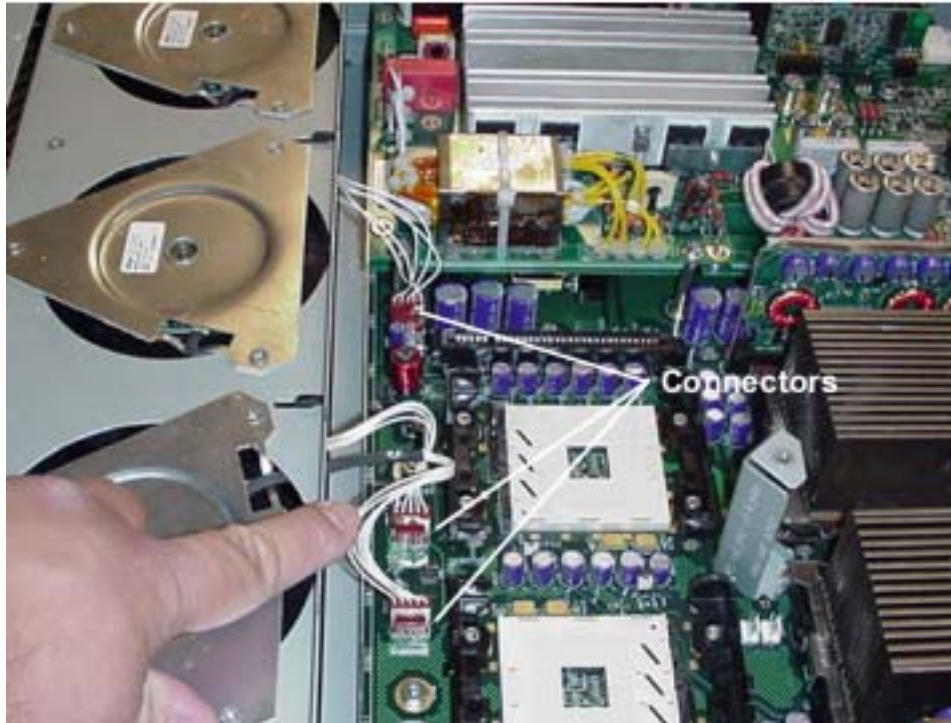
4.   Loosen the two thumbscrews securing the assembly and push the tabs toward the center.

Figure 4-8.   Thumbscrews

5.   Rotate the fan assembly and lift it up and out.

Figure 4-9.   Removing Fan Assembly

4.4.4 CPU Enclosure Memory Power Board

1. Remove the CPU enclosure as described in Section 3.4.1.

2. Remove the CPU enclosure cover as described in Section 4.4.1.

3. Remove the two screws securing the metal cover over the memory power board and lift off the cover.

Figure 4-10.   Metal Cover Screws
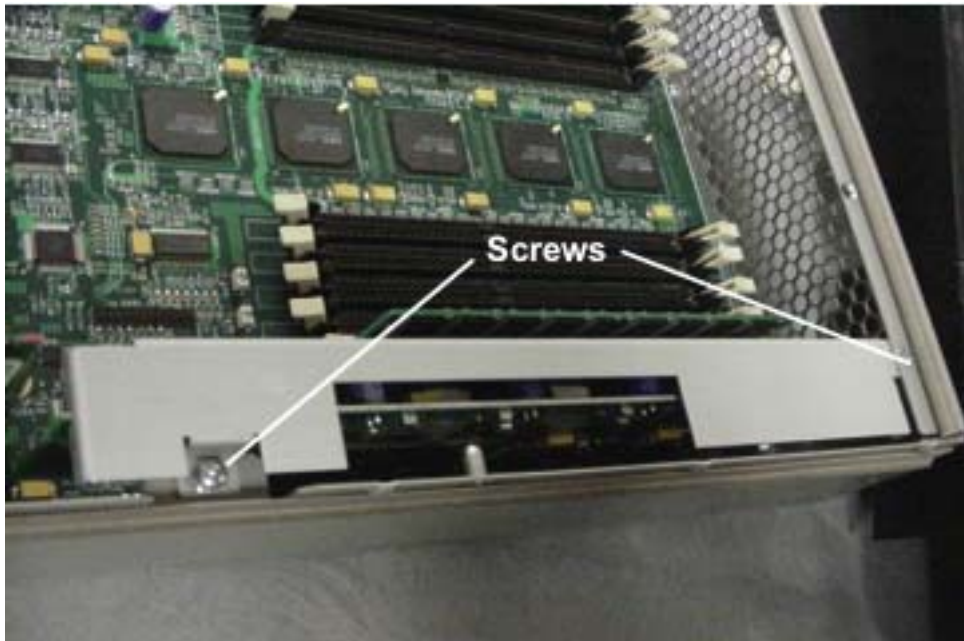
4. Pull the memory power board straight out.

4.4.5 Expansion I/O Enclosure PCI Riser PCB

1. Remove the expansion I/O enclosure as described in Section 3.4.2.

2. Remove the I/O enclosure cover as described in Section 3.4.3.

3. Remove all the PCI adapters as described in Section 3.4.6.

4. Remove the four screws securing the bracket holding the PCI riser PCB.

Figure 4-11.   Bracket Screws
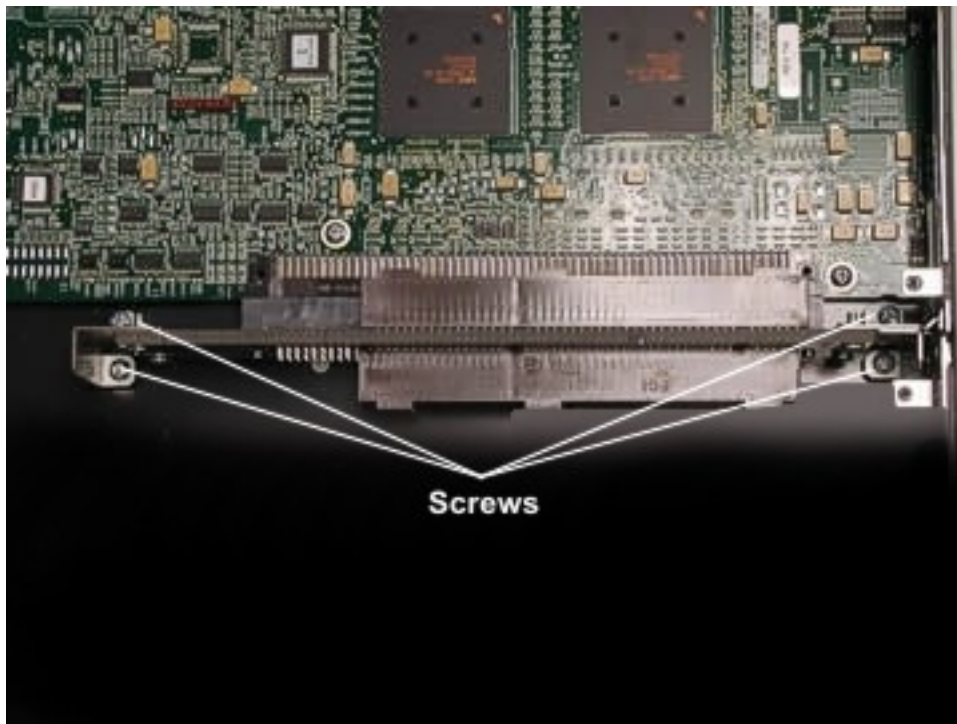
5. Pull the PCI riser bracket horizontally out of its connector.

6. Remove the four screws securing the PCI riser PCB to the bracket.

Figure 4-12.   PCI Riser PCB Screws
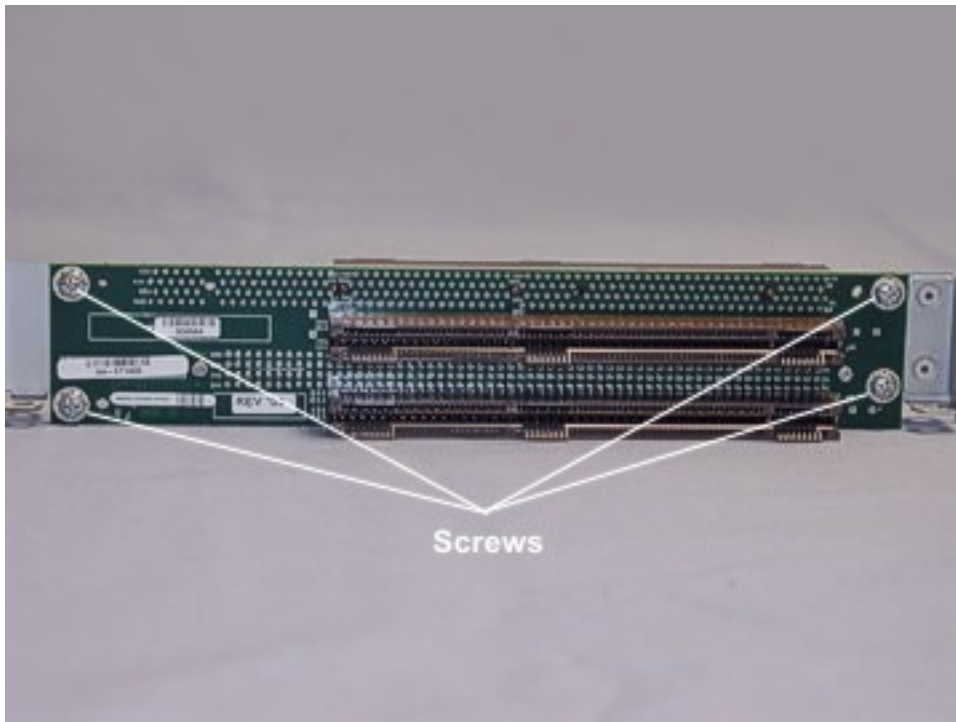
4.4.6 Core I/O Enclosure Power Supply

1. Remove the core I/O enclosure as described in Section 3.4.2.

2. Remove the I/O enclosure cover as described in Section 3.4.3.

3. Remove the three screws securing the fan assembly and carefully pull the assembly out of the way. You do not have to remove the fan assembly cables.

Figure 4-13.   Fan Assembly Screws

4. Disconnect the power cables from the SCSI backplane, CD-ROM interface board, and the I/O core board.

Figure 4-14.   Power Cables at SCSI Backplane, CD-ROM Interface Board and I/O Core Board

5. Remove the screw securing the AC inlet cover and lift the cover off.

Figure 4-15.   AC Inlet Screw
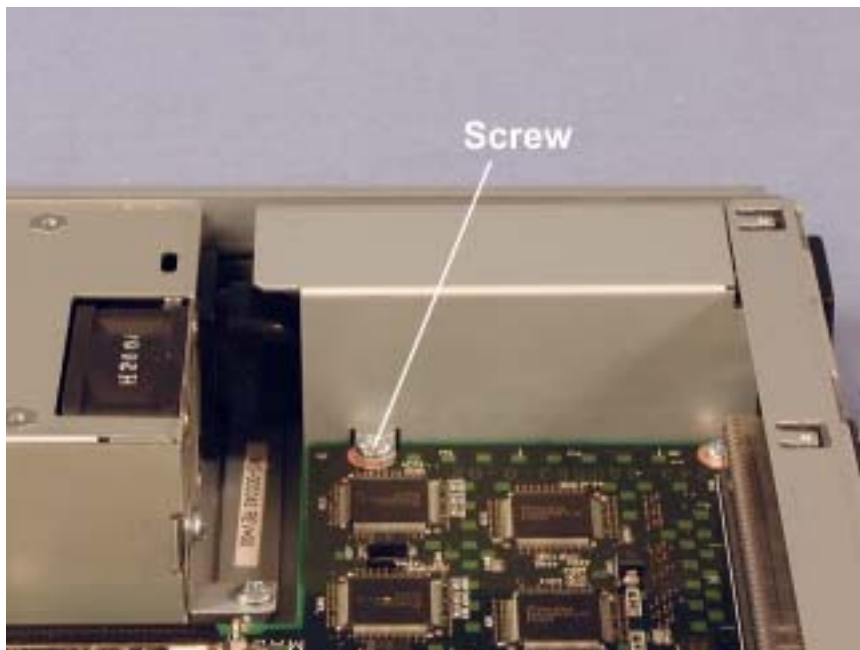
6. Remove the three screws securing the power supply.

Figure 4-16. Power Supply Screws
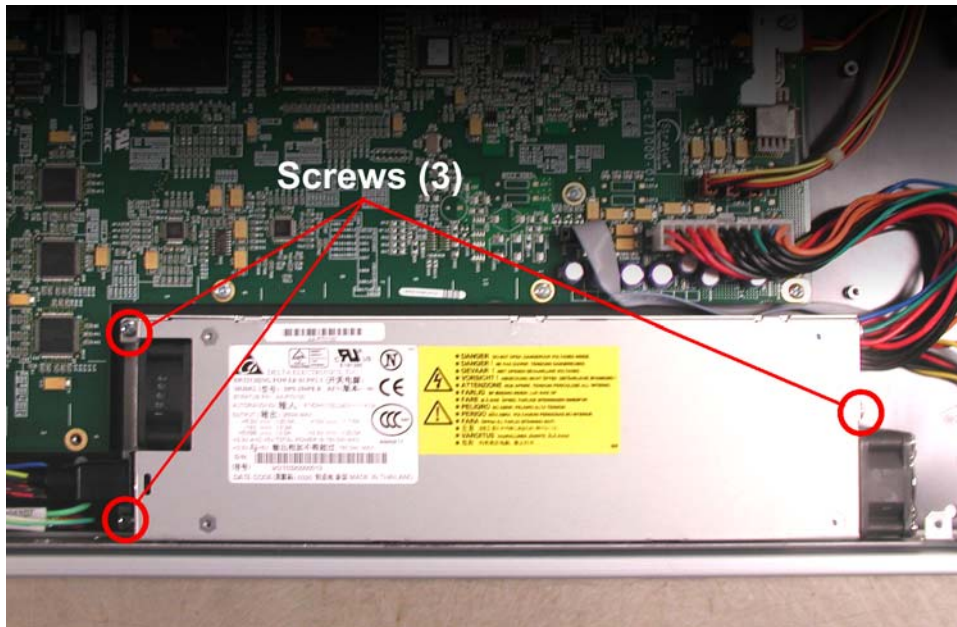
7. Lift the end of the power supply and slide it slightly forward.

Figure 4-17. Removing Power Supply
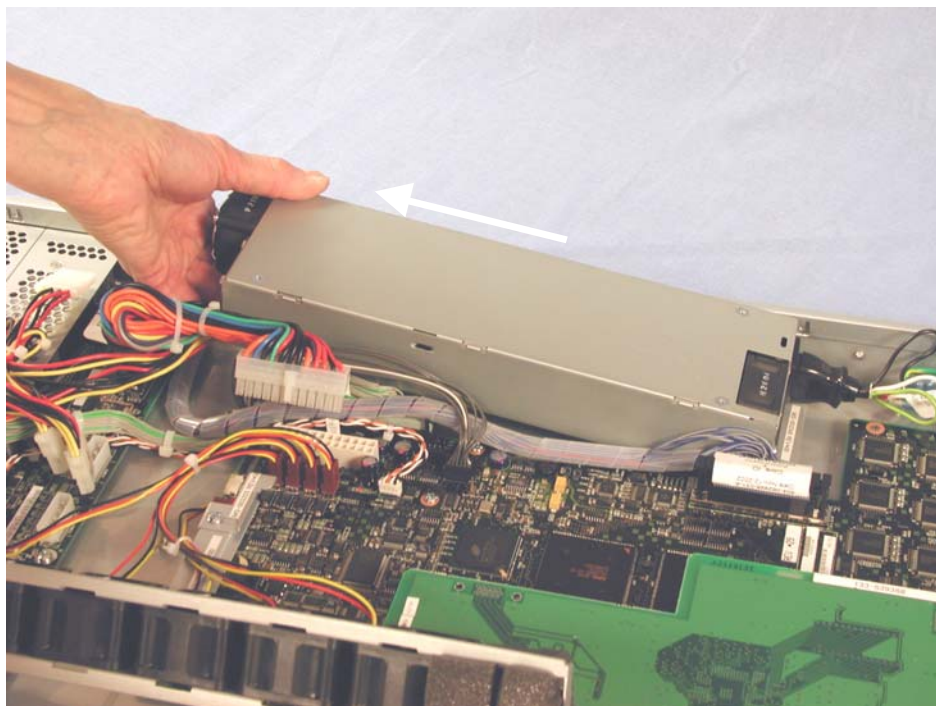
8. Disconnect the power jumper cable from the power supply.

Figure 4-18.   Power Jumper Cable Connection

4.4.7 Expansion I/O Enclosure Power Supply

1. Remove the expansion I/O enclosure as described in Section 3.4.2.

2. Remove the I/O enclosure cover as described in Section 3.4.3.

3. Remove the three screws securing the fan assembly and carefully pull the assembly out of the way. You do not have to remove the fan assembly cables.

Figure 4-19.   Fan Assembly Screws

4. Disconnect the power cable from the expansion I/O board.

Figure 4-20.   Power Cable Connection at Expansion I/O Board

5. Remove the screw securing the AC inlet cover and lift the cover off.

Figure 4-21.   AC Inlet Screw
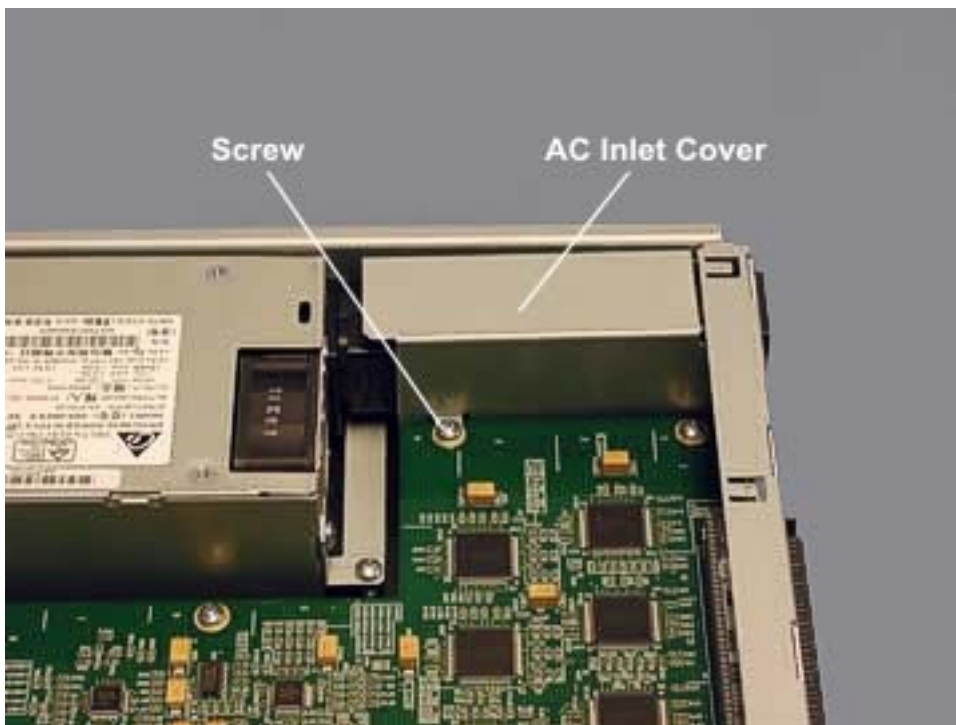
6. Remove the three screws securing the power supply.

Figure 4-22. Power Supply Screws

7. Lift the end of the power supply and slide it slightly forward.

Figure 4-23. Removing Power Supply
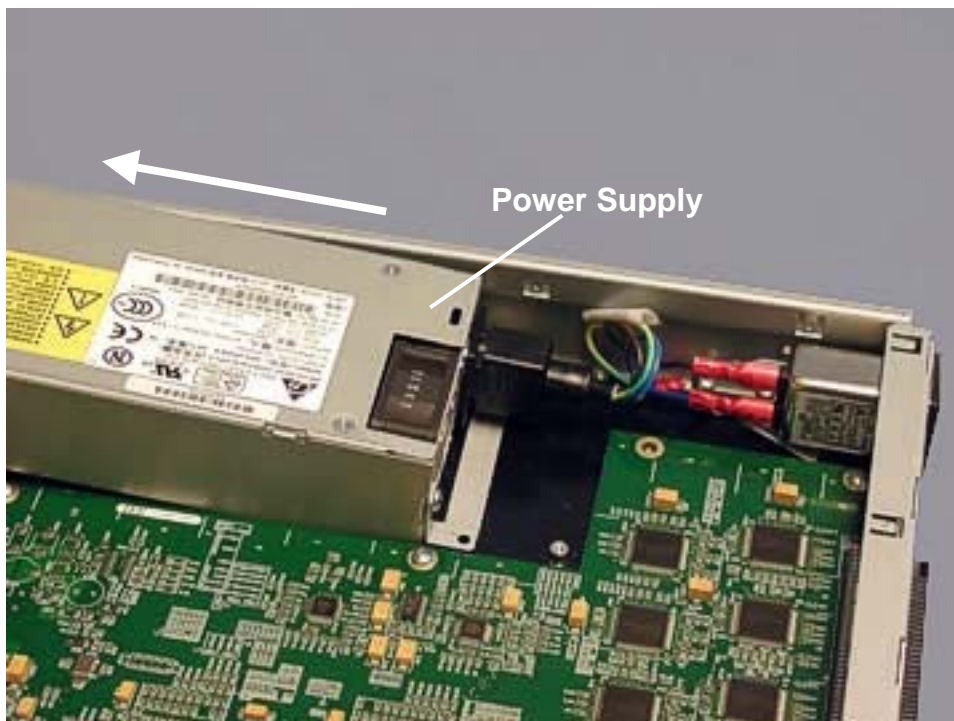
8. Disconnect the power jumper cable from the power supply.

Figure 4-24.   Power Jumper Cable Connection
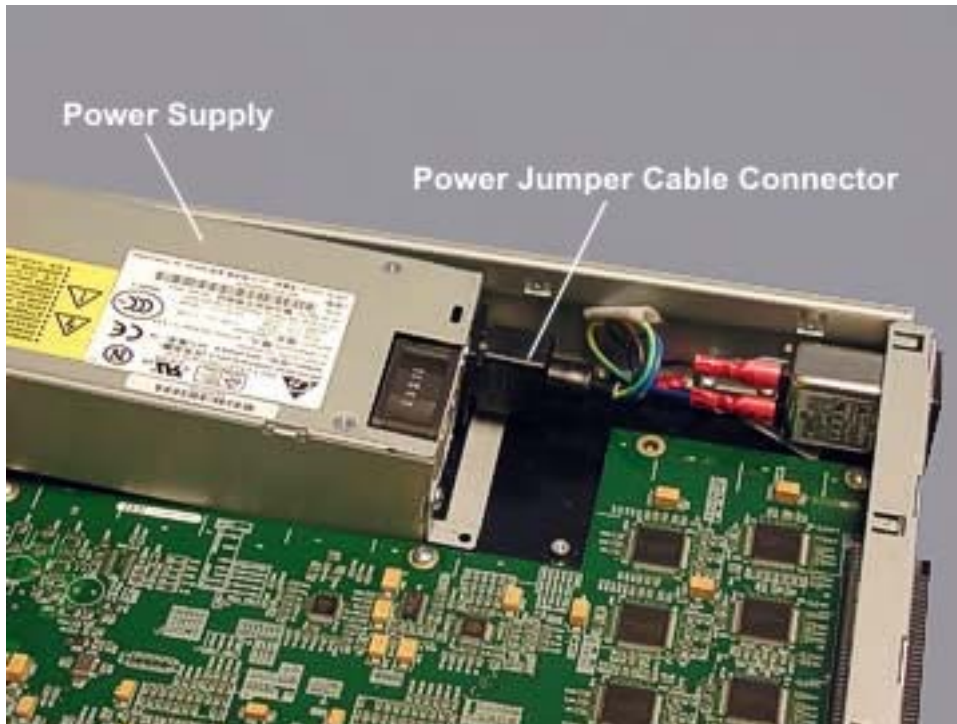
4.4.7 Backplane PCB

To remove the backplane PCB, you must shut down the system and disconnect it from power.

1. Shut down the ftServer system as described in Section 3.3.

2. At the rear of the cabinet, disconnect the power cords from the power strip and all the cables connected to the connector I/O PCB.

Figure 4-25.   Power Cord and Cable Connections at Rear of Cabinet
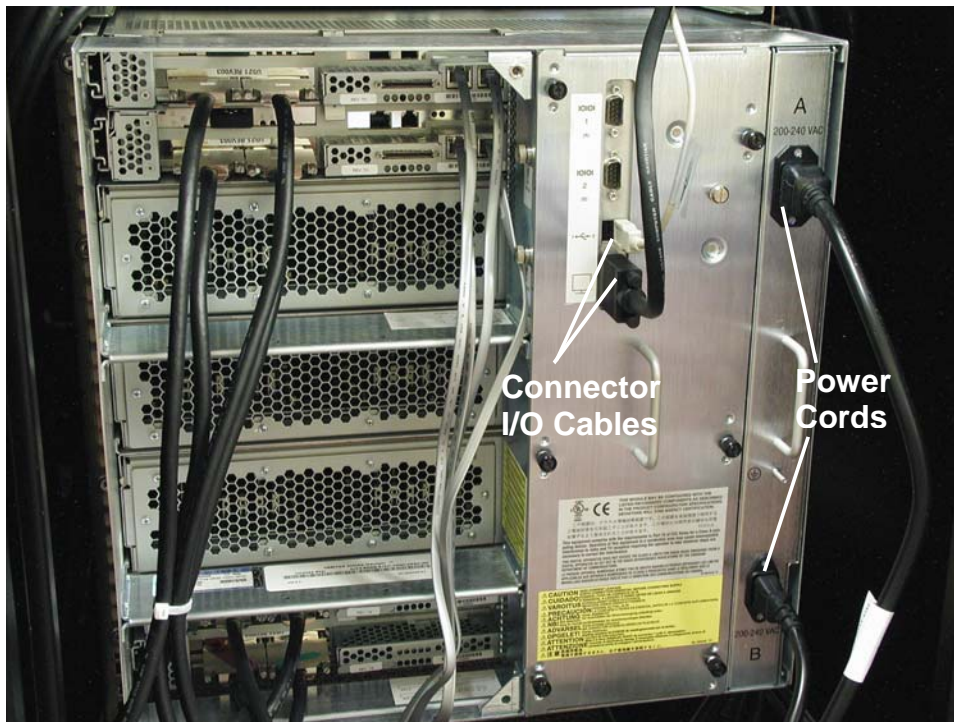
3. At the front of the cabinet, loosen the two thumbscrews on the front of each CPU and I/O enclosure and open the ejector levers to disengage all the enclosures from the backplane.

Figure 4-26. CPU and I/O Enclosure Thumbscrews and Ejector Levers
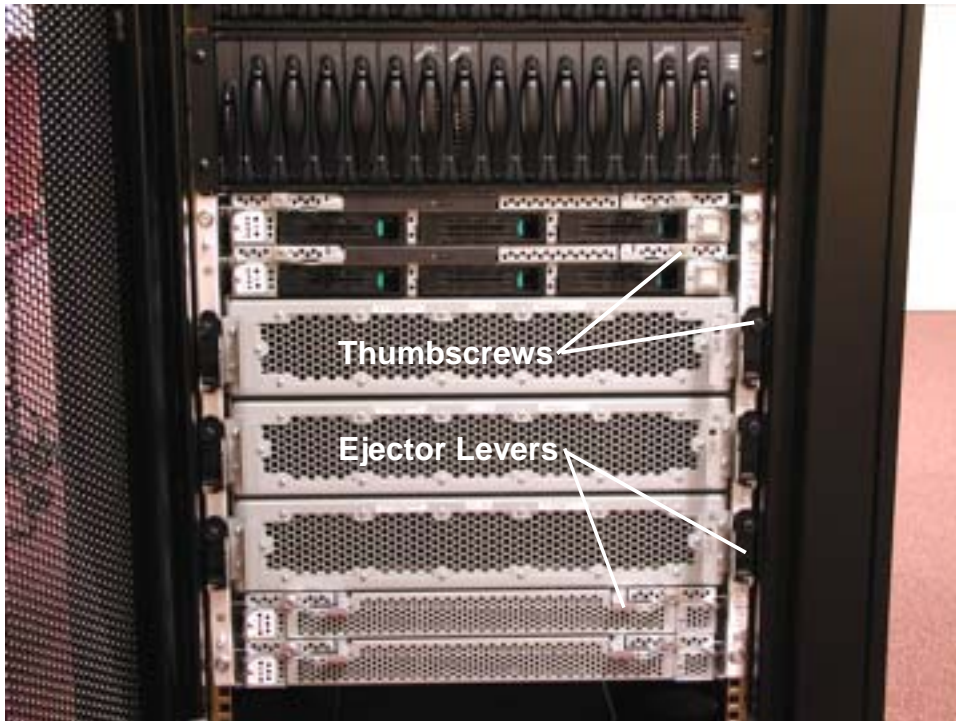
4. Unscrew the six thumbscrews and remove the backplane cover plate.

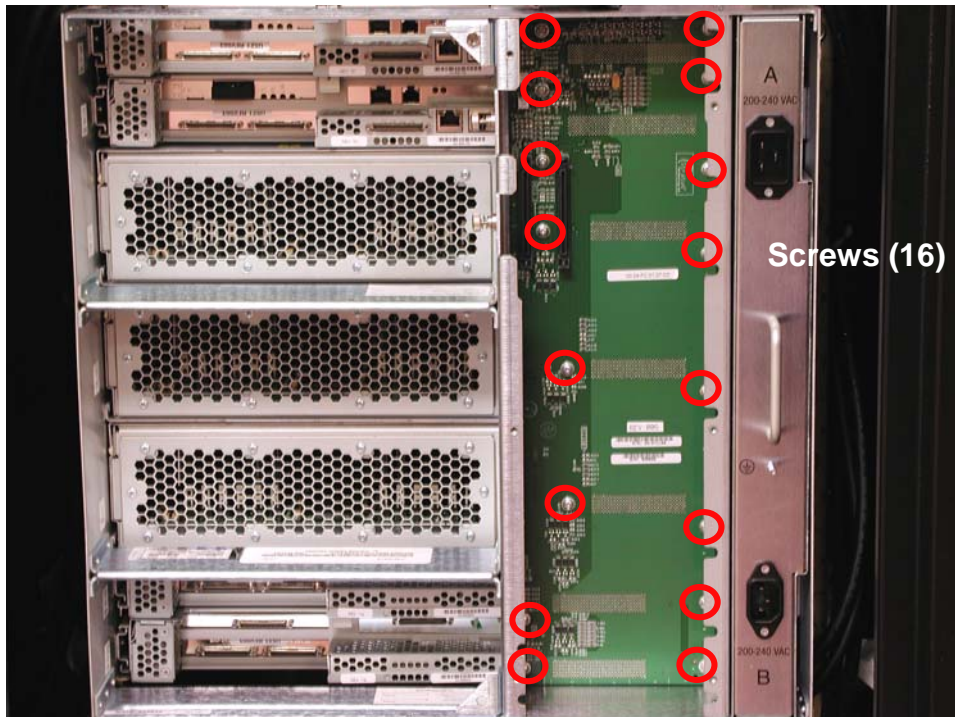*Figure 4-27. Backplane Cover Plate Thumbscrews*
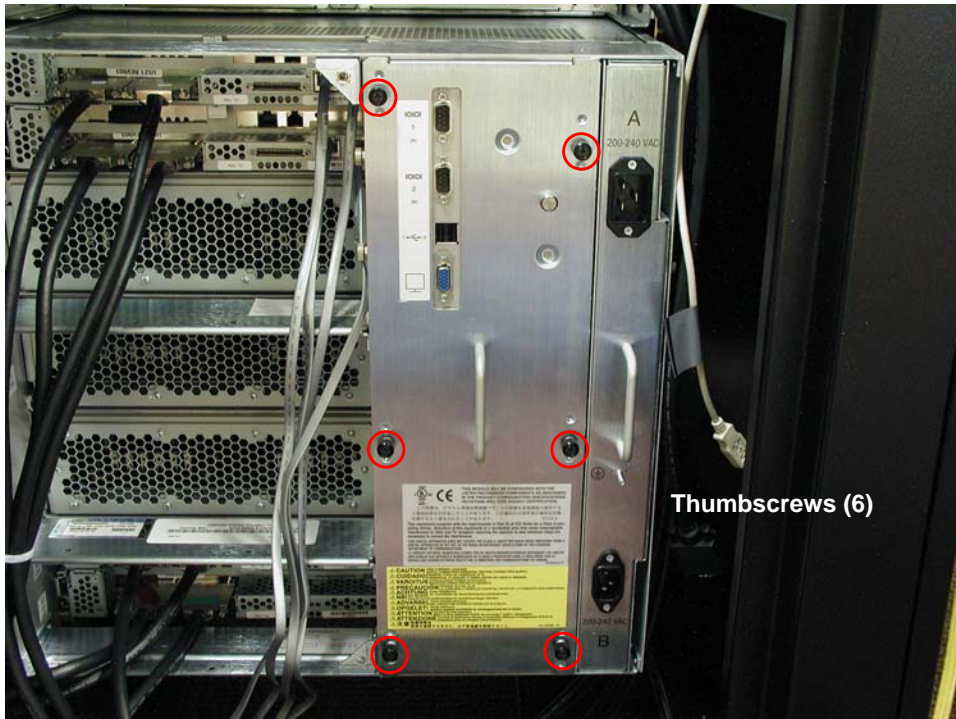
5. Loosen the thumbscrews securing the clock card and connector I/O PCB and remove them from the backplane PCB.

Figure 4-28.   I/O Connector PCB and Clock Card Screws
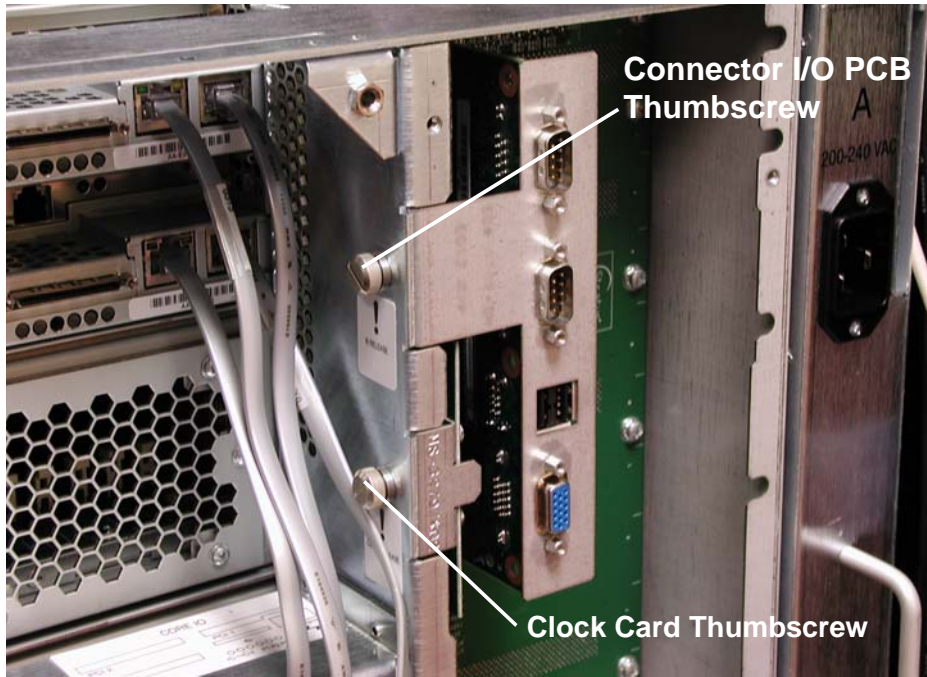
6. Remove the 16 screws that secure the backplane PCB and carefully lift it out of the cage.

Figure 4-29.   Backplane PCB Screws

4.4.8 Power Strip

To remove the power strip, you must shut down the system and disconnect it from power.

1. Shut down the ftServer system as described in Section 3.3.

2. At the rear of the cabinet, disconnect the power cords from the power strip and all the cables connected to the connector I/O PCB and the PCI adapters.

Figure 4-30.   Power Cord and Cable Connections at Rear of Cabinet
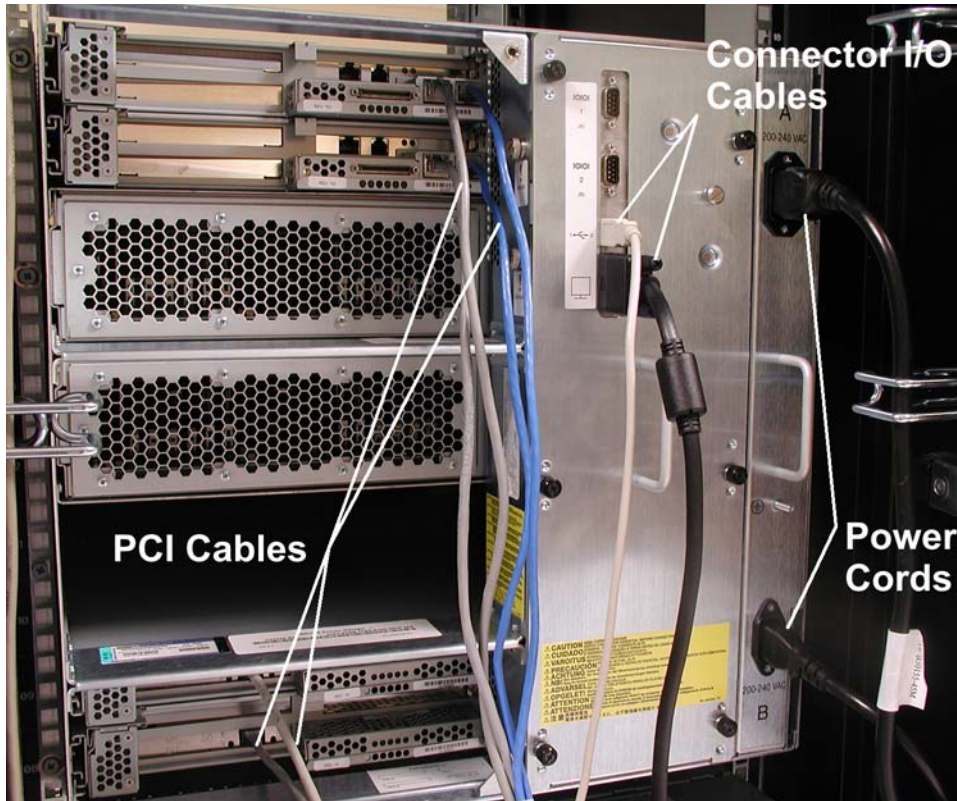
7. Remove all CPU and I/O enclosures as described in Sections 3.4.1 and 3.4.2.

8. At the front of the cabinet, reach in and remove the four screws securing the power strip.

Figure 4-31.   Power Strip Screws
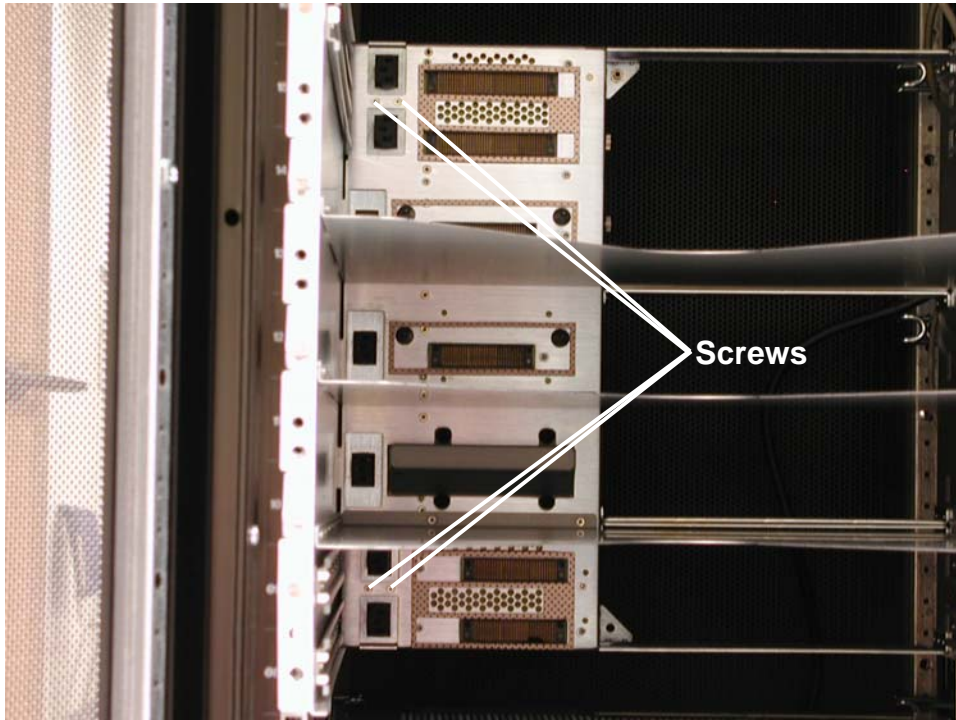
9. At the rear of the cabinet, carefully remove the power strip.

5. DRU Hardware Removal/Replacement Procedures

This section lists the Distributor Replaceable Units (DRUs) in the ftServer 6600 systems and describes the removal and replacement procedures for each one.

In most instances DRUs are duplexed and can be removed and replaced without total removal of power. However, in some instances, the system must be shut down and both main power switches turned off prior to DRU removal and replacement.

5.1 List of DRUs

The following table lists the DRUs in the ftServer 6600 system.

Component	Part Number
CPU Enclosure Processor/Heat Sink (2.0-GHz, 1-MB Cache)	AK-000440
CPU Enclosure Processor/Heat Sink (2.8-GHz, 2-MB Cache)	AK-000431
CPU Enclosure Motherboard	AA-G90200
CPU Enclosure Daughter Board	AA-E92500
CPU Enclosure Power Supply	AA-P64000
Core I/O Enclosure Power Switch Assembly	AS-000389
Core I/O Enclosure PCI Riser PCB	AA-E70400
Core I/O Enclosure Core I/O Board	AA-E70000
Core I/O Enclosure CD-ROM IDE Interface Board	AA-E71500
Core I/O Enclosure Ultra160 SCSI Jumper 68P	AW-001104
Core I/O Enclosure SCSI Backplane	AA-E70500
Core I/O Enclosure Power Switch Cable Assembly	AW-001123
Core I/O Enclosure IDE Cable	AW-001124
Expansion I/O Enclosure Expansion I/O Board	AA-E71000
Core/Expansion I/O Enclosure Ground Cable (14 AWG)	AW-001117
Core/Expansion I/O Enclosure Internal Power Jumper Cable	AW-001107
Core/Expansion I/O Enclosure LED Cable	AW-001102

5.2 Power Removal

If total power removal is required, the system must be shut down prior to removing power and rebooted after the replacement unit is installed.

1. To shut down the ftServer system, click the **Start** button on the Windows 2000 desktop and click **Shut Down**.

Figure 5-1.   Start Menu
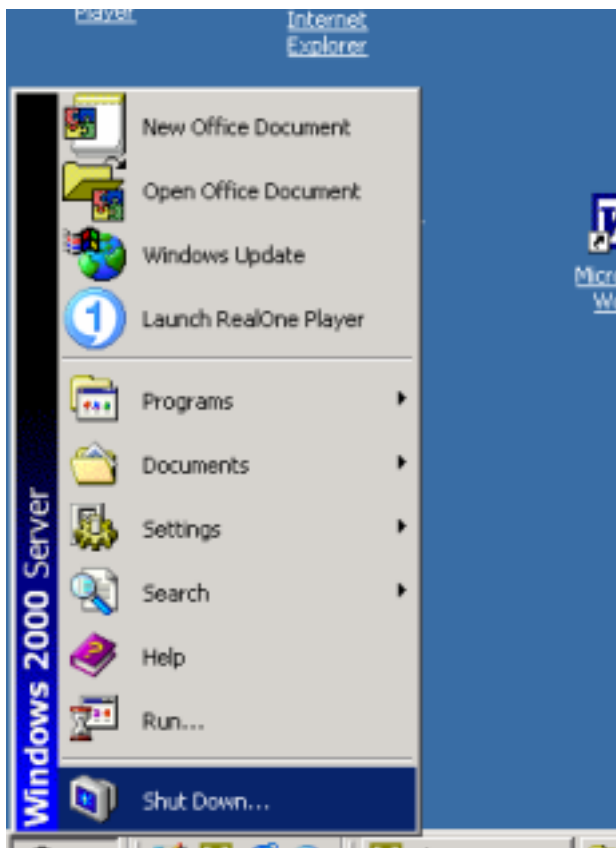
2. In the **Shut Down Windows** dialog box, select **Shut Down** and then click **OK**. A message states that your system is shutting down.

Figure 5-2.   Shut Down Menu

3. When the system displays the message `It is now safe to turn off your computer`, the system will turn off its power automatically.
   This removes main power from the system; however, standby power to the Baseboard Management Controller (BMC) remains on.

4. Turn off power to the monitor and any peripheral devices.

5. At the back of the system, disconnect the two AC power cords.

Figure 5-3.   AC Power Cords
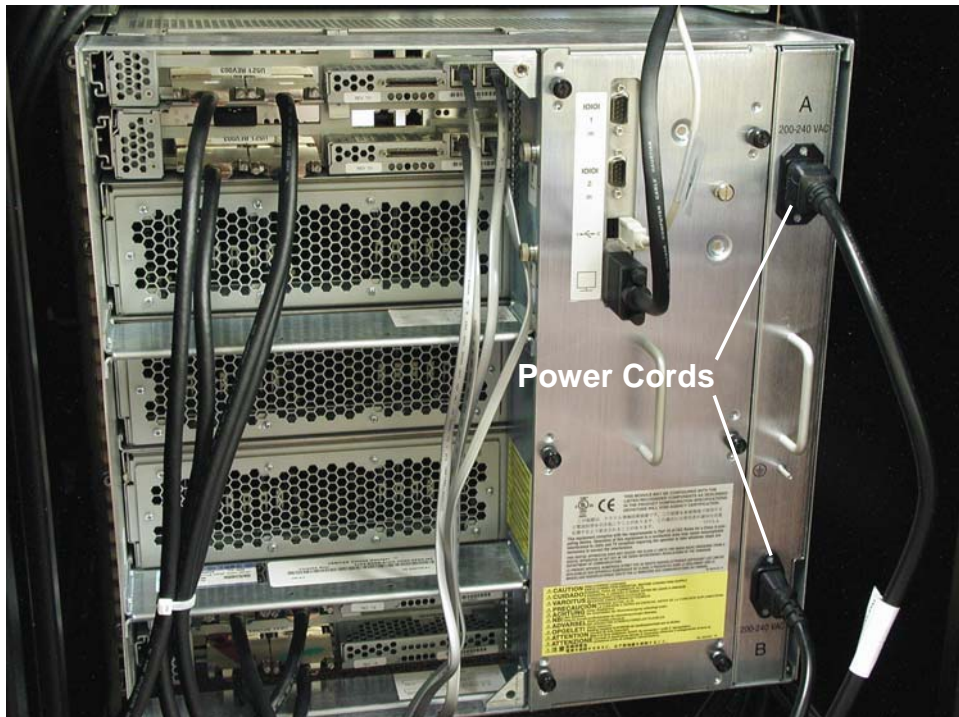
5.3 Handling ESD Sensitive Parts

Clock cards and PCI adapters are particularly sensitive to damage from electrostatic discharge (ESD) because the electronic components are exposed when the device is not fully installed.

Caution: To avoid damaging these parts during handling, always take the following precautions.

- Always store cards and adapters in their static-protective envelope until you are ready to install them in the system.

- Always hold an adapter or card by its edges.

- Always ground yourself before handling a clock card or a PCI adapter, or before removing or replacing the I/O enclosure. Ground yourself by wearing a grounding strap.

5.4 Hardware Removal Procedures

This section contains the removal procedures for the DRUs listed in the preceding table. Each of these procedures indicates any power removal requirements.

To perform the replacement procedure for each DRU, reverse the removable procedure. If any special replacement considerations are necessary, a replacement note is included.

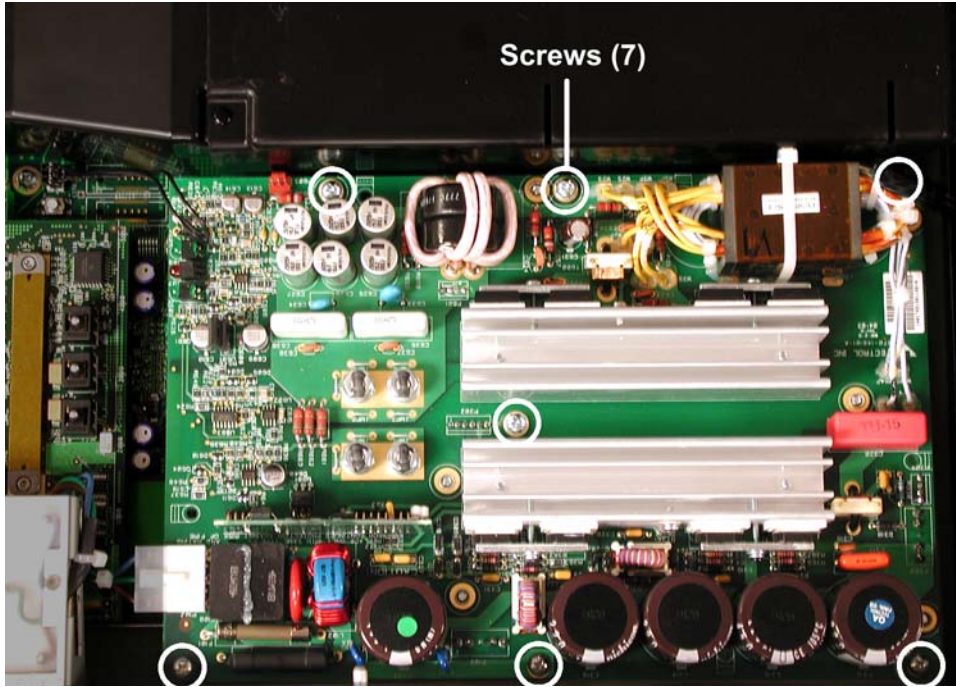### 5.4.1 CPU Enclosure Power Supply

1. Remove the CPU enclosure as described in Section 3.4.1.

2. Remove the CPU enclosure cover as described in Section 4.4.1.

3. Disconnect power supply cables from the motherboard and line filter and cut the tie wrap securing the fan cable at the power supply.

Figure 5-4.   CPU Enclosure Power Supply Cables
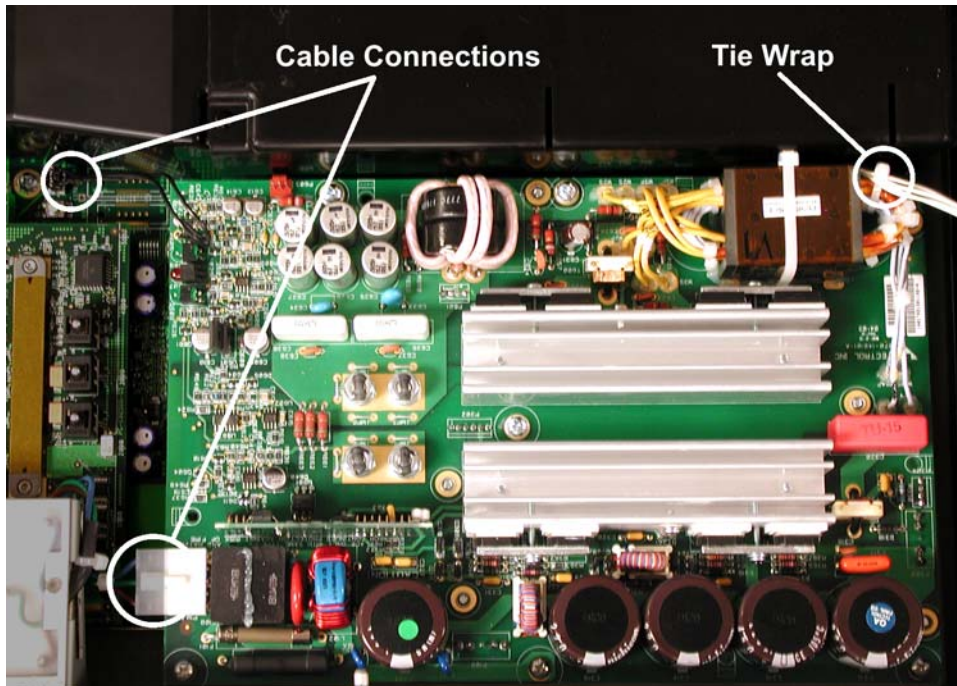
4. Remove the seven screws securing the power supply and lift it out.

Figure 5-5.   CPU Enclosure Power Supply Screws

5.4.2 CPU Enclosure Processor/Heat Sink

1. Remove the CPU enclosure as described in Section 3.4.1.

2. Remove the CPU enclosure cover as described in Section 4.4.1.

3. Remove the three screws securing the airflow cover and lift it off.

Figure 5-6.   Airflow Cover Screws
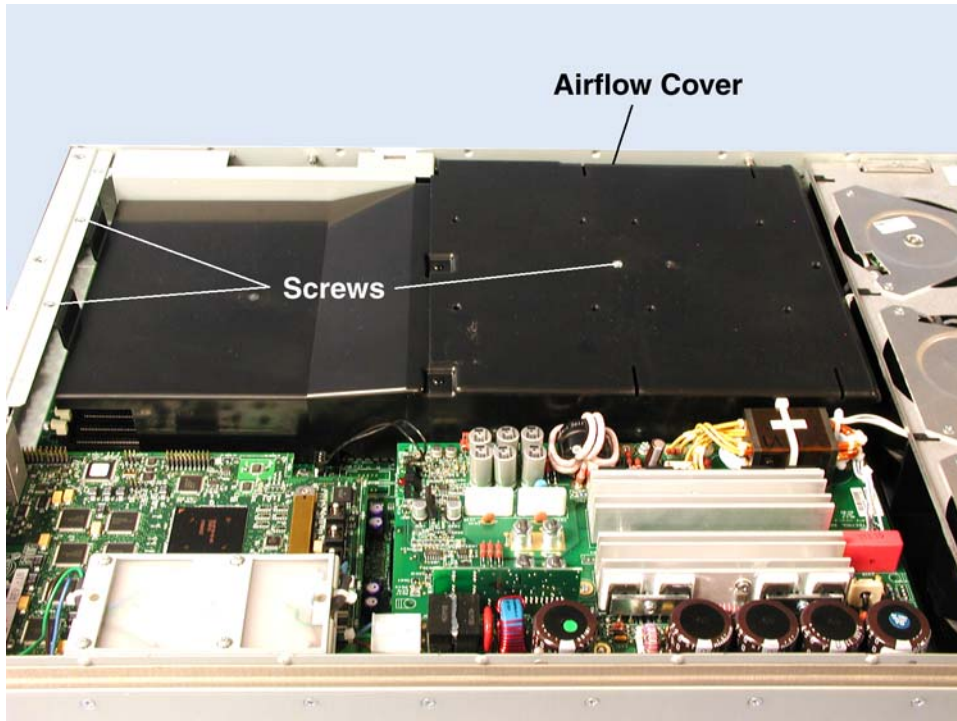
4. The heat sink must be removed before the CPU is removed. This is done by pushing down on the heat sink clip and using the special heat sink clip tool to remove it. Using any other tool will damage the motherboard. The heat sink must then be heated with a heat gun to allow it to be removed from the processor.
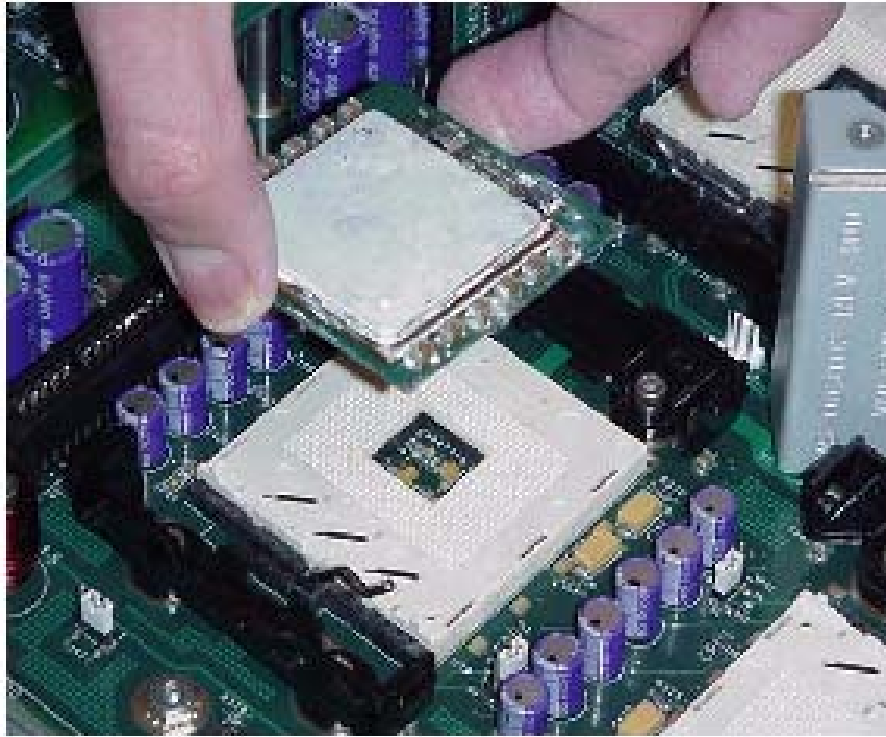
Figure 5-7.   Heat Sink Clip

5. Release the processor's ejector lever and pull the processor straight up and out of the socket.

Figure 5-8.   Processor Ejector Lever
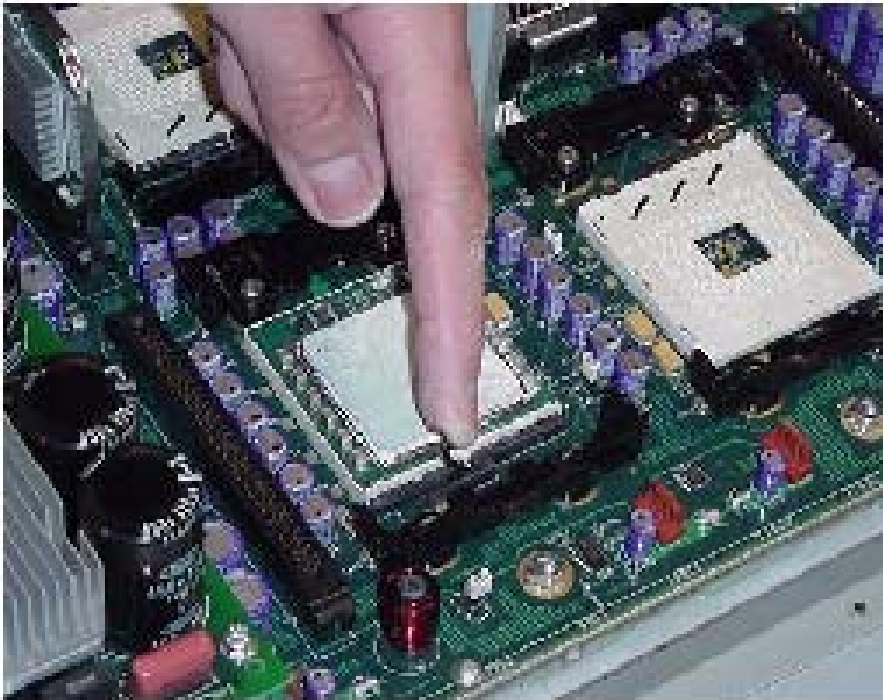
6. To replace the processor, verify the ejector lever on the socket is in the open position and carefully insert the new processor making sure it is seated properly

Figure 5-9. Inserting Processor

7. Close the ejector lever completely, making sure the levers engages the top of the processor to ensure a secure connection.

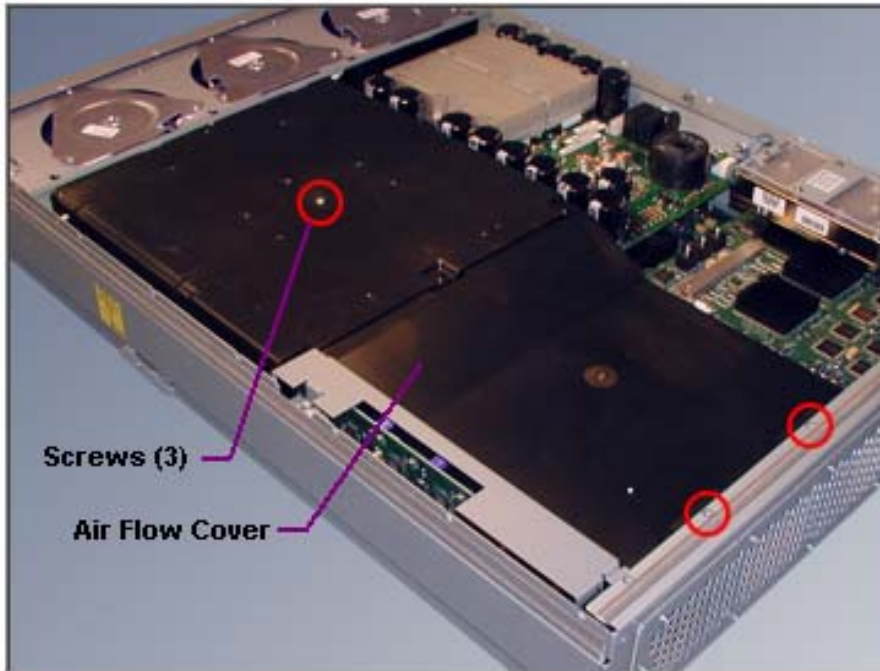8. A new heat sink must be placed on the replacement CPU, using the thermal grease included in the CPU kit.

Figure 5-10.   Replacing Heat Sink
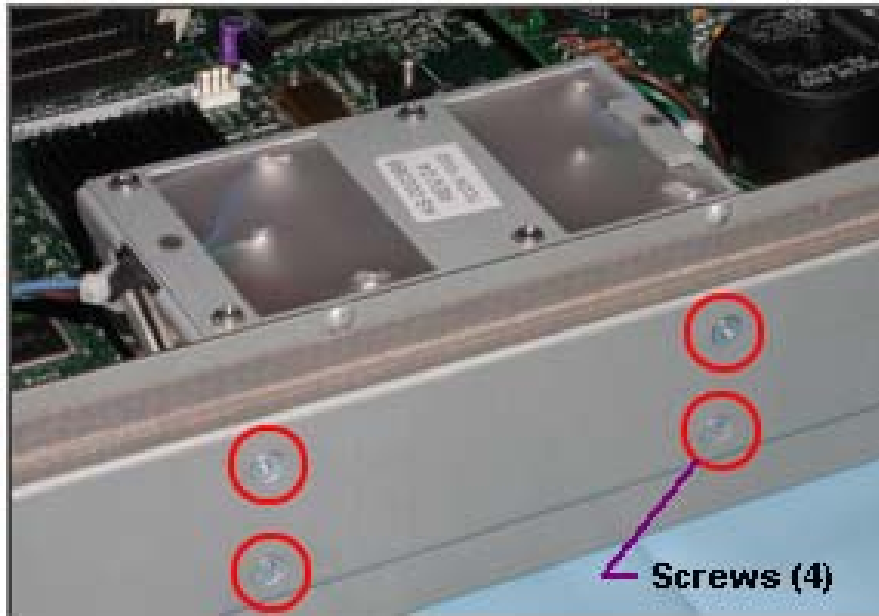
5.4.3 CPU Daughter Board

1. Remove the CPU enclosure as described in Section 3.4.1.

2. Remove CPU enclosure cover as described in Section 4.4.1.

3. Remove the three screws securing the airflow cover and lift it off.

Figure 5-11.   Air Flow Cover

4. Remove the screws holding the line filter by removing four screws on the side of enclosure, and move to the outside of the enclosure. Note that there are two lengths; the top screws are shorter.

Figure 5-12.   Line Filter Screws

5. Remove the two Phillips screws and two Allen screws holding the daughter board in place. The stiffener bar held in place by the Allen screws will be used on the replacement board.

Figure 5-13.   Daughter Board Screws

IMPORTANT: Do not touch the gold dot connectors on the bottom of the card and on the motherboard. Data integrity can be compromised.

5.4.4 CPU Enclosure Motherboard

1. Remove the CPU enclosure as described in Section 3.4.1.

2. Remove the CPU enclosure cover as described in Section 4.4.1.

3. Remove the memory DIMMs as described in Section 4.4.2.

4. Remove the fan assembly as described in Section 4.4.3.

5. Remove the memory power board as described in Section 4.4.4.

6. Remove the power supply as described in Section 5.4.1.

7. Remove the heatsinks and processors as described in Section 5.4.2.

8. Remove the daughter board as described in Section 5.4.3.

9. Remove the remaining screws securing the motherboard and lift it out of the enclosure

5.4.5 Core I/O Enclosure PCI Riser PCB

1. Remove the core I/O enclosure as described in Section 3.4.2.

2. Remove the I/O enclosure cover as described in Section 3.4.3.

3. Remove all the PCI adapters as described in Section 3.4.6.

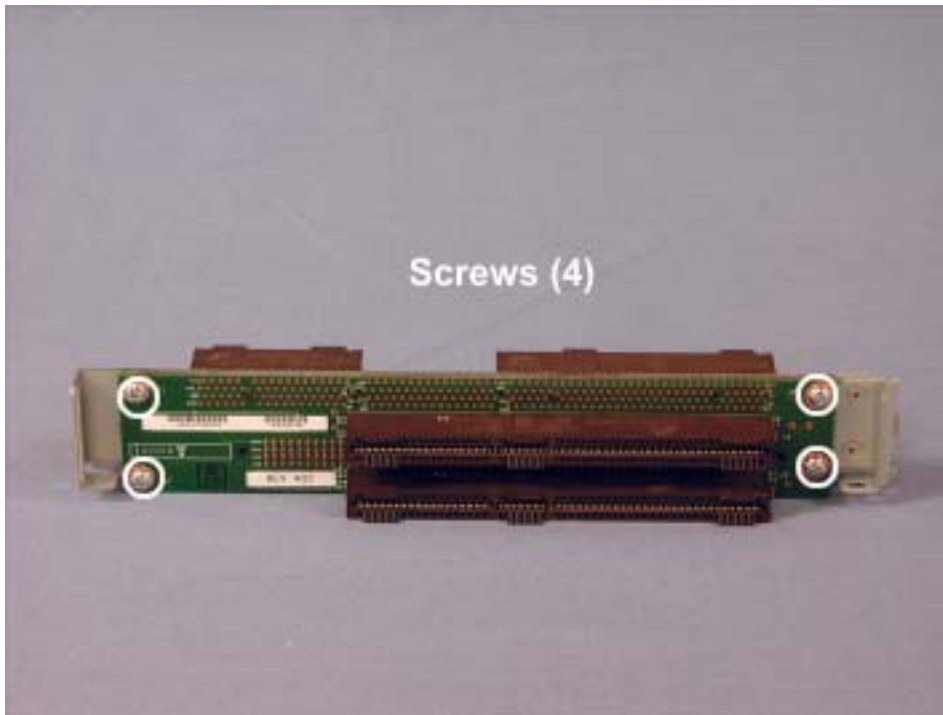4. Remove the four screws securing the bracket holding the PCI riser PCB.

Figure 5-14.   Bracket Screws
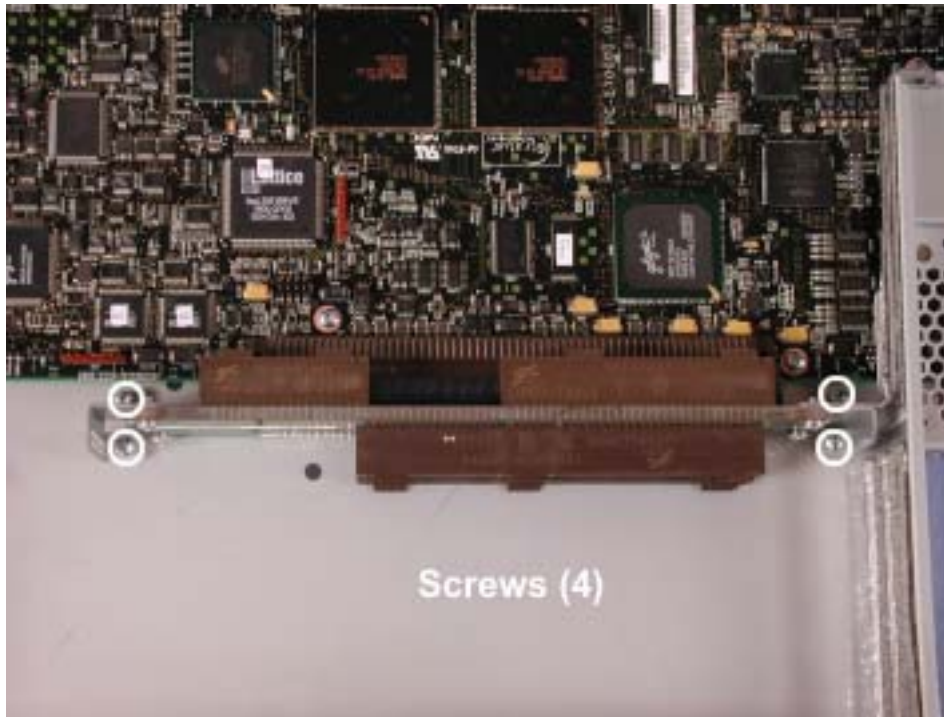
5. Pull the PCI riser bracket horizontally out of its connector.

6. Remove the four screws securing the PCI riser PCB to the bracket.

Figure 5-15.   PCI Riser PCB Screws

5.4.6 Core I/O Enclosure Power Switch Assembly

1. Remove the core I/O enclosure as described in Section 3.4.2.

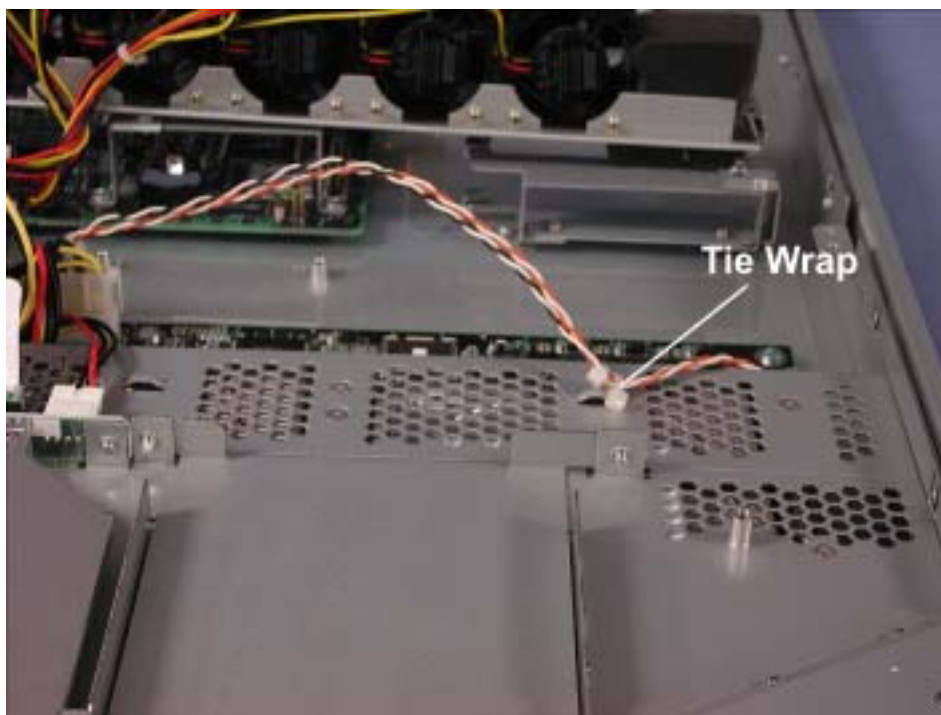2. Remove the I/O enclosure cover as described in Section 3.4.3.

3. Remove the three screws securing the fan assembly and carefully pull the assembly out of the way. You do not have to remove the fan assembly cables.

Figure 5-16.   Fan Assembly Screws

4. Cut the tie wrap securing the power switch cable to loosen the tension on the cable.

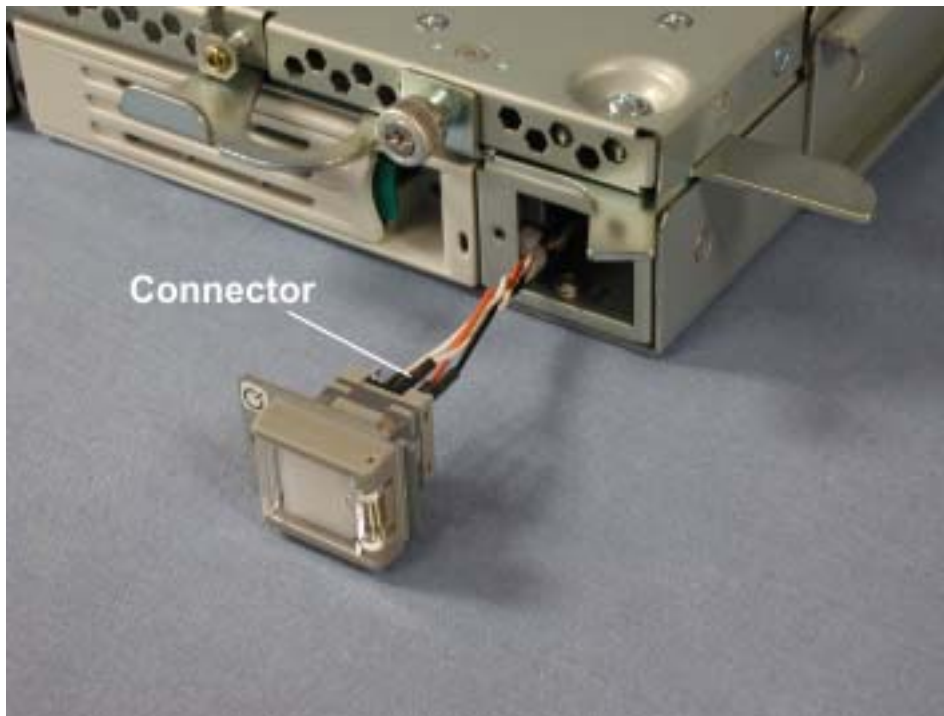*Figure 5-17.   Power Switch Cable Tie Wrap*

5. At the front of the enclosure, remove the screw securing the power switch cover.

Figure 5-18.   Power Switch Cover Screw

Screw
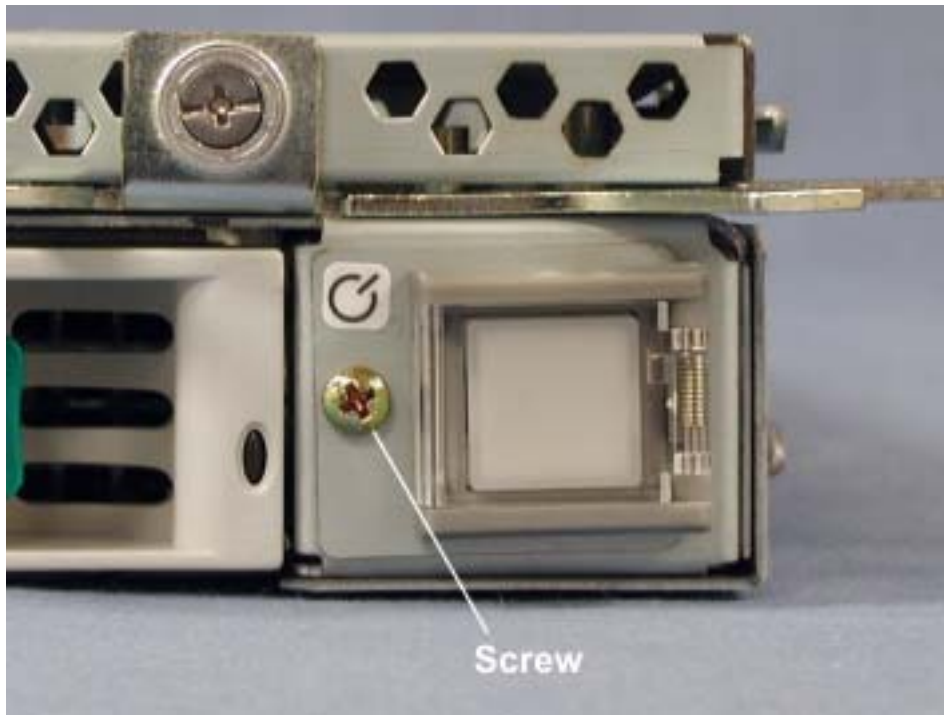
6. Pull the power switch slightly out the front of the I/O enclosure and disconnect the cable from the switch.

Figure 5-19.   Removing Power Switch

Connector

5.4.7 Core I/O Enclosure Core I/O Board

1. Remove the core I/O enclosure as described in Section 3.4.2.

2. Remove the I/O enclosure cover as described in Section 3.4.3.

3. Remove the fan assembly as described in Section 3.4.7.

4. Disconnect the remaining cables (five total) from the core I/O board.

Figure 5-20.   Core I/O Board Cables
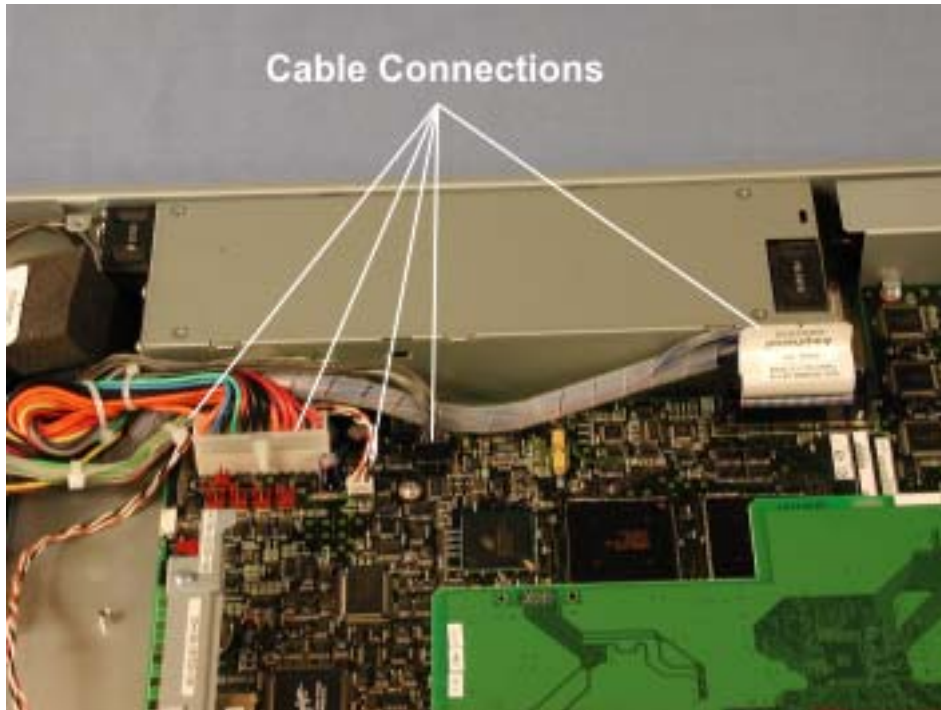
5. Remove each of the PCI adapters as described in Section 3.4.9.

6. Remove the PCI Riser PCB as described in Section 4.3.7.

7. Remove the two screws securing the PCB stabilizing bracket to the core I/O board.

Figure 5-21.   Stabilizing Bracket Screws

8. Remove the screw securing the AC inlet cover and lift off the cover.

Figure 5-22.   AC Inlet Cover Screw
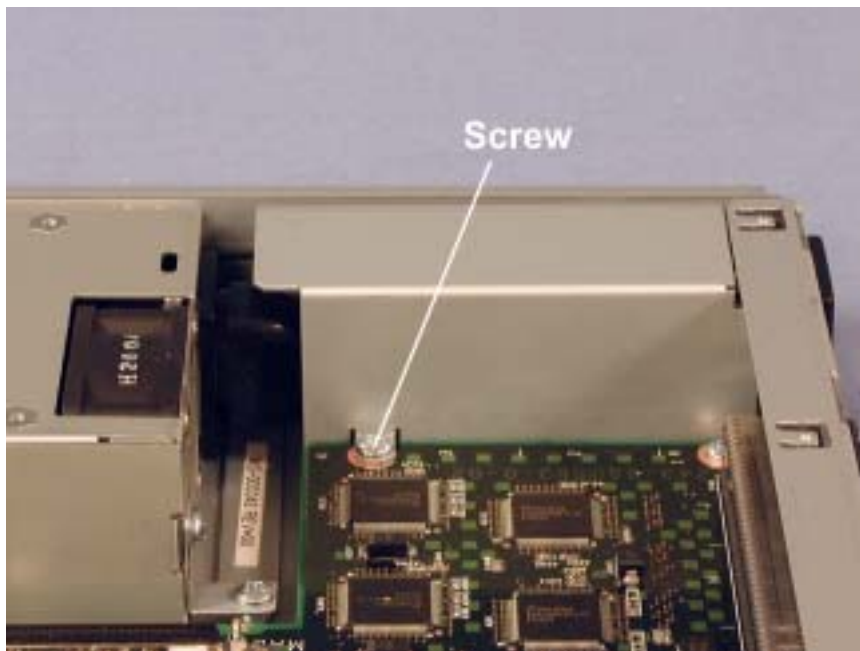
9. Remove the two screws securing the external SCSI connector at the rear of the enclosure.

Figure 5-23.   External SCSI Connector Screws

10. Remove the remaining eight screws from the core I/O board.

Figure 5-24.   Core I/O Board Screws
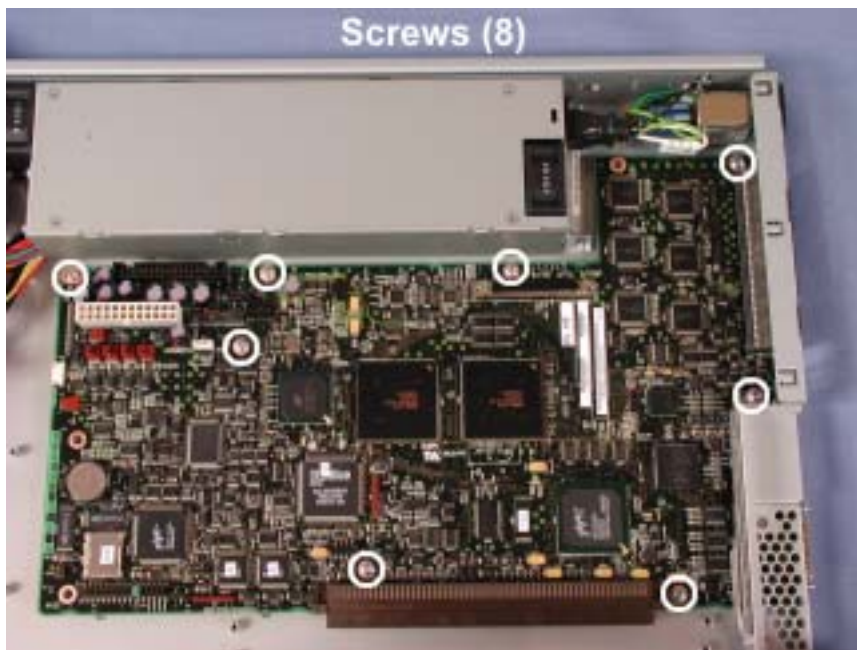
11. Carefully lift the end of the core I/O board and pull it slightly forward until the connectors at the rear clear the sheet metal.

5.4.8 CD-ROM Interface Board

1. Remove the core I/O enclosure as described in Section 3.4.2.

2. Remove the I/O enclosure cover as described in Section 3.4.3.

3. Disconnect the cables from the CD-ROM interface board.

Figure 5-25.   CD-ROM Interface Board Cables

4. Remove the two screws securing the Interface board.

Figure 5-26.   CD-ROM Interface Board Screws

5. Disengage the CD-ROM interface board from the CD-ROM and lift it out

5.4.9 Expansion I/O Enclosure Expansion I/O Board

1. Remove the expansion I/O enclosure as described in Section 3.4.2.

2. Remove the I/O enclosure cover as described in Section 3.4.3.

3. Disconnect the power cable and LED cable from the expansion I/O board.

Figure 5-27.   Power Cable and LED Cable Connections at I/O Expansion Board

4. Remove the fan assembly as described in Section 3.4.10.

5. Remove each of the PCI adapters as described in Section 3.4.6.

6. Remove the PCI Riser PCB as described in Section 4.4.4.

7. Remove the two screws securing the PCB stabilizing bracket to the expansion I/O board.

Figure 5-28.   Stabilizing Bracket Screws
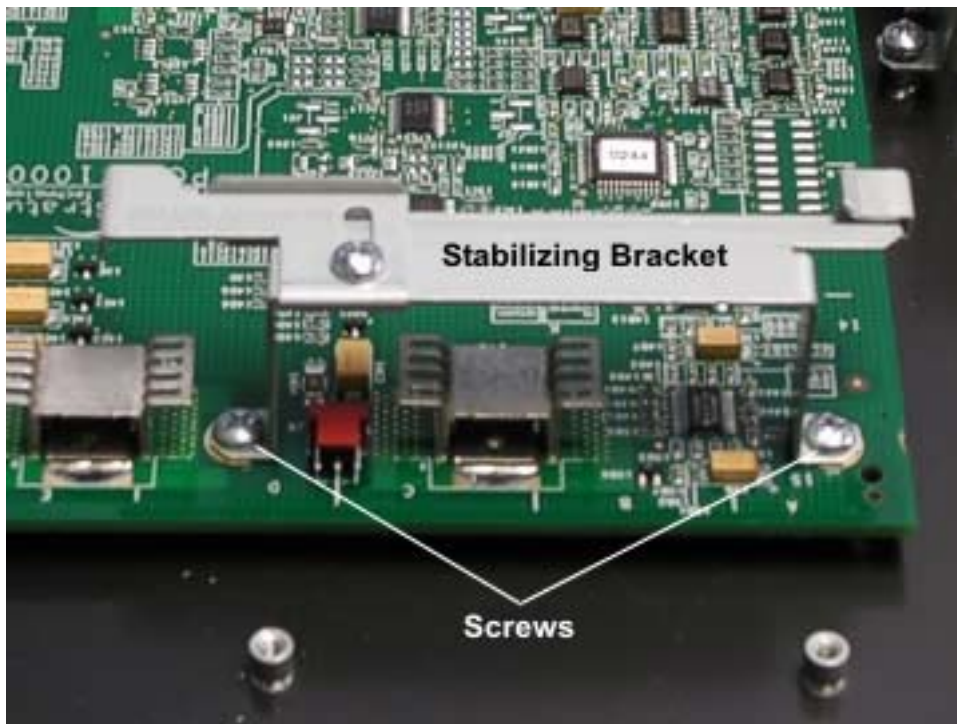
8. Remove the screw securing the AC inlet cover and lift off the cover.

Figure 5-29.   AC Inlet Cover Screw
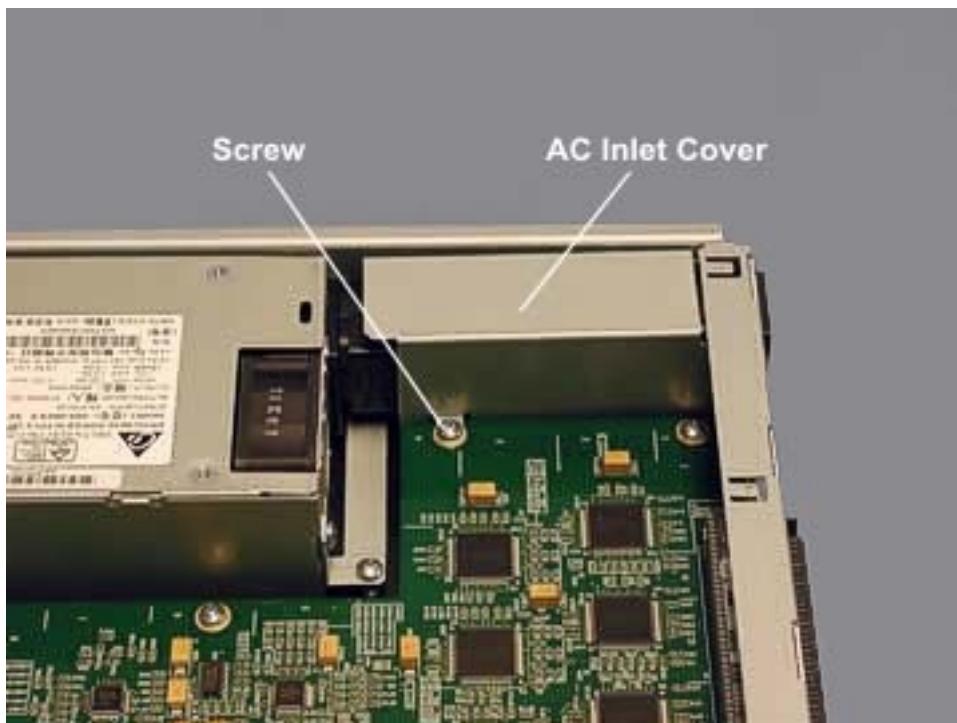
9.   Remove the remaining eight screws from the expansion I/O board.

Figure 5-30.   Expansion I/O Board Screws

10. Carefully lift the end of the expansion I/O board and pull it slightly forward until the connectors at the rear clear the sheet metal.

5.4.10 Core I/O Enclosure LED Cable

1. Remove the I/O enclosure as described in Section 3.4.2.

2. Remove the I/O enclosure cover as described in Section 3.4.3.

3. Remove the three screws securing the fan assembly and carefully pull the assembly out of the way. You do not have to remove the fan assembly cables.

Figure 5-31.   Fan Assembly Screws

4. Disconnect the power cable and LED cable from the core I/O board.

Figure 5-32.   Power Cable and LED Connections at Core I/O Board

5. Remove the screw in the I/O enclosure LED PCB at the front of the enclosure.

Figure 5-33.   I/O Enclosure LED PCB Screw
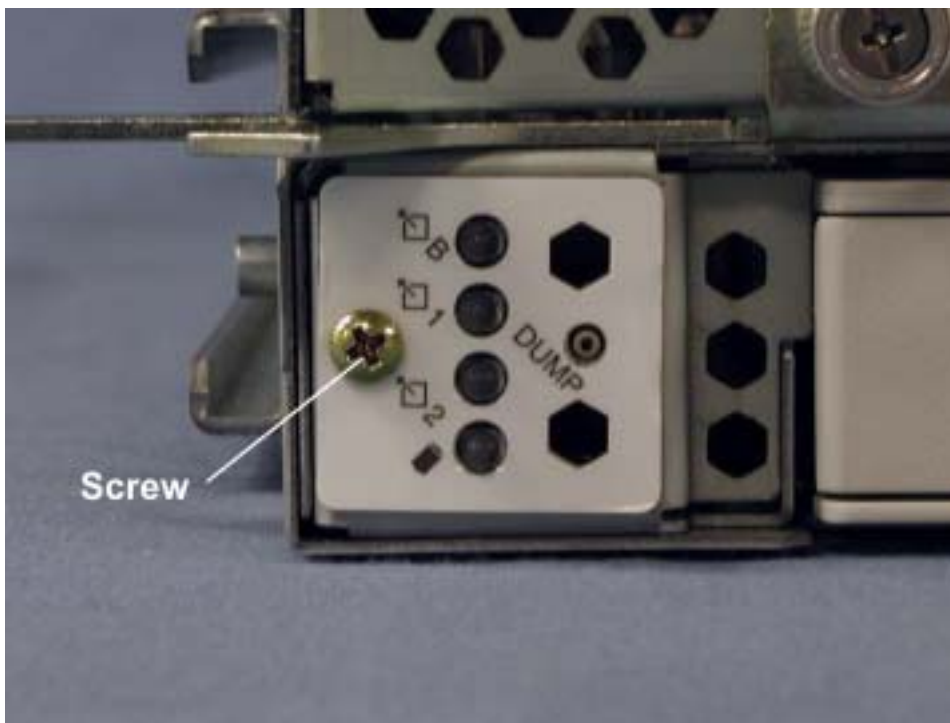
6. Pull the I/O enclosure LED PCB and cable straight forward and out of the enclosure.

Figure 5-34.   Removing LED PCB and Cable
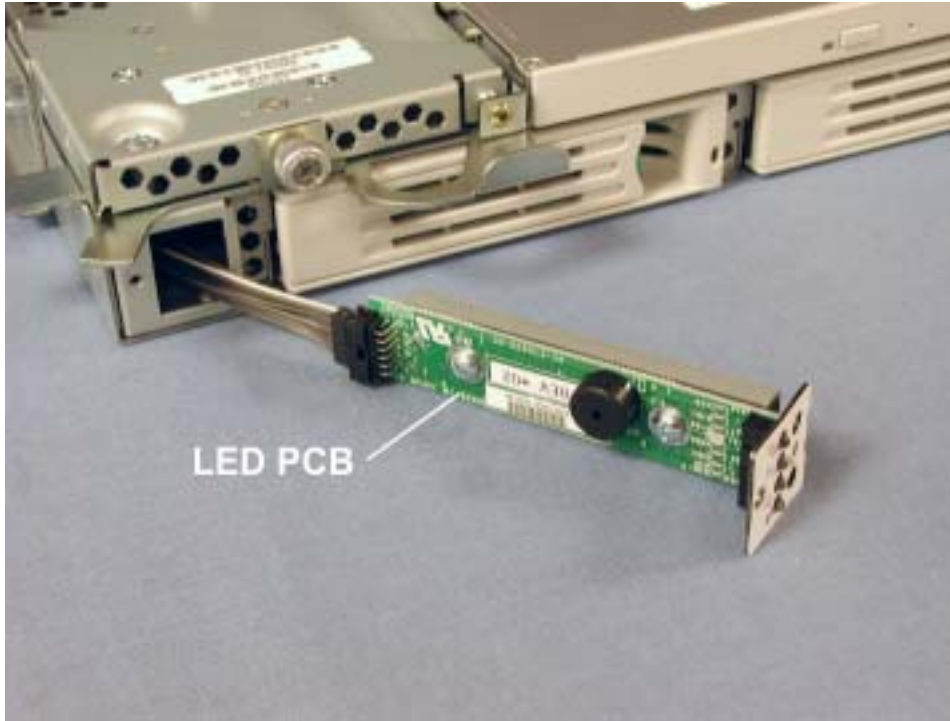
7. Disconnect the LED cable from the back of the LED PCB.

5.4.11 Expansion I/O Enclosure LED Cable

3. Remove the expansion I/O enclosure as described in Section 3.4.2.

4. Remove the I/O enclosure cover as described in Section 3.4.3.

5. Remove the three screws securing the fan assembly and carefully pull the assembly out of the way. You do not have to remove the fan assembly cables.

Figure 5-35.   Fan Assembly Screws

6. Disconnect the power cable and LED cable from the expansion I/O board.

Figure 5-36.   Power Cable and LED Connections at Expansion I/O Board

7. Remove the screw in the I/O enclosure LED PCB at the front of the enclosure.

Figure 5-37.   I/O Enclosure LED PCB Screw

8. Pull the I/O enclosure LED PCB and cable straight forward and out of the enclosure.

Figure 5-38.   Removing LED PCB and Cable

9. Disconnect the LED cable from the back of the LED PCB.
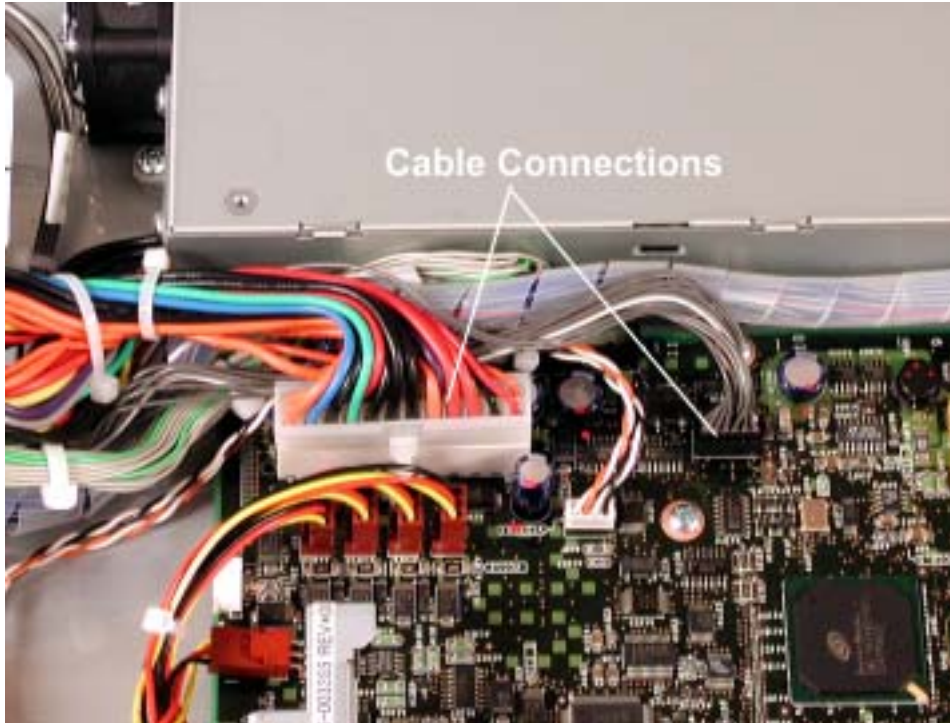
5.4.12 Core I/O Enclosure Ground Cable

1. Remove the I/O enclosure as described in Section 3.4.2.

2. Remove the I/O enclosure cover as described in Section 3.4.3.

3. Remove the three screws securing the fan assembly and carefully pull the assembly out of the way. You do not have to remove the fan assembly cables.

Figure 5-39.   Fan Assembly Screws

4. Remove the screw securing the AC inlet cover and lift off the cover.

Figure 5-40. AC Inlet Cover Screw

5. Remove the three screws securing the power supply and lift it out of the way. You do not need to disconnect the power connector.

Figure 5-41. Power Supply Screws
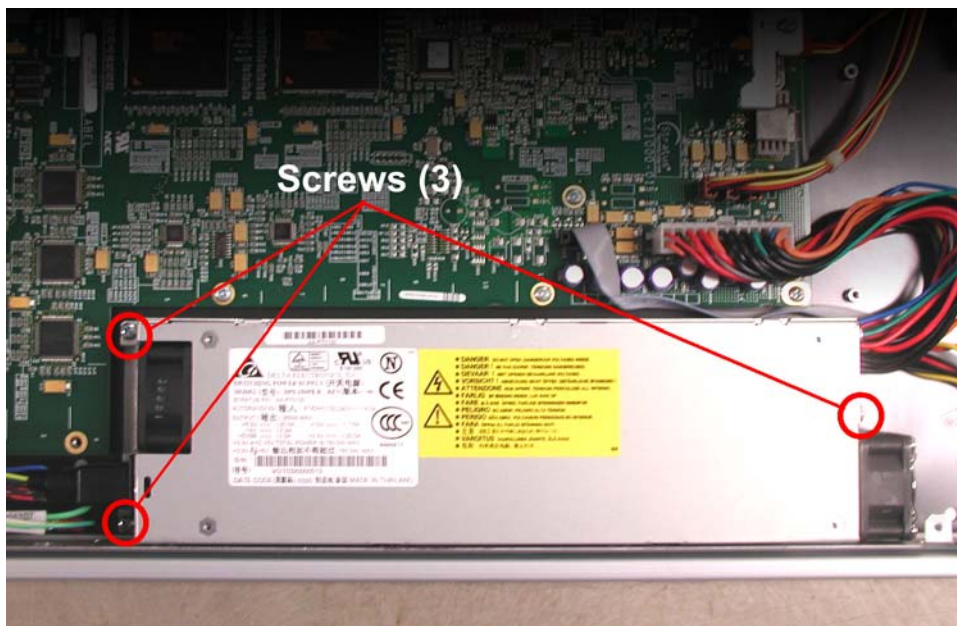
6. Disconnect the black and white wires on the power jumper cable from the AC inlet.

Figure 5-42.   Power Jumper Cable Wires at AC Inlet
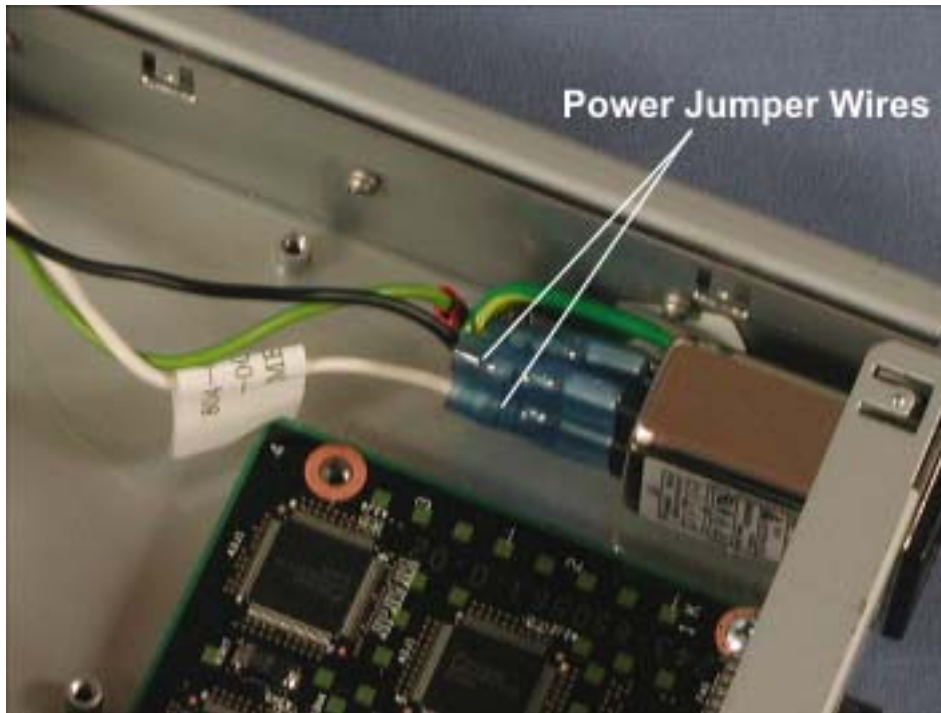
7. Disconnect the ground cable from the AC inlet.

Figure 5-43.   Ground Cable Connection at AC Inlet
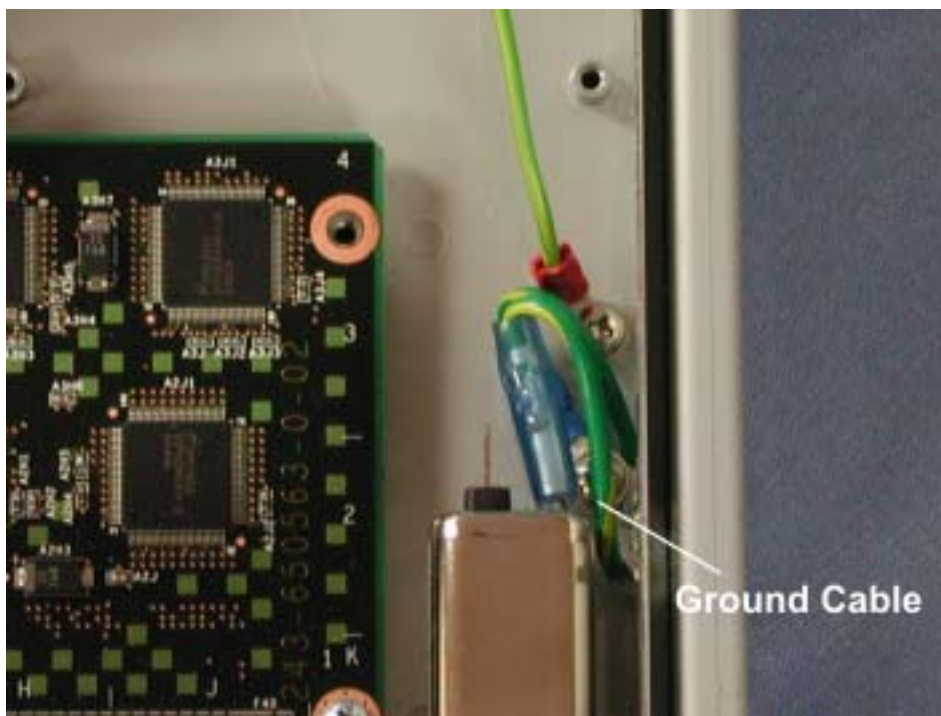
8. Remove the screw securing the ground cable to the enclosure.

5.4.13 Expansion I/O Ground Cable

1. Remove the expansion I/O enclosure as described in Section 3.4.2.

2. Remove the I/O enclosure cover as described in Section 3.4.3.

3. Remove the three screws securing the fan assembly and carefully pull the assembly out of the way. You do not have to remove the fan assembly cables.
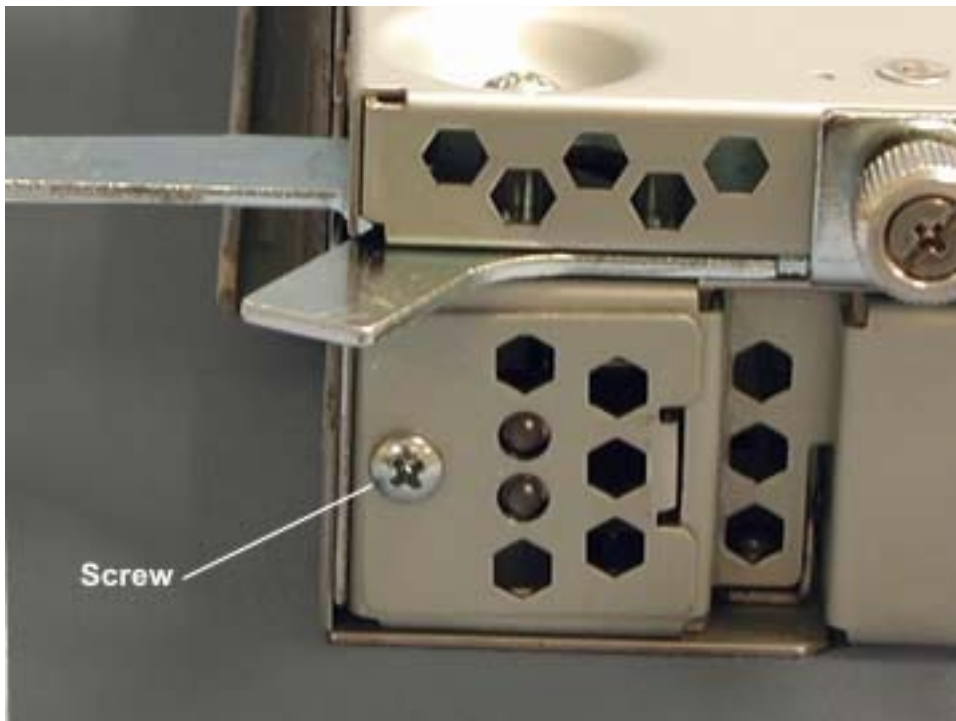
Figure 5-44.   Fan Assembly Screws

4. Remove the screw securing the AC inlet cover and lift off the cover.

Figure 5-45.   AC Inlet Cover Screw

5. Remove the three screws securing the power supply and lift it out of the way. You do not need to disconnect the power connector.

Figure 5-46.   Power Supply Screws
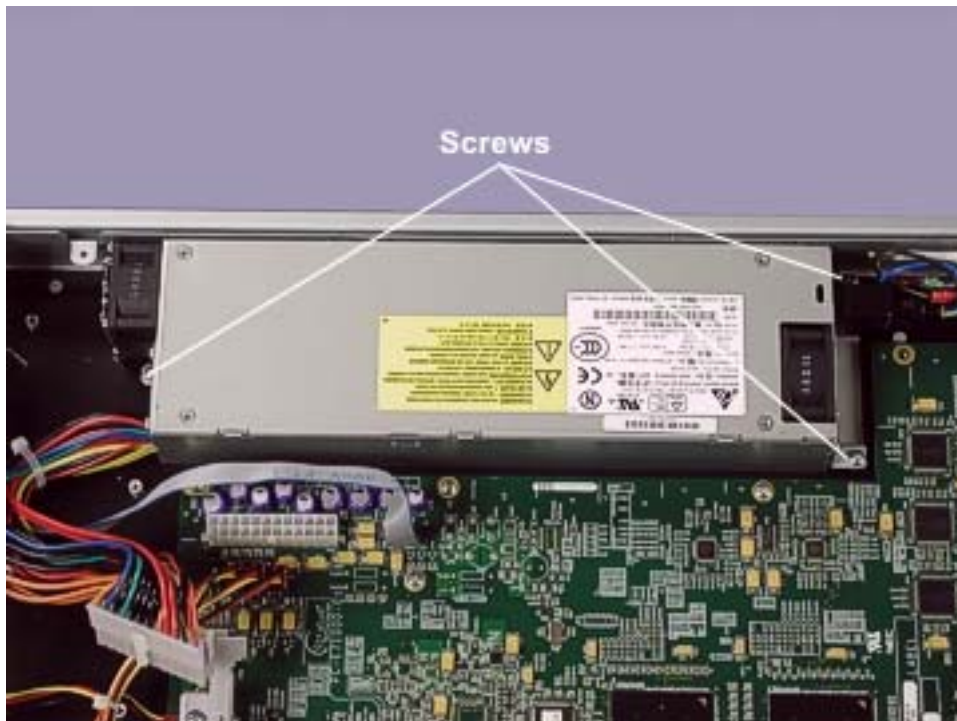
6. Disconnect the brown and blue wires on the power jumper cable from the AC inlet.

Figure 5-47.   Power Jumper Cable Wires at AC Inlet
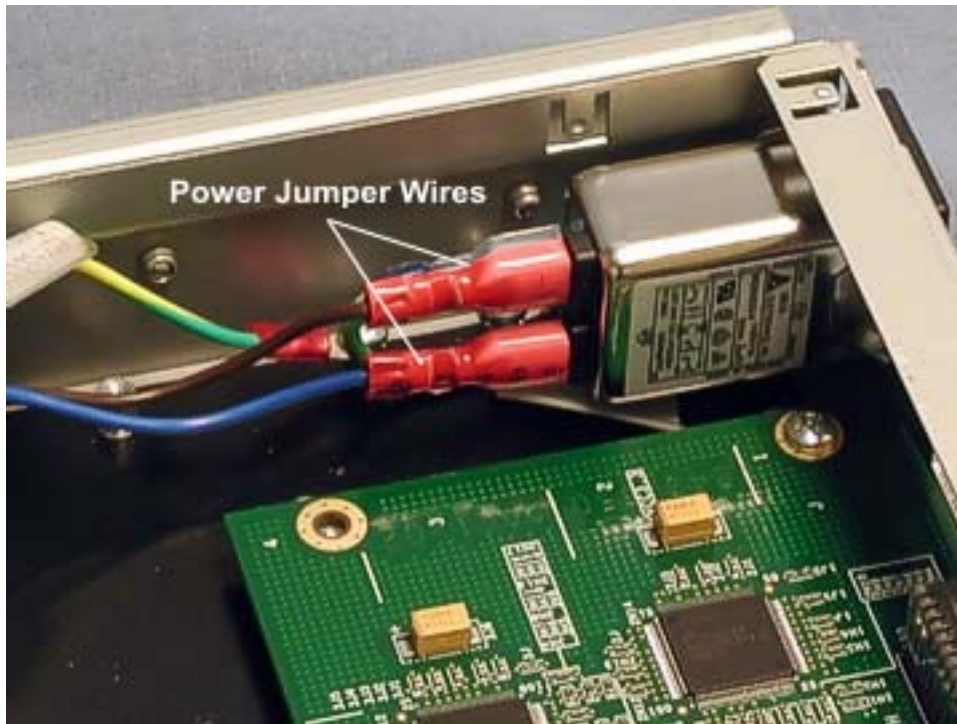
7. Disconnect the ground cable from the AC inlet and remove the screw securing it to the enclosure.

Figure 5-48.   Ground Cable Connection at AC Inlet
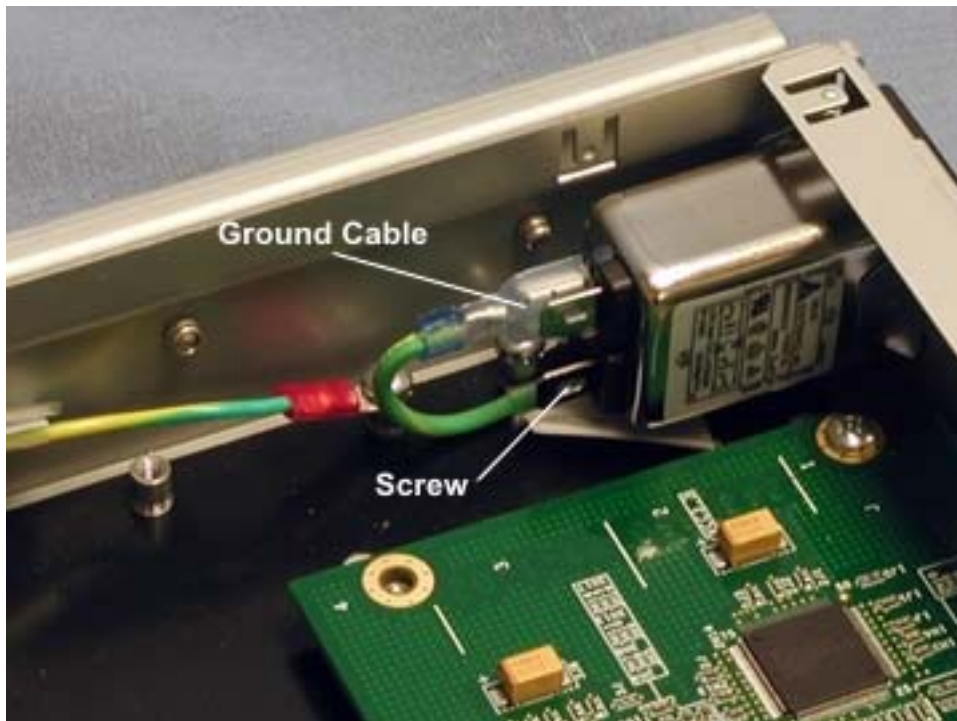
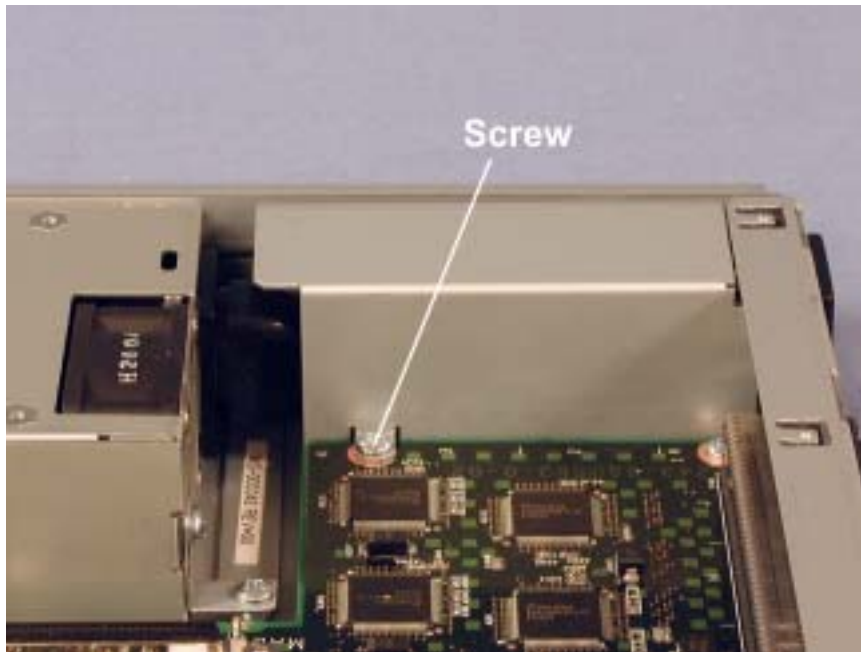## 5.4.14 Core I/O Enclosure Power Switch with LED and Guard

1. Remove the I/O enclosure as described in Section 3.4.2.

2. Remove the I/O enclosure cover as described in Section 3.4.3.

3. Remove the three screws securing the fan assembly and carefully pull the assembly out of the way. You do not have to remove the fan assembly cables.

Figure 5-49.   Fan Assembly Screws

4. Cut the tie wrap securing the power switch cable to the chassis to loosen the tension on the cable.

Figure 5-50. Power Switch Cable Tie Wrap

5. Disconnect the power switch cable and power cable at the core I/O board.

Figure 5-51. Power Switch Cable Connection at Core I/O Board
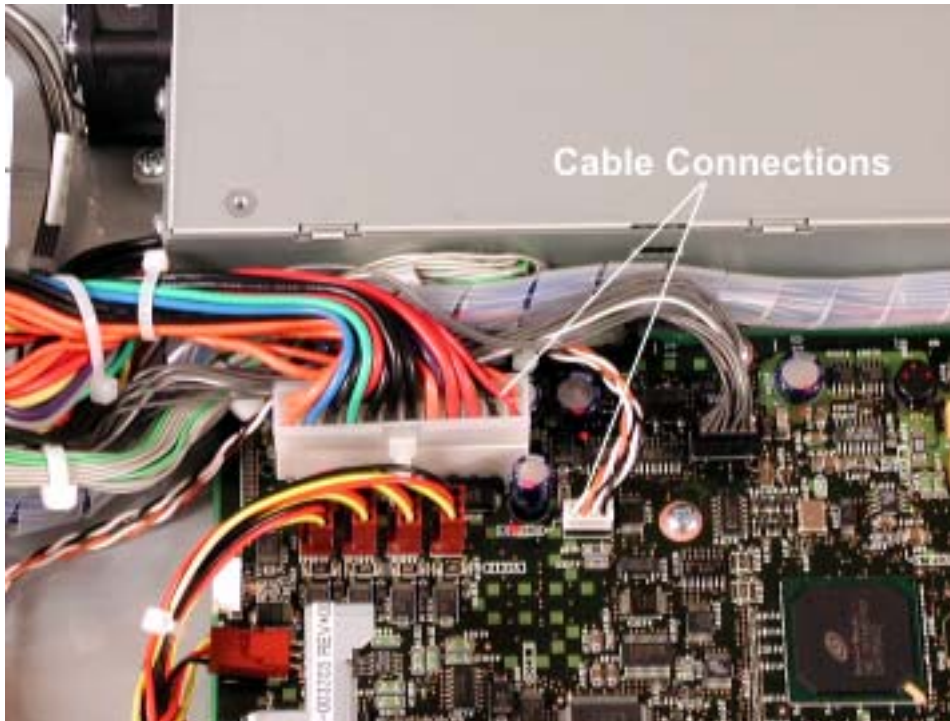
6. At the front of the enclosure, remove the screw securing the power switch assembly cover.

Figure 5-52.   Power Switch Assembly Cover Screw

Screw
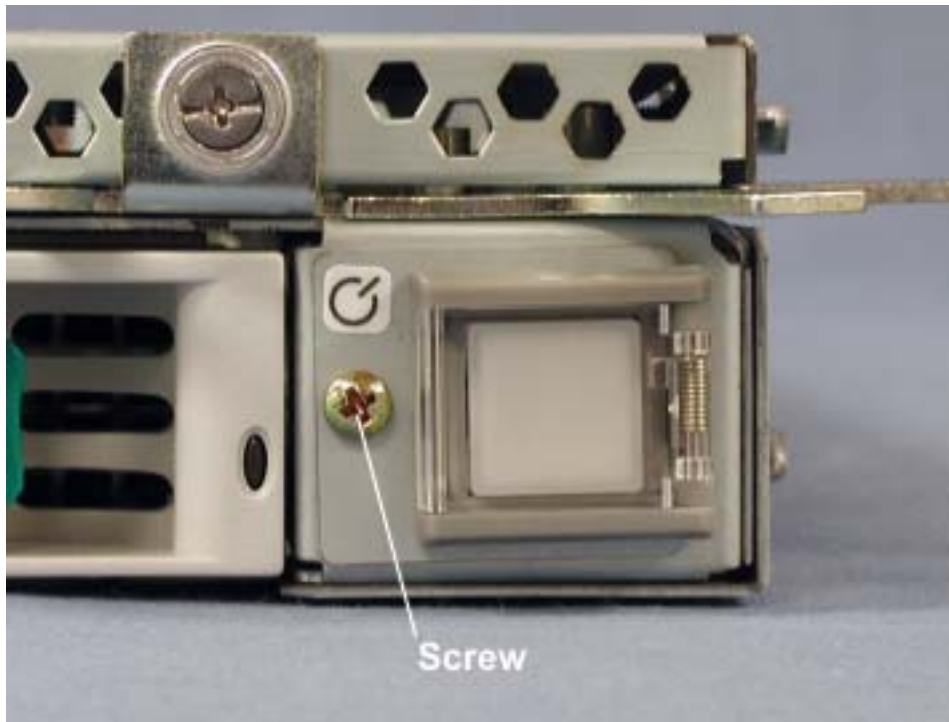
7. Pull the power switch assembly out the front of the I/O enclosure.

Figure 5-53.   Removing Power Switch Assembly

Power Switch Assembly
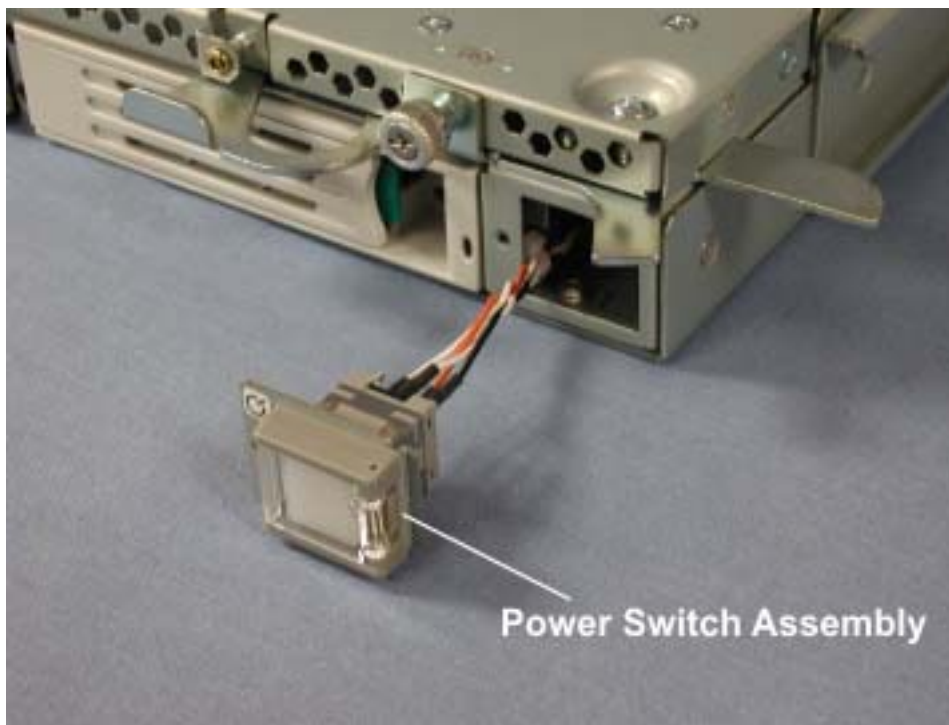
5.4.15 Core I/O Enclosure IDE Cable

1. Remove the I/O enclosure as described in Section 3.4.2.

2. Remove the I/O enclosure cover as described in Section 3.4.3.

3. Remove the three screws securing the fan assembly and carefully pull the assembly out of the way. You do not have to remove the fan assembly cables.

Figure 5-54.   Fan Assembly Screws

4. Disconnect the power cable at the core I/O board.

Figure 5-55. Power Cable Connection at Core I/O Board
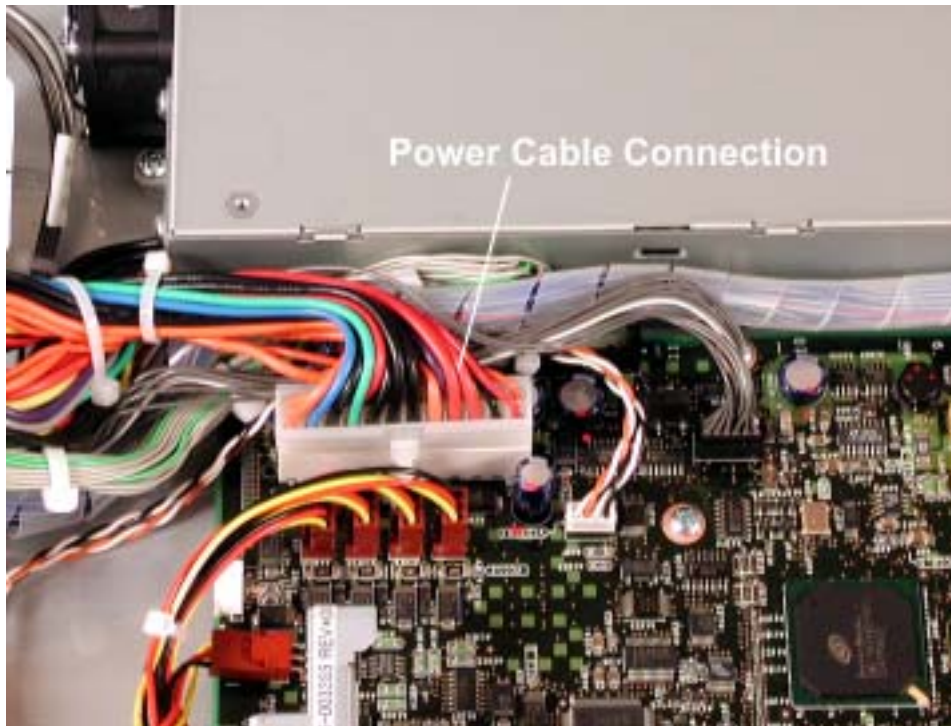
5. Disconnect the IDE cable at the CD-ROM interface board and the core I/O board.

Figure 5-56. IDE Cable Connections at CD-ROM Interface Board and Core I/O Board
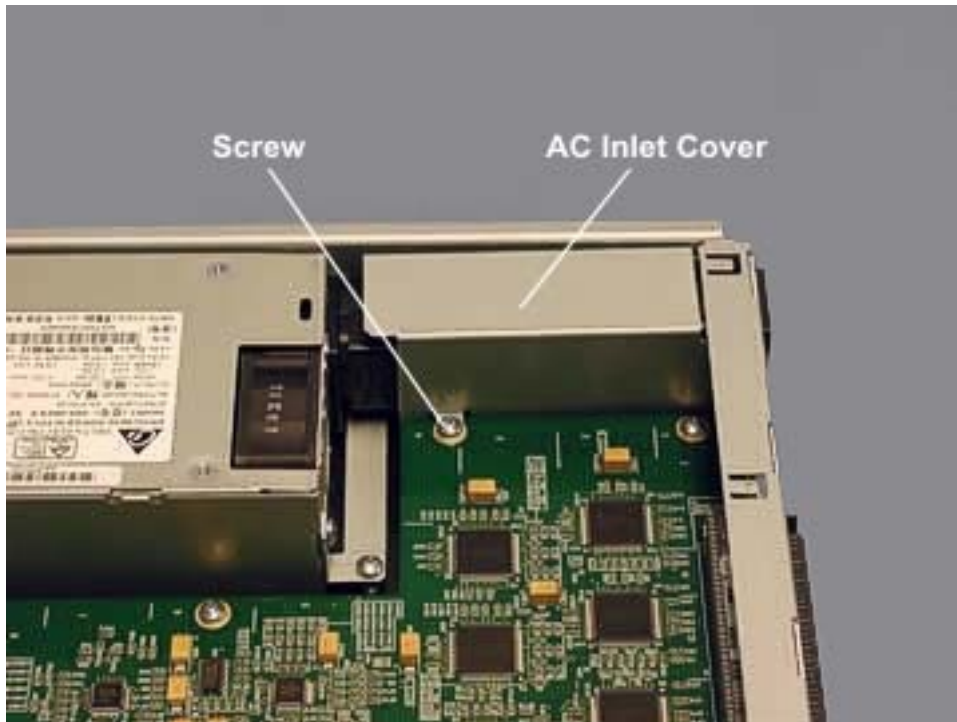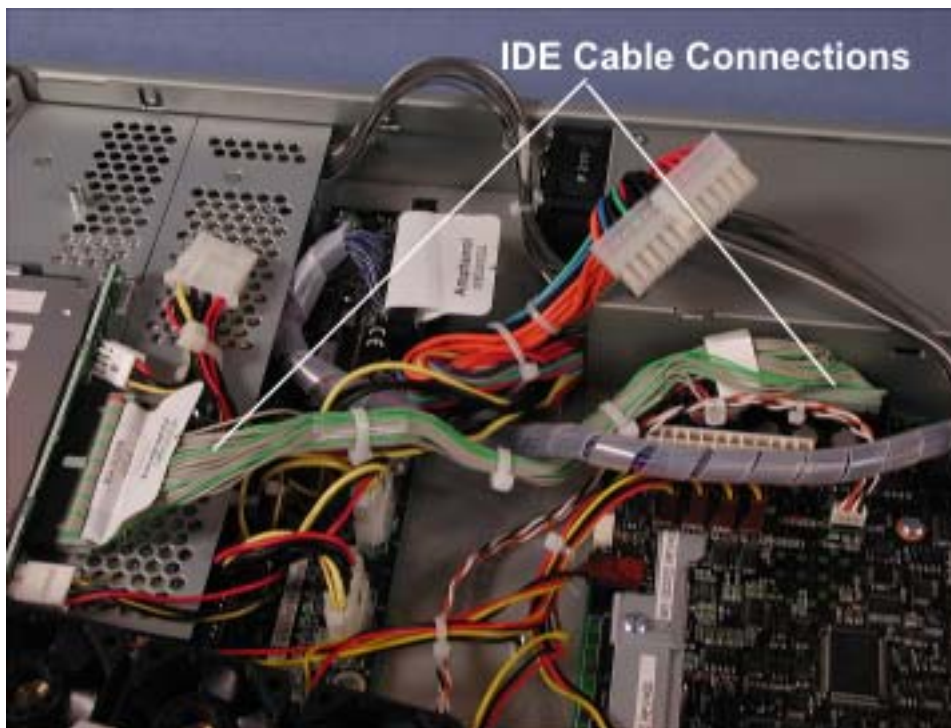
5.4.16 Core I/O Enclosure Power Jumper Cable

1. Remove the I/O enclosure as described in Section 3.4.2.

2. Remove the I/O enclosure cover as described in Section 3.4.3.

3. Remove the three screws securing the fan assembly and carefully pull the assembly out of the way. You do not have to remove the fan assembly cables.

Figure 5-57.   Fan Assembly Screws

4. Remove the screw securing the AC inlet cover and lift off the cover.

Figure 5-58.   AC Inlet Cover Screw
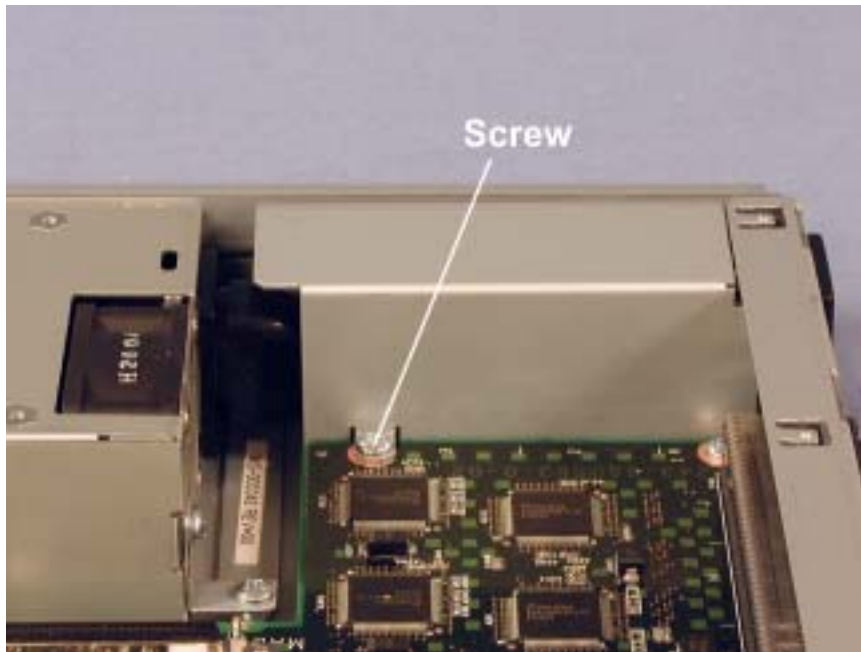
5. Remove the three screws securing the power supply and pull it slightly forward. You do not need to disconnect the power connector.

Figure 5-59.   Power Supply Screws
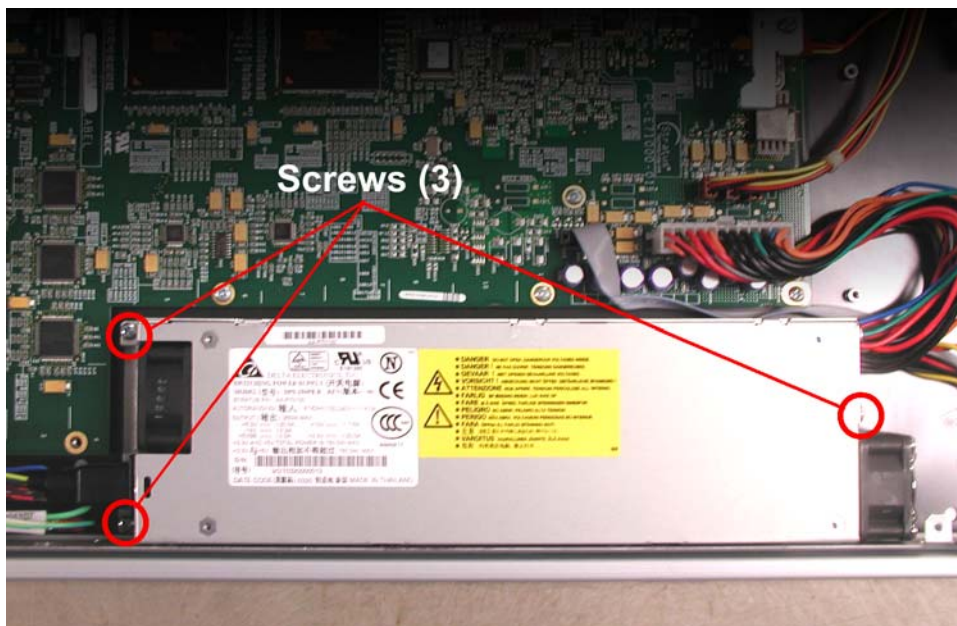
6. Disconnect the power jumper cable from the power supply

Figure 5-60.   Power Jumper Cable Wires at Power Supply
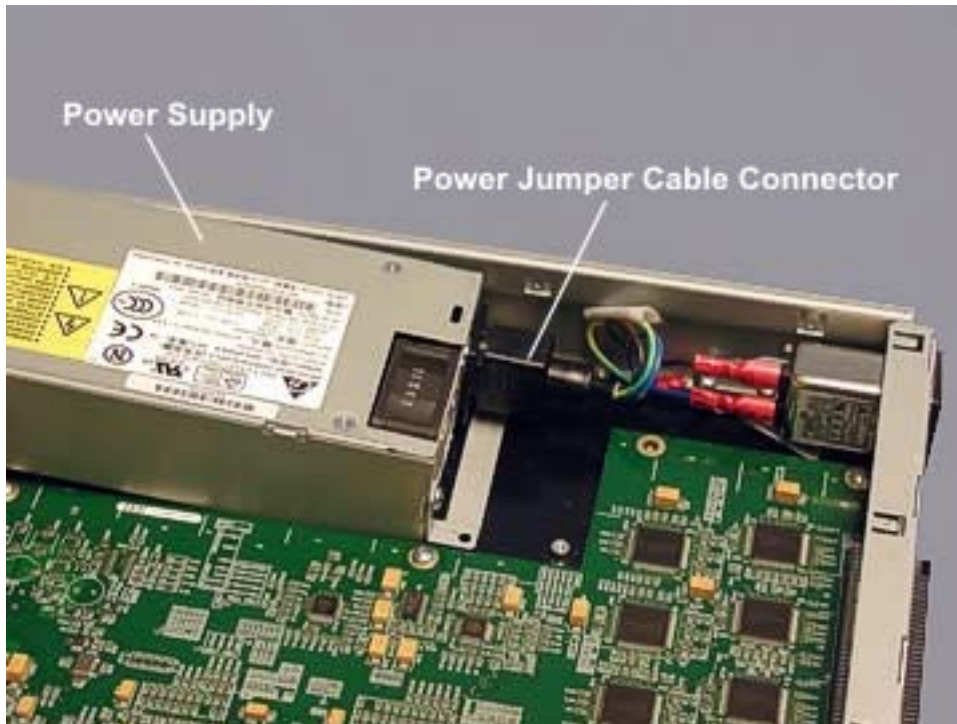
7. Disconnect the black and white wires on the power jumper cable from the AC inlet.

Figure 5-61.   Power Jumper Cable Wires at AC Inlet
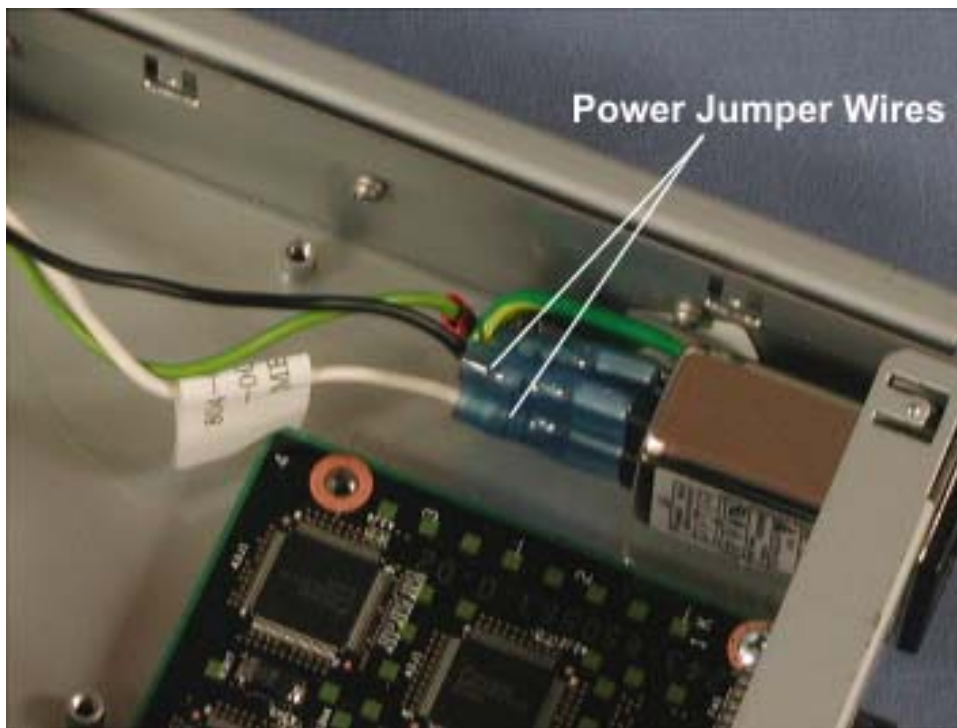
8. Remove the screw securing the power jumper cable's ground wire to the enclosure.

Figure 5-62.   Power Jumper Cable Ground Wire
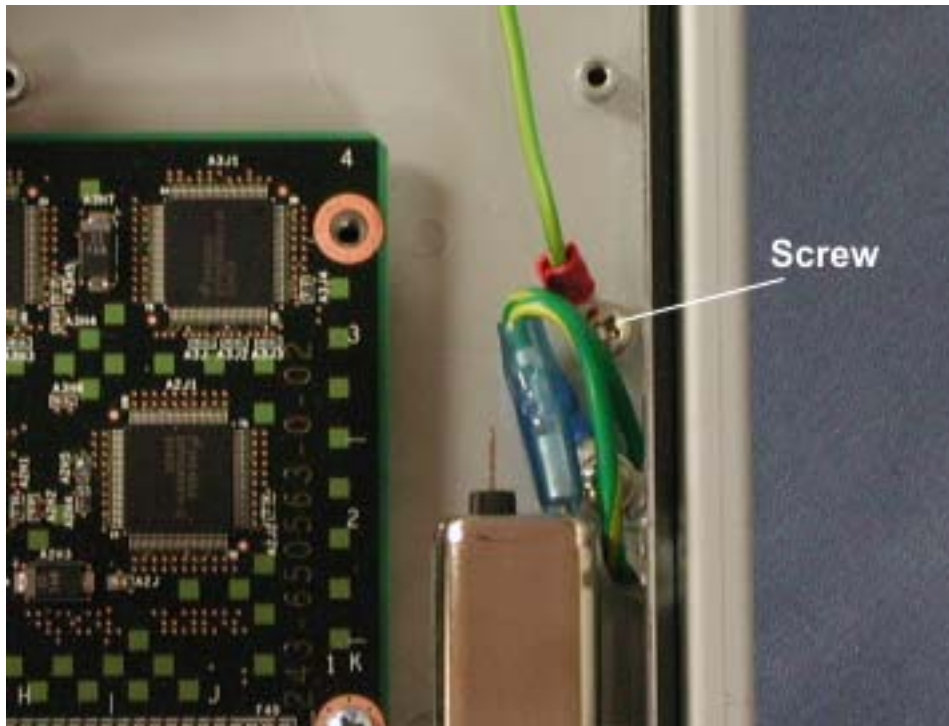
5.4.17 Core I/O Enclosure Ultra160 SCSI Jumper

1. Remove the I/O enclosure as described in Section 3.4.2.

2. Remove the I/O enclosure cover as described in Section 3.4.3.

3. Disconnect the power cable from the core I/O board.

Figure 5-63.   Power Cable Connection at Core I/O Board
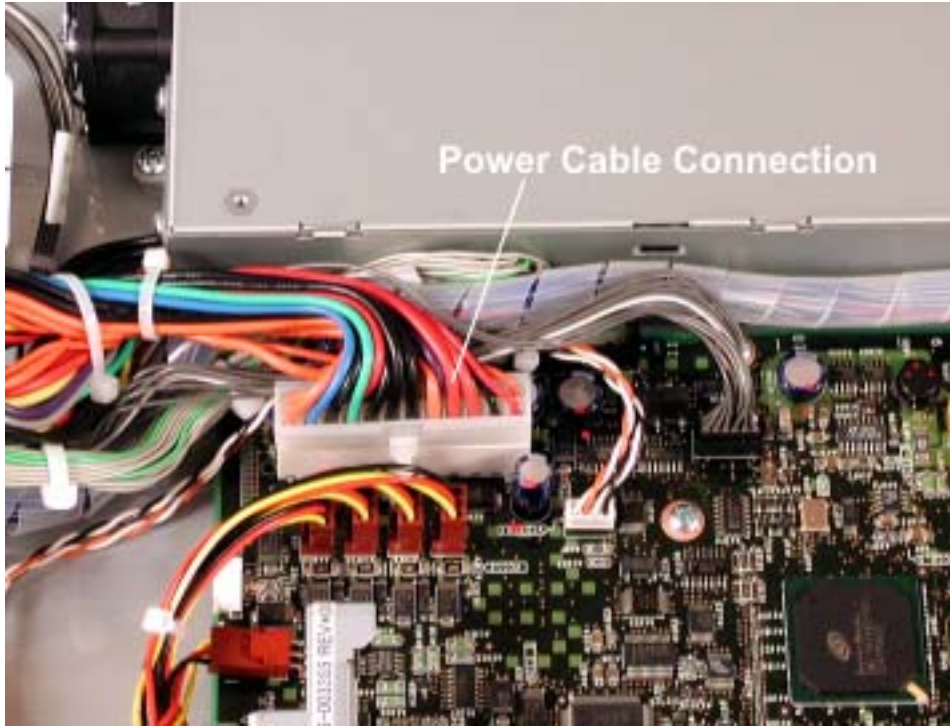
4. Disconnect the Ultra160 SCSI jumper from the SCSI backplane and the core I/O board.

Figure 5-64.   Ultra160 SCSI Jumper Connections

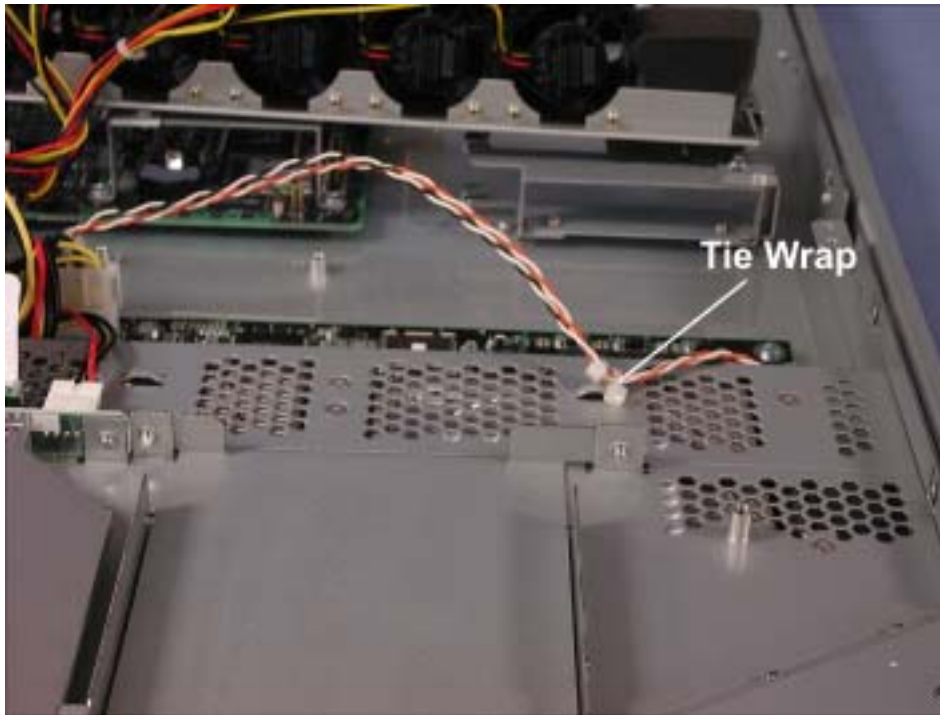## 5.4.18 Core I/O Enclosure SCSI Backplane

1. Remove the I/O enclosure as described in Section 3.4.2.

2. Remove the I/O enclosure cover as described in Section 3.4.3.

3. Remove the three screws securing the fan assembly and carefully pull the assembly out of the way. You do not have to remove the fan assembly cables.

Figure 5-65.   Fan Assembly Screws

4. Disengage each disk drive from the SCSI backplane by pressing in the green tab at the end of the disk drive lever and pulling the lever out to its fully open position.

Figure 5-66.   Disk Drive Lever
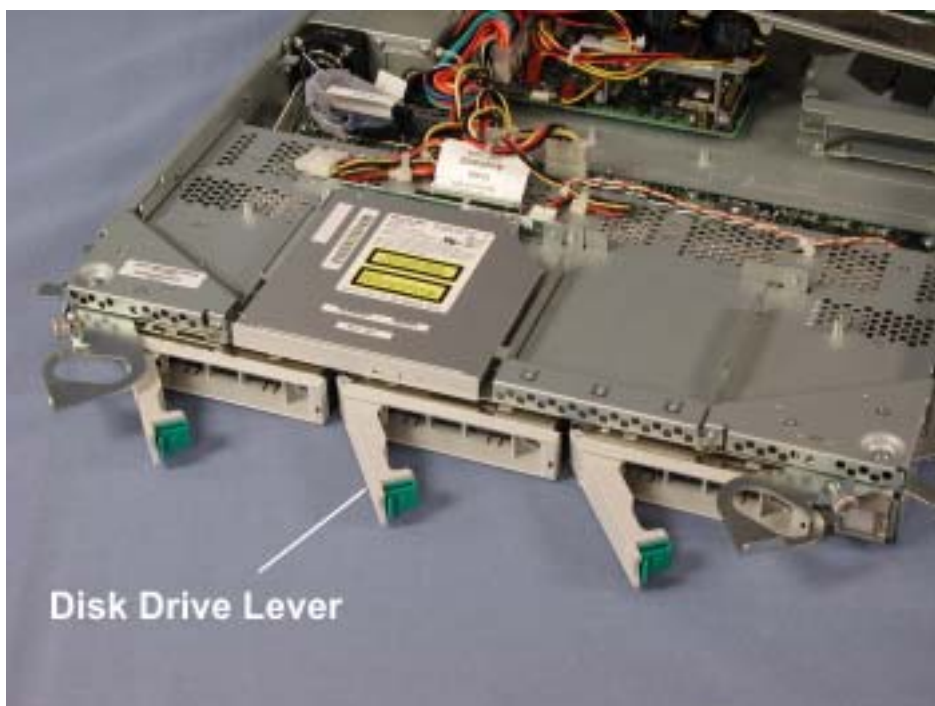
5. Disconnect the two power cables and the SCSI cable from the SCSI backplane..

Figure 5-67.   SCSI and Power Cables at SCSI Backplane
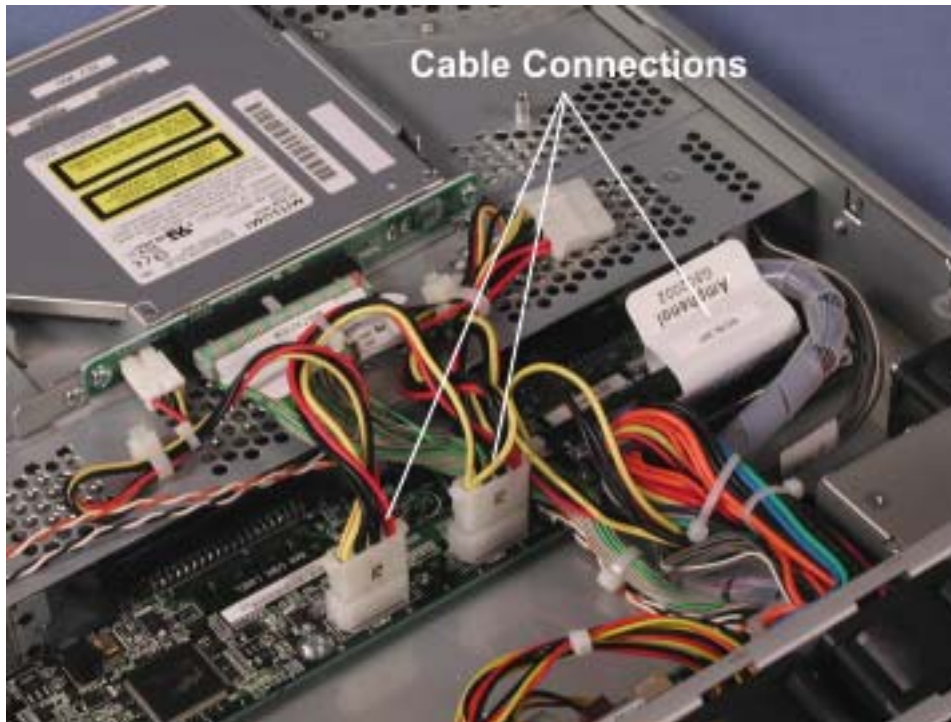
6. Remove the eight screws securing the SCSI backplane and lift it out of the enclosure.

Figure 5-68.   SCSI Backplane Screws

6. Part Numbers

The tables in the following subsections list the part numbers for the Customer Replaceable Units (CRUs), Field Replaceable Units (FRUs), and Distributor Replaceable Units (DRUs) in ftServer 6600 systems.

6.1 CPU Enclosure

Description	CRU/FRU/DRU	Part Number
CPU Enclosure, Large Cache	CRU	AA-G92200
CPU Enclosure, Small Cache	CRU	AA-G92500
Motherboard	DRU	AA-G90200
Fan Assembly	FRU	AA-E83800
Memory Power Board	FRU	AA-E95500
Daughter Board	DRU	AA-E92500
Power Supply	DRU	AA-P64000
2.0-GHz, 1-MB Cache Processor Kit	DRU	AK-000440
2.8-Ghz, 2-MB Cache Processor Kit	DRU	AK-000431
512-MB DIMM	FRU	AA-M86700
1-GB DIMM	FRU	AA-M86800

6.2 Core I/O Enclosure

Description	CRU/FRU/DRU	Part Number
Core I/O Enclosure	CRU	AA-E90100
Fan Assembly	CRU	MA-000569
CD-ROM Drive	CRU	AA-D55100
CD-ROM Interface Board	DRU	AA-E71500
LED Cable	DRU	AW-001102
LED PCB Panel	CRU	AA-E70600
18G-B 15K RPM Disk Drive	CRU	AA-D53300
36-GB 10K RPM Disk Drive	CRU	AA-D53100
73-GB 10K RPM Disk Drive	CRU	AA-D53200
Power Supply	FRU	AA-P70100
Power Switch Assembly	DRU	AS-000389
Power Switch Cable Assembly	DRU	AW-001123
PCI Riser PCB	DRU	AA-E70400
Core I/O Board	DRU	AA-E70000
SCSI Backplane	DRU	AA-E70500
Ground Cable (14 AWG)	DRU	AW-001117
68P Ultra160 Jumper Cable	DRU	AW-001104
Internal Power Jumper Cable (IEC 320 C 13.6)	DRU	AW-001107
UL/CSA, IDE Cable	DRU	AW-001124

6.3 Expansion I/O Enclosure

Description	CRU/FRU/DRU	Part Number
Expansion I/O Enclosure	CRU	AA-E89900
Power Supply	FRU	AA-P70100
Ground Cable (14 AWG)	DRU	AW-001117
Internal Power Jumper Cable (IEC 320 C 13.6)	DRU	AW-001107
Fan Assembly	CRU	MA-000574
PCI Riser PCB	FRU	AA-E71400
Expansion I/O Board	DRU	AA-E71000
LED Cable	DRU	AW-001102
LED Panel PCB	CRU	AA-E70700

6.4 PCI Adapters

Description	CRU/FRU/DRU	Part Number
ftServer Access Adapter	CRU	AA-U46200
8-port Async PCI Adapter	CRU	AA-U48600
1-Port Ethernet PCI Adapter	CRU	AA-U51500
Ultra2 Tape Adapter		AA-U51600
Ultra160 2-port SCSI HBA - Qlogic 12160, with 2 SCSI Cables	CRU	AX-U52100
20 Mbyte PCMCIA Flash Card	CRU	AA-U52500
PCMCIA Flash, UX Programmed HPUX	CRU	AA-U52600
Intel pro/1000 F Server Adapter 1000base-sx (Fiber Gigabit)	CRU	AA-U57000
Intel pro/1000 T Server Adapter (Copper Gigabit)	CRU	AA-U57100
Modular Cable Assembly	CRU	AW-B20246
8-way DB-25 Fan-Out Cable for Digi Async Card	CRU	AW-001122
SCSI Cable	CRU	AW-001080-0
Fault-Tolerant SSN Attach Kit	CRU	AK-000403

6.5 Backplane

Description	CRU/FRU/DRU	Part Number
Backplane Assembly	CRU	AA-E71700
Backplane PCB	FRU	AA-E71100
Connector I/O PCB	CRU	AA-E71800
Clock Card	CRU	AA-E71900
Power Strip Unit (PSU)	FRU	AA-P41103

6.6 Ultra160 SCSI Storage Enclosure

Description	CRU/FRU/DRU	Part Number
Storage Enclosure with Split Backplane	CRU	AA-D52001
Cluster Services Module (CSM)	CRU	AA-E52200
LED Module - Right	CRU	AA-000385
LED Module - Left	CRU	AA-000386
146-GB 10K.7 SCSI Disk Drive	CRU	AA-D51900
36-GB 10K Disk Drive	CRU	AA-D52210
73-GB 10K Disk Drive	CRU	AA-D52310
18-GB 15K Disk Drive	CRU	AA-D52410
Advanced Cooling Module (ACM)	CRU	MF-000041
Locking Slot Blocker	CRU	AA-000388
UL/CSA SCSI Data Cable (66", VHDCI to VHDCI)	CRU	AW-001080-01

6.7 Tape Subsystem

Description	CRU/FRU/DRU	Part Number
HP DDS-4 DAT Tape Drive	CRU	AA-T51100
HP DD-4 DAT Auto Loader	CRU	AA-T51200
QUANTUM DLT-8000 Tape Drive	CRU	AA-T51300
External Tape Controller Cable (10 feet)	CRU	AW-001046-01
fExternal Tape Controller Cable (30 feet)	CRU	AW-001046-02
SCSI Daisy Chain Cable (3 feet)	CRU	AW-001072
SCSI Terminator LVD/SE Multi Mode	CRU	AX-T50004

6.8 Power Distribution Unit (PDU)

Description	CRU/FRU/DRU	Part Number
30-Amp PDU	CRU	AA-P41105
Japanese PDU 30A/250V Input	CRU	AA-P41105-J
Jumper Cable for PDU (Gray)	CRU	AW-B50502-02M
Jumper Cable for PDU (Black)	CRU	AW-B50503-02M

6.9 Peripherals/Cabinet

Description	CRU/FRU/DRU	Part Number
Intellimouse Microsoft Optical	CRU	AA-V11610
Monitor, 15'' Flat Panel	CRU	AA-V12900
Monitor, 1U for ftServer	CRU	AA-V12800
USB Keyboard/Mouse	CRU	AA-V11520
USB Floppy Disk Drive	CRU	AA-000400
USB Extender Cable A-A, 6ft Long	CRU	AW-B20247-06
1U 4-Port KVM Switch Kit with Cables and Rails	CRU	AK-000470
UL/CSA VGA Cable (6')	CRU	AW-B20240
UL/CSA USB Cable (6')	CRU	AW-B51100
Cabinet Ground Cable (15 ft., 10 AWG)	CRU	AW-002000

7. Theory of Operation

This section contains an overview of the theory of operation for the ftServer 6600 systems. It provides information on how the system operates and includes a description of each of the following major assemblies/subsystems.

- CPU Enclosure
- Core I/O Enclosure
- Expansion I/O Enclosure
- Backplane
- SCSI Ultra160 Storage Subsystem
- Tape Subsystem
- Power Subsystem
- Cooling Subsystem

The figure on the following page is a block diagram of the ftServer 6600 system.

Figure 5-1. ftServer 6600 Block Diagram
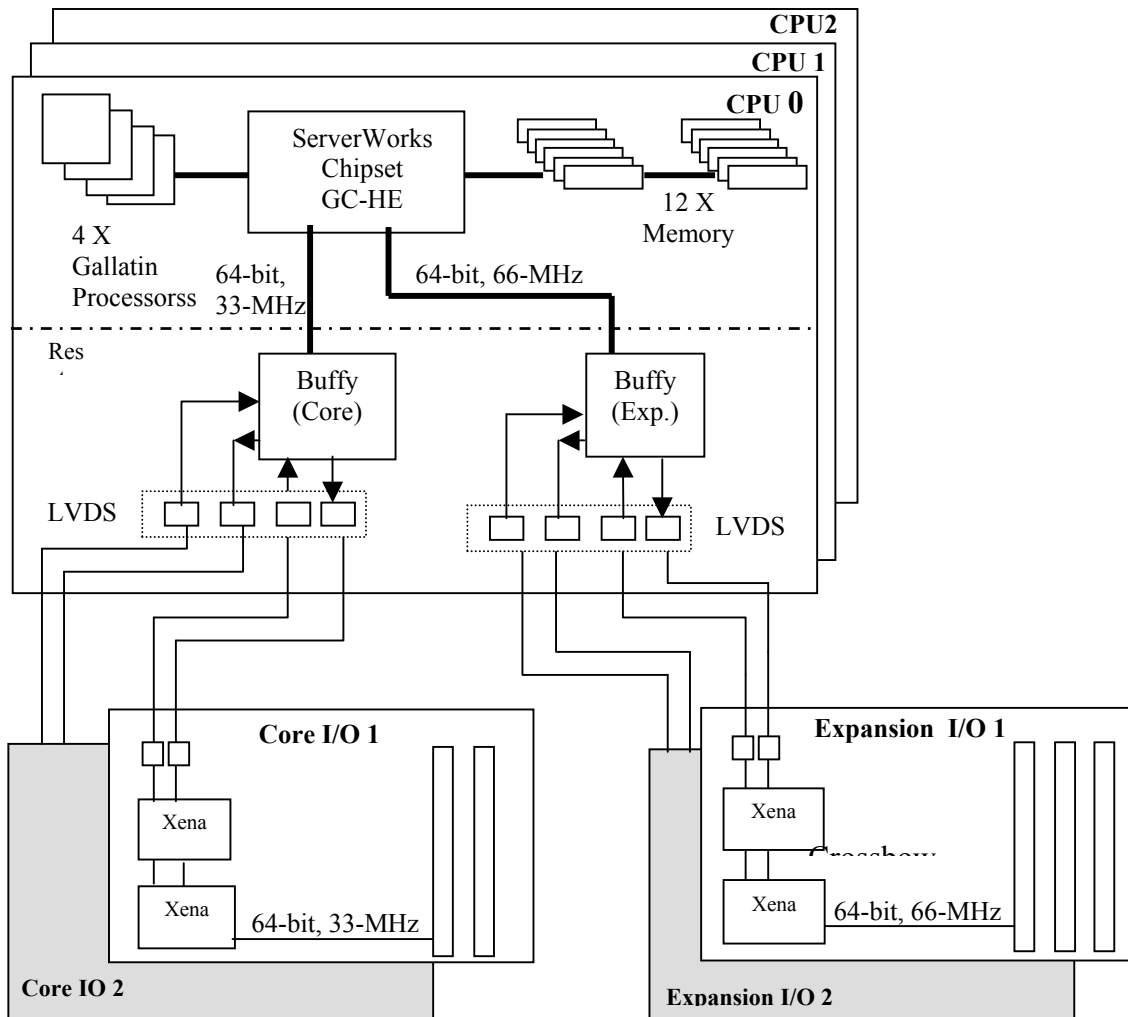
7.1 CPU Enclosure

Each ftServer 6600 CPU contains two or four processors operating at 2.8 GHz (with 2 MB iL3 cache) or 2.0 GHz (with 1 MB iL3 cache). The configurations are 2-way or 4-way (one or two processors per CPU, respectively) symmetric multiprocessing (SMP).

The ftServer 6600 uses DDR (Dual Data Rate) Dual Inline Memory Module (DIMM) memory in 512-MB and 1-GB configurations.

The ftServer 6600 system provides scalable fault tolerance supporting Dual Mode Redundancy (DMR), and Triple Mode Redundancy (TMR) using a processor module containing up to four Gallatin CPU processors.

The CPU enclosure has the following features:

- 4 Gallatin Processors (2.0 MHz 1M L3 Cache or 2.8 MHz 2M L3 Cache) – "Intel Xeon MP"
- 400 MHz system bus (FSB)
- 12 DIMMs (512 MB or 1 GB DDR)
- Maximum memory of 12GB
- Serverworks HE chipset (CIOB30, REMC, CMIC-HE, & CSB5)
- 33-MHz/64-bit Core PCI (Compatibility Buffy)
- 66-MHz/64-bit Expansion PCI (Expansion Buffy)
- Memory (3 rows of 4 = up to 12 DIMMs)

The following figure is a block diagram of the CPU enclosure.

Figure 7-1.   CPU Enclosure Block Diagram
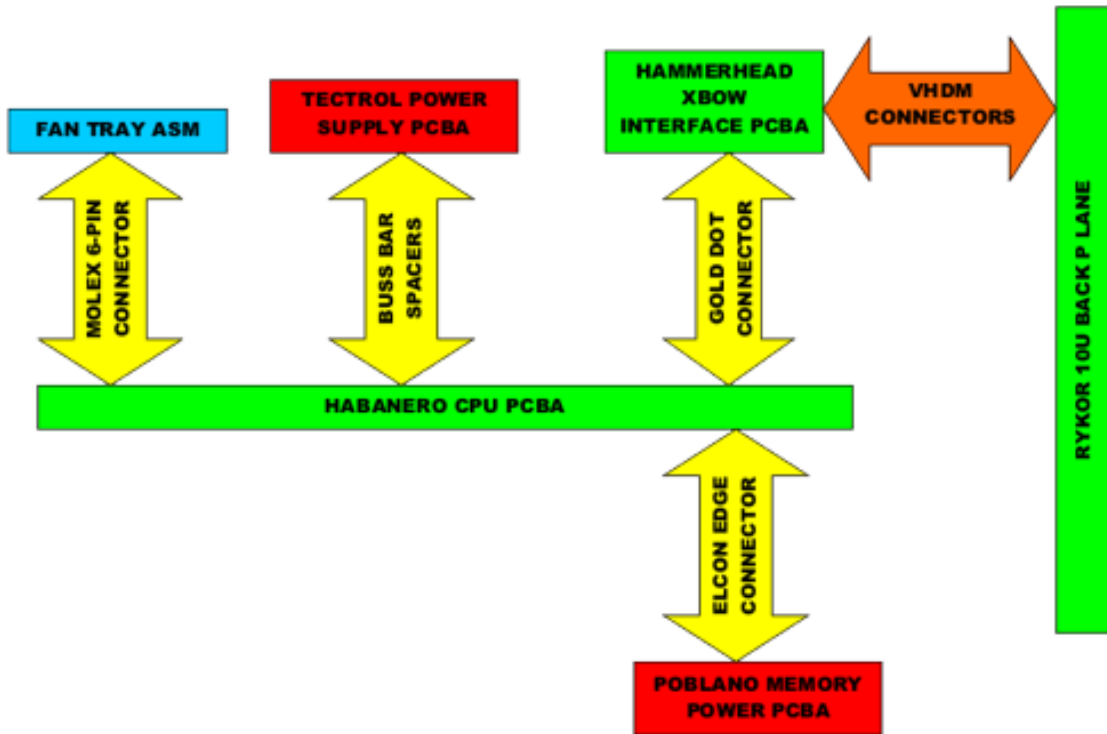
7.2 Core I/O Enclosure

The core I/O board provides the legacy I/O (keyboard, mouse, serial ports and IDE) for the 6600 system. In addition to providing legacy support, it also provide the following features:

- Embedded SCSI controller
- SCSI backplane with 3 Ultra-3 SCSI slots
- 10/100 Ethernet controller
- 10/100/1000 Ethernet controller
- 2x64bit 33-MHz PCI slots
- 1x32bit 33-MHz PCI slot (with ftSAA sideband connector)
- Video, through sideband connector for fault tolerant video
- External SCSI port

The heart of the core I/O board is the PCI bus provided by the Xena ASIC pair. This bus is a 64-bit bus operating at a frequency of 33 MHz. To increase performance, all of the PCI devices and PCI slots are connected directly to the primary PCI bus.

The following figure is a block diagram of the core I/O enclosure.

Figure 5-3. Core I/O Enclosure Block Diagram
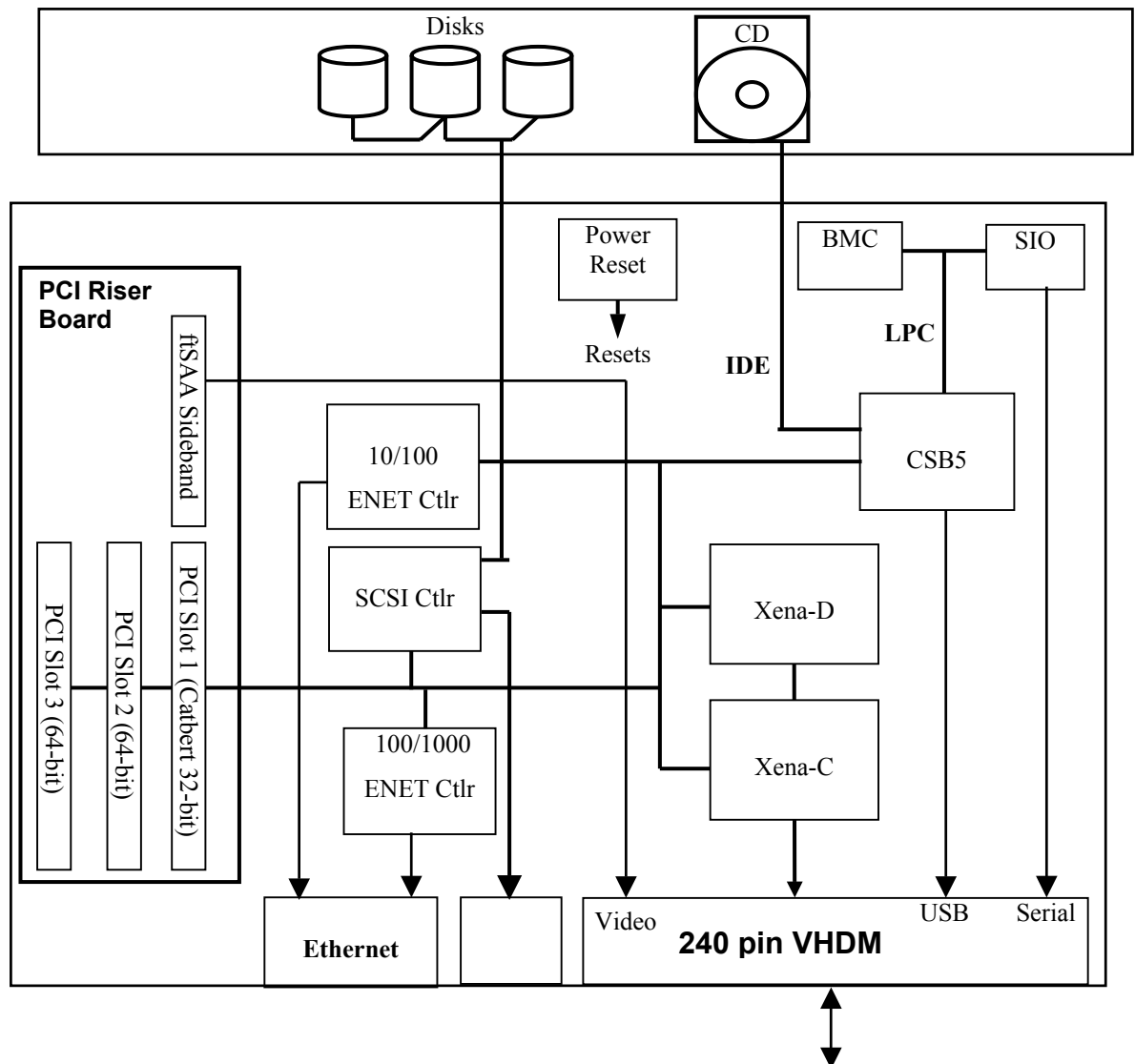
7.2.1. User-Defined PCI Slots

The core I/O enclosure can accept up to three user-installed PCI cards. Two of the PCI slots are 64-bit 33-Mhz PCI slots, and the third is a 32-bit 33-Mhz slot. The PCI cards are inserted into the PCI riser card that is attached in a horizontal position to thecor I/O board. PCI slot 1 (32-bit slot) can accept an ftSAA card or an NEC video card. A sideband connector is provided to accommodate video, power and communication signals. To insert or remove a PCI card the whole Core I/O enclosure must be removed.

For PCI card and embedded PCI controller configuration, the IDSEL lines of the devices/slots are connected as described in the following table,

Xena Primary Address Bit	Device Number	PCI device
16	0	PCI Slot 1
17	1	PCI Slot 2
18	2	PCI Slot 3
19	3	100/1000 Ethernet
21	5	12160 SCSI ctrlr
22	6	10/100 Ethernet
31	15	CSB5

7.2.2 SCSI Controler

The core I/O enclosure contains an embedded 12160 PCI-to-SCSI bridge from Qlogic. This controller contains two SCSI busses: one is connected to an Ultra-3 SCSI backplane contained within the core I/O enclosure, and the second goes to a 68-pin very high density external connector located to the rear of the core I/O enclosure. The SCSI bus is connected to the internal SCSI backplane and the other is connected to the external connector.

The external port of the SCSI controller on the core I/O board supports both single-ended (SE) and Low Voltage Differential (LVD) SCSI. The SCSI mode is selected by the device plugged into the external port. The external SCSI port is used to control a SCSI tape drive

The internal backplane support s LVD disks. The disks installed in the core I/O enclosure are single initiated; therefore a failure of a core I/O board removes all of the disks in that core I/O enclosure from service. The disks in the partner core I/O board run in simplex mode until the faulty core I/O board has been replaced and the disks re-mirrored.

7.2.3 Ethernet Controllers

The 6600 Core I/O board has two embedded Ethernet controllers; the first is an Intel 82554 10/100/1000 Mbits/sec controller, and the second is an Intel 82559/82550 10/100 Mbits/sec controller.

The two Ethernet controllers share the following features:

- Full auto-negotiation for connection speed and half/full duplex
- Integrated MAC and Physical layer functions
- Serial PROM for device configuration
- Copper RJ45 network interface
- Bus mastering PCI controller
- Reside on Core I/O primary PCI bus.
- LEDs to indicate connection status/speed.

7.2.3.1 10/100-Mbit 82559/82550 Ethernet Controller

The ftServer 6600 system uses the 82559 or the 82550 Ethernet controller. The 82559/82550 Ethernet controllers are 32-bit PCI devices They are supplied in a 196BGA package device and reside on the lower 32-bits of the core I/O PCI bus. The device requires only a small number of external components to implement a complete fast Ethernet interface. Physical connection to this controller is through an RJ45 connector that contains integrated magnetic components to provide electrical isolation and LEDs to show connection status and connection speed. When the system is in a standby state, the 10/100-Mbit port is still powered and can communicate with the BMC through the interface. Through this interface the BMC can remotely power on and boot a system.

7.2.3.2 10/100/1000-Mbit 82544 Ethernet Controller

The 10/100/1000-Mbit/sec connection to the core I/O enclosure is provided by the 82544 Ethernet controller. This device supports full auto-negotiation to a 10/100/1000-Mbit Ethernet network. A pulse transformer located on the motherboard between the 82544 and the RJ45 connector is used to isolate the onboard receive and transmit lines from the external interface. The RJ45 connector used for the 10/100/100-Mbit Ethernet port also contains integrated LEDs for connection status and connection speed indication.

7.2.4 VHDM interface

The core I/O enclosure mates with the ftServer 6600 chassis backplane through a 240-pin VHDM connector. This connector contains a path for the following signals:

- Crossbow bus
- System management
- Video
- Serial
- USB
- Clock
- Board present
- Gsync bus
- Power to backplane

As with the CPU enclosure, the crossbow bus uses LVDS serializers and de-serializers to reduce connector pin count.

In order to prevent corruptIon of the crossbow bus when enclosures are inserted certain signals on the VHDM connector have shorter pins, these recessed pins are used to ensure the bus pins are securely mated before power is applied to the board.

7.2.5 Legacy I/O

The ftServer 6600 uses the CSB5 and a National Semiconductor PC87417 Server I/O controller to provide Legacy I/O support. The CSB5 resides on the primary Xena bus providing two USB ports and an IDE interface to the CD-ROM. The Server I/O device provides a Real Time Clock (RTC) along with interfaces to the two serial ports and the SMBus interface. The Server I/O communicates to the PCI interface through a PCI-LPC bridge contained within the CSB5. The CSB5 also contains an ACPI controller through which ACPI functionality is supported. The Core I/O in the ftServer 6600 system does not contain an internal floppy disk drive; instead the system supports an externally attached USB floppy drive.

Keyboard and mouse connection to the system is via the USB interface. The RTC and SMBus interfaces are powered from the standby power supplied by the PSU. This allows all system events to be time stamped, including events that occur when the system is powered off. Battery backup for the RTC and BIOS CMOS is provided to retain correct time when a system has been removed from its AC source. A backup battery is located on each of the Core I/O enclosures. There is no parallel port support on the ftServer 6600 system.

7.2.6 System Management

System management for the ftServer 6600 is designed to incorporate a server management module (SMM) that resides on each core I/O enclosure. The functIon of the SMM or Baseboard Management Controller (BMC) is to provide Intelligent Platform Management Interface (IPMI) functions, fault tolerant maintenance and diagnostics functions, and system control. The ftServer 6600 has been designed to support both distributed and centralized server management control.

The distributed server management strategy incorporates distributed intelligent management controllers on each I/O enclosure and CPU enclosure. Each core I/O enclosure incorporates a QLogic Zircon BMC intelligent controller that provides an IPMI Keyboard Controller Style (KCS) interface to the HOST over the low pin count (LPC) bus to the Serverworks CSB5 south bridge. Each CPU board uses a QLogic Zircon PM, implemented as a satellite management controller (SMC), reporting sensor events to the BMC and providing a bridge from the BMC to I^{2}C devices residing on the CPU's or ExpansIon I/O's local I^{2}C bus/SMBus.

Each of the BMC and SMC controllers contain an interface to I2C. The I2C port from the controllers are connected to I/O expanders and I2C compatible devices to provide access to system data including, fan rotation speed, temperature, voltage levels on the various enclosures and system ID. The I2C busses are also used to control system functions such as LEDs and component power control.

The secondary BMC controller monitors the health of the primary controller using a heartbeat protocol. If it does not receive heartbeats from the primary BMC for a specified period of time it assumes the primary controller has failed and will attempt to become the primary SMM. The BMC controller also monitors the state of the system OS when the system is booted. It uses a watchdog timer to determine if the OS has crashed or halted. In the event of a hung system, the SMM takes appropriate action to re-start the system.

When anftSAA adapter is used in the ftServer 6600 system, it becomes the SMM and the Zircon BMC controller on the core I/O reverts to an SMC mode.

7.3 Expansion I/O Enclosure

The expansion I/O enclosure supports up to three 64-bit 66-Mhz user-defined PCI adapters. The three PCI adapters reside on the Xena primary PCI bus. Each expansion I/O enclosure partners with the other expansion I/O enclosure to provide a fault tolerant pair. There are no additional embedded ethernet or SCSI controllers in the expansion I/O enclosure.

The following figure is a block diagram of the expansion I/O enclosure.

Figure 5-3. Expansion I/O Enclosure Block Diagram
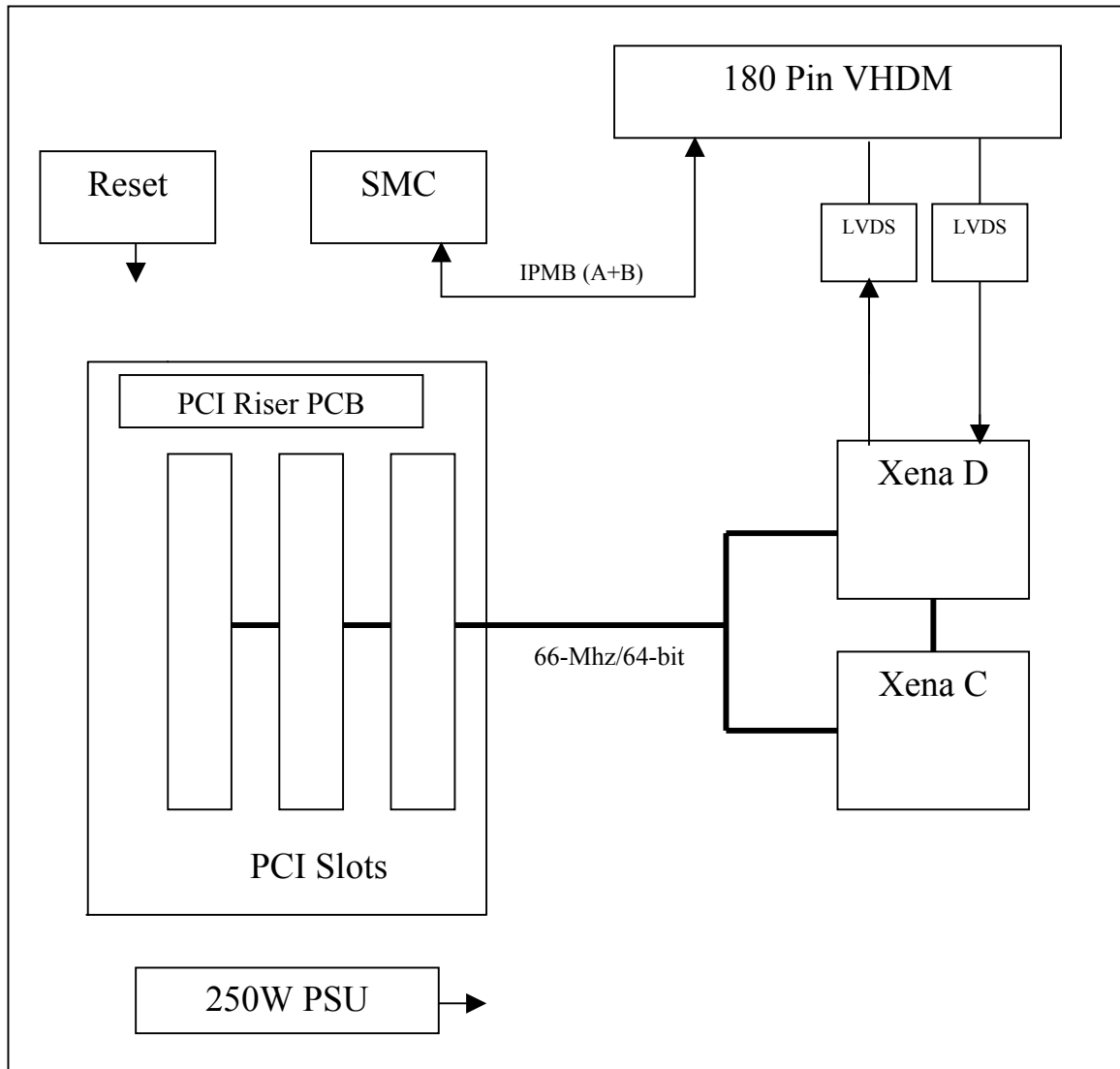
Each Expansion I/O enclosure incorporates a pair of Xena ASICs (one C side and one D side) that act as one logical ASIC that performs voting on transactions from the lock

stepped CPUs, and interfaces to the rest of the expansion I/O board via a standard 64-Bit / 66-MHz PCI bus.

These two ASICs along with the Buffy ASICs, which reside in the CPU enclosures form the system's fault tolerant PCI – PCI bridge between the CPU and I/O enclosures. The Buffy ASICs are the north half and the Xena ASICs are the south half.

By comparing or 'Voting' on transactions from lock stepped CPU enclosures the Xenas can decide if a particular CPU is not operating correctly and remove it from the system.

There are two 64-bit 66-MHz expansion signals that require extra processing on the Expansion I/O motherboard, they are M66EN and REQ64#.

M66EN is a PCI bus signal, which indicates that a PCI device is operating at a frequency of 66 MHz when the signal is asserted high. It is one common WIRE-OR-ed signal for all user PCI slots on the bus. This is processed by the RESET CPLD on the expansion I/O enclosure. The RESET CPLD generates the CLOCK_SEL_66 control signal to the XENA ASICs and the clock circuit. This way 33-MHz/66-MHz bus speed is selectable or can be forced if required.

Any PCI card not capable of running at 66 MHz grounds this signal, forcing the PCI bus to operate at 33 MHz.

REQ64# is a PCI bus signal, used during reset to distinguish between parts that are connected to a 64 bit data path and those that are not. XENA must drive REQ64# low during the time that RST# is asserted. Devices on the PCI bus that see REQ64# asserted on the rising edge of RST# are connected to the 64-bit data path and those that do not see REQ64# asserted are connected to a 32-bit data path. It is possible to have a mixture of 32-bit and 64-bit cards.

The IDSEL on each PCI device is similar to a chip select signal and is used during a configuration read from or configuration write to a specific PCI device. In the expansion I/O enclosure each IDSEL is tied to a dedicated address line thru a 100Ω resistor.

PCI slot resets are individually controlled by the Xena ASICs. Xena-C issues slot resets to PCI slots 1 and 2. Xena-D issues the slot reset for PCI slot 3.

There are two physical expansion I/O boards in a system (side 0 and 1), each with 3 interrupts. These 3 interrupts are routed to both Xena ASICs on each expansion I/O board. This means that between the two expansion I/O enclosures there can be six interrupts in total. Each of these six interrupts has a dedicated interrupt pin on the Buffy ASICs on each CPU.

The expansion I/O enclosure runs synchronously with the 8.3333 MHz LVPECL system clock, which is generated on the system clock card located on the backplane.

The LVCPECL clock is converted to an 8-MHz LVCMOS clock using MPC940 PECL to CMOS clock converter/driver. This 8-MHz CMOS clock is then used to generate the 66.666-MHz clock (ICS670-02).

The 66-MHz output from the ICS device is the input to an ICS8701 device, which is a low skew LVCMOS clock driver chip, capable of scaling the input frequency x1 or x $^1/_2$.

The device has 4 banks of 5 output clock drivers which can drive either 33.333-MHz or 66.666-MHz clocks.

In order to phase align the 33MHz and 66MHz clock to the 8MHz clock, one of the 33MHz clock outputs of the ICS8701 is fed back to the ICS670-02. The ICS670-02 has a built-in PLL, which uses a 33MHz, feed back clock from the clock driver in this application.

A Satellite Management Controller (SMC) is provided for system management between the BMC in the I/O Core enclosure and the expansion I/O enclosure.

7.4 Backplane

The ftServer 6600 system contains a backplane, which is part of the system cage. The backplane interconnects the CPU and I/O enclosures. Data is transferred between the CPU and I/O enclosures using the Stratus proprietary Crossbow Bus protocol.

The blindmate backplane is a single unit into which the Core I/O, Expansion I/O, and CPU enclosures plug. The ftServer 6600 system interconnect is achieved via a VHDM (very high density metric) connection on the backplane

The Backplane contains 180-pin VHDM male connectors to mate with the CPU enclosure. 240-pin VHDM male connectors mate with the core I/O enclosures. AC power is provided to each enclosure slot through an IEC power connector.

The backplane contains the system clock card, two IDPROMs, and the connector I/O card.

7.4.1 System Clock Card

The ftServer 6600 system contains only one clock card. This card supplies a copy of the 8 Mhz PECL clock to each of the slots in the chassis. The board contains the minimum number of parts required to generate the clocks to maximize the MTBF. A crystal oscillator is used to generate the 8.3333 Mhz with buffers to supply the required number of copies of the clock required by the system. To reduce system repair time, a spare clock card can be stored in a card holder on the backplane of each system shipped. This clock card is not powered and does not provide a fault tolerant clock. The system clock card is not hot pluggable and therefore the system must be powered off before the clock card is removed. The clock card is inserted into connector J5 on the SCSI backplane.

To reduce the risk of a system outage, the clocks are distributed using a pair of MC100LEVL14 clock buffers. Each buffer supplies clocks to specific slots, such that, in the event of a failure of one of the buffers, the alternate buffer will still supply clocks to one of the CPU and core I/O enclosures.

The following is a diagram of the backplane.

Figure 5-4. Backplane Diagram
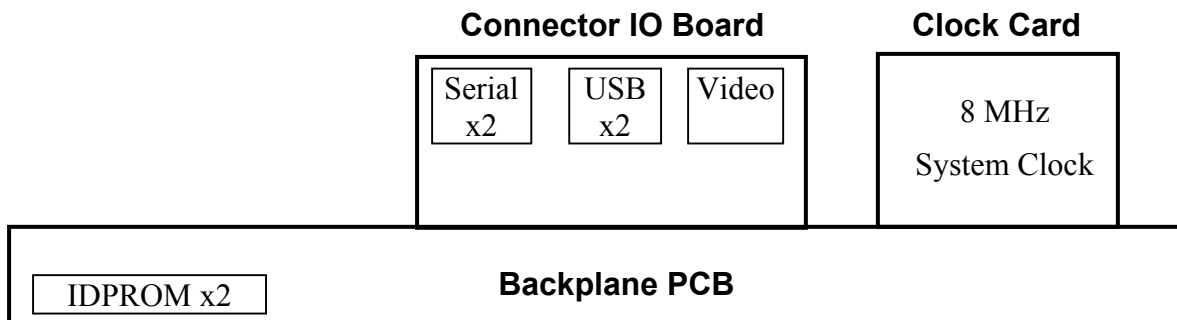
7.4.2 Connector I/O board

The connector I/O board provides the following outputs to the user:

- Video X 1
- Serial ports X 2
- USB ports X 2

Only one of the core I/O enclosures can drive the video, serial, and USB ports at any one time. To achieve this, these signals from both core I/O boards are FET isolated and then wire ORed on the connector I/O board. The connector I/O board plugs into an 80 pin SCA-2 connector (J6) on the backplane.

The active compatibility core I/O enclosure drives the system I/O. In the event of a failure of the active compatibility core I/O the system, I/O transfers to the other core I/O enclosure after it has become the active compatibility core I/O.

Serial port two of the ftServer 6600 system can be used through a modem as a system management interface. This serial port is connected to the BMC controller on the core I/O board, Through this interface system events can be monitored and system power on/off can be controlled.

7.5 Ultra160 SCSI Storage Enclosure

The Ultra 160 storage enclosure is an optional storage component. It is installed in a 19-inch rack mount configuration. It consists of the following major components:

- 2 Cluster Services Modules (CSMs)
- 2 Power Supply Modules (PSM s)
- 2 Advanced Cooling Modules (ACMs)
- 1 Enclosure LED Module
- 2-14 Disk Drives

The CSM provides monitoring, reporting, and control of the system storage enclosure. The CSM reports status and receives control information via the SCSI bus per the SCSI-3 Enclosure Services specification. And finally, the CSM supports enclosure clustering capabilities. When a CSM is installed, the enclosure is in the cluster configuration. Each external SCSI connector can have 25 meters of SCSI cable attached. Each cable is connected to a Host. The CSM uses SCSI Expander chips to isolate the internal SCSI bus backpanel from the externally cabled Host SCSI bus. When a Host is disconnected from the enclosure, the CSM isolates the disconnected host from the internal storage and remaining Host. This allows one host to be taken offline without data disruption to the other Host.

The CSM module has 5 LED indicators and two external SCSI connectors. The CSM also contains an Environmental Services Processor ESP, repeater chips and terminators. The Environmental Services (ES) activity LED (labelled "ACTIVE") shows if the ES block of the CSM is active or in standby mode. If the LED is on, the ES block is active and, if off, the ES block is in standby mode. In split bus mode Bus A will be on for one connector and Bus B will be on for the other connector corresponding to the buses they are connected to.

The Ultra160 SCSI enclosure consists of two Power Supply Modules (PSMs). The enclosure requires one power supply for normal operation. The second power supply provides redundancy for the power system. Two power supplies are required. The power supplies are hot swappable and fully redundant. Each power supply has two LEDs for status indication, a green LED (good output voltage) and an amber LED (power supply fault).

The Ultra160 SCSI enclosure consists of two Advanced Cooling Modules (ACMs). Each of the ACM units contains two variable speed fans, providing a total of four fans. The cooling system allows for the individual components (power supplies, disk drives, I/O modules, and all other embedded electronics) to meet their full operating specifications such that component maximum temperatures are not exceeded. The enclosure requires two ACMs for normal operation. The enclosure can run indefinitely with one fan failed within one ACM (i.e. three fans operational). The enclosure provides front to back airflow cooling. The ACMs are hot swappable. Each fan RPM is monitored and each ACM unit has two amber fault indicators (one per fan) located on the ACM assembly. Each ACM can communicate revision, status and receive speed set instructions.

The ACM fans have multiple speed capability and the ES Block sets the ACM speed depending upon ambient temperature and failure status. The ACM fans are set to high speed if one fan is detected to have failed. The ACMs are also set to high speed if one power supply is detected to have failed. The following table provides indicative values at which the ACM speeds may change.

ACM speed	Ambient Temp (ºC)
Speed 1	0 to 26
Speed 2	26 to 28
Speed 3	28 to 30
Full speed	30+

The LED module consists of three light pipes that carry light indications from the backpanel to the front of the enclosure where they are visible. It has 3 LED indicators at the front that provide information on the enclosure. The LED indicators indicate enclosure power on, enclosure joined/split, and enclosure fault. The following table lists each LED in further detail.

LED	Meaning	Color	Position	Description
P LED	Enclosure Power On	Green	Top	ON indicates power is applied to the enclosure. OFF indicates no power is applied.
S LED	SCSI Bus Split mode	Green	Middle	On only when SCSI bus is in split mode.
F LED	Enclosure Fault	Amber	BOTTOM	OFF indicates no faults exist in the enclosure. ON indicates storage enclosure has a fault.

The disk drives are 1.0-inch SCA-2 direct-attach disk drives. Each disk drive has two LED indicators visible from the front of the storage enclosure. The green LED is the disk drive activity LED. The disk drive has control over the green LED.   The second LED is a bicolor LED which the CSM module controls

The following table describes the LEDs.

Name	Color	Description	Safe to Remove Disk Drive?
Disk Drive State LED (located on the right)	**Solid green**	**Illuminates when the disk drive is initialized (contains at least one volume or partition) and mirrored, or when the disk drive is uninitialized (working but does not contain any volumes or partitions).**	**Yes**
	Solid amber	**Illuminates when the disk drive is initialized but not mirrored.**	**No**
	Blinking amber	**Illuminates when a fault occurs within the disk drive.**	**Yes**
	Slow blinking green	**Illuminates when the storage enclosure is first powered on (in its initial state) or when the disk drive is offline.**	**No, if the storage enclosure has just been powered on** **Yes, if the disk drive is offline**
	Fast blinking green	**Illuminates when the disk drive is being identified.**	**No**
Disk Activity LED (located on the left)	**Solid green**	**Illuminates when the disk drive is active (performing read/write operations).**	**No**

7.5.1 SCSI Bus

In ftServer 6600 systems the Ultra 160 SCSI storage enclosure supports a split (or dual**)** bus configuration. The split bus configuration consists of two virtual, independent, dual initiated SCSI buses. It requires two Cluster Service Modules (CSMs).

SCSI IDs available for disks are 8 through 14 on bus A and 8 through 14 on bus B. The left side of the enclosure is controlled by the left SCSI connections and the right side of the enclosure is controlled by the right SCSI connections. There are two SCSI bus connections on each CSM (for a total of four), one for each of the two HBAs per bus. In this configuration there are actually 6 separately terminated buses, three per virtual bus. There are two virtual buses (Bus A and Bus B)

per enclosure. Each virtual bus consists of three physical buses. One bus connects from one HBA to the CSM via SCSI cable, one from the CSM through the internal SCSI bus back to the CSM, and one from the CSM to the other HBA via SCSI cable. Each HBA port (two per card) supplies termination and termination power. The two internal buses (one per virtual bus) are terminated separately and the 4 external buses (two per virtual bus) are terminated separately.

The following figure shows how the SCSI controllers are connected in a split bus configuration.

Figure 5-5. Split Bus Configuration
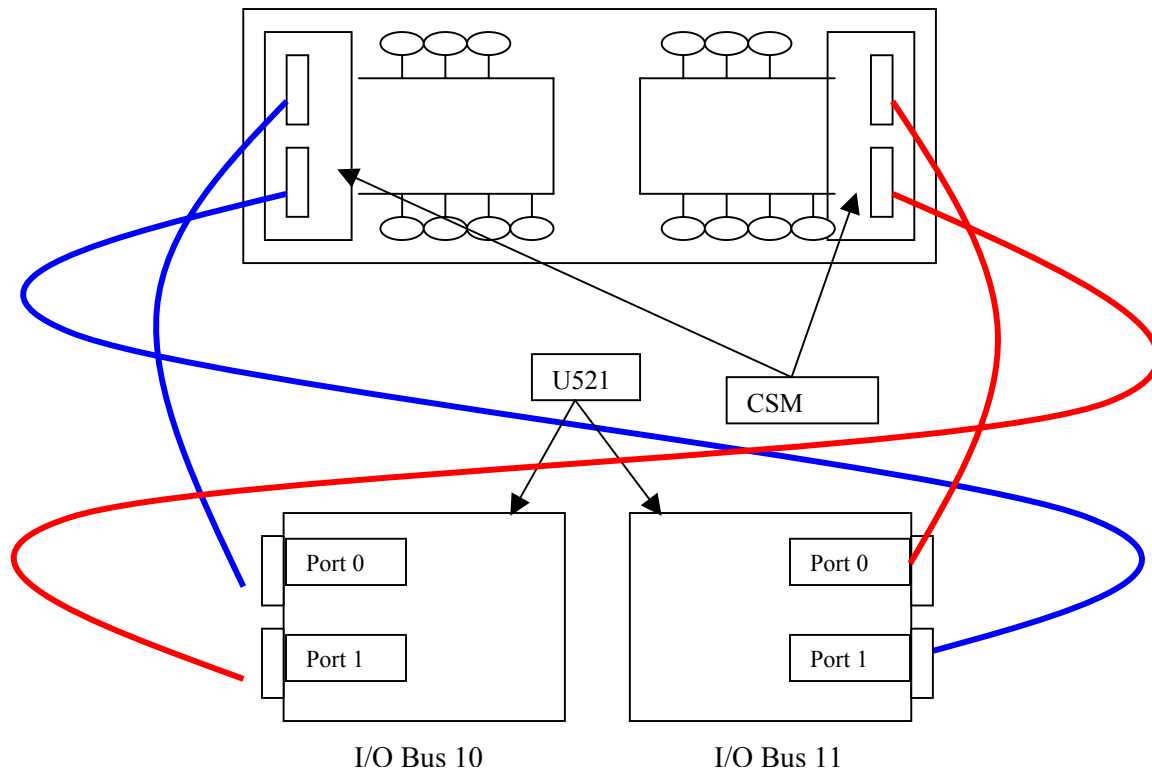
7.5.2 SCSI ID Slot Assignments

Front View

Disk Slot	14	13	12	11	10	9	8	7	6	5	4	3	2	1
SCSI ID	14	13	12	11	10	9	8	14	13	12	11	10	9	8

7.6 EMC Symmetrix/Clariion Storage System

The EMC Symmetrix/Clariion Storage System is a full Fibre Channel networked storage system. The ftServer 6600 system supports two types of Fibre Channel (FC) PCI adapters for connections to the storage system.

The U525 Optical Fibre Channel PCI Adapter provides a 2-gigabit (Gb) attachment to the storage system through a Storage Area Network (SAN) or switch.

The U526 Optical Fibre Channel PCI Adapter provides a 2-Gb direct attachment to the storage system.

7.7 Tape Subsystem

ftServer 6600 systems support DLT 8000 and DDS-4 tabletop tape drives. No drives are mounted in the storage enclosure.

The tape drive connects to the external SCSI connector on the core I/O enclosure. If this is the only tape drive on the bus, it must be terminated by an external terminator. If a second tape drive is daisy chained to the first, it must be terminated since it is the last drive on the SCSI bus.

Each tape drive must have a unique SCSI ID assigned. Failure to do so will create SCSI bus conflicts.

7.7.1 DDS-4 Tape Drive

The DDS-4 tape drive is the 4th generation of DDS products. DDS-4 has all of the benefits of previous DDS products with faster transfer speeds (3-6 MB/sec sustained), higher capacity and increased reliability. To achieve the speed and capacity benefits, DDS-4 150M media must be used. Cartridge capacity is 20-MB per cartridge native (40-MB per cartridge assuming 2:1 data compression). Previously archived data is easily accessible with read/write backward compatibility. The drives implement the LVD interface. DDS-4 drives are available on ftServer 6600 systems in both a single-cartridge mechanism and a 6 to 8-cartridge magazine autoloader configuration.

7.7.2 DLT 8000 Tape Drive

DLT 8000 is the 4th generation of DLT products. Native transfer speed for the DLT 8000 product is 6 MB/s native (up to 10 MB/s w/compression). Cartridge capacity is 40 MB per cartridge native (80 MB per cartridge assuming 2:1 data compression). To achieve the speed and capacity, DLT Tape IV media must be used. Previously archived data is accessible with backward read/write compatibility. The drives implement the LVD interface. DLT 8000 drives are available on ftServer 6600 systems in both a single-cartridge mechanism and autoloader configurations.

7.7.3 Tape Drive Configuration

The tape drive enclosure has two 68-pin Wide SCSI .050 series socket connectors that support a cable-in, cable-out daisy-chaining configuration or a cable-in and terminate configuration. There is a switch on the back of the enclosure that allows the selection of the device's SCSI ID.

The tape drive power supply is auto ranging to support 110-240 VAC and 47-63 Hz. A power switch is located on the back of the tape drive.

7.7.4 Tape Drive Termination

A tape drive is terminated externally if the drive is the last device on the SCSI bus. The terminator is a 68-pin SCSI-3, single-ended, low voltage differential, auto-switching multi-mode terminator.

7.7.5 Tape Drive Cabling

The maximum cable length for an LVD SCSI bus is 12 meters (approx. 39 ft.). The SCSI bus cable for the tape drives is available in three lengths: 12 ft., 20 ft., and 36 ft.

The cable connects from the U516 controller to an external tape drive. If this is the only tape drive on the bus, it must be terminated by an external terminator. If a second tape drive is daisy chained to the first, it must be terminated since it is the last drive on the SCSI bus.

7.8 Power Subsystem

The system is powered via dual power cords from a single-phase domestic power source. The system chassis contains a power block assembly with two AC line inputs and an individual output for each of the enclosures. The following table shows which enclosures are powered from each of the AC inputs.

AC power block in 1 (Top)	**Core IO 0** **CPU 0**
AC power block in 2 (Bottom)	**Core IO 1** **CPU 1**

A failure of one of the power cords or AC sources does not result in a system outage, provided the system is running in DMR. Each of the I/O enclosures contains a switched mode power supply that provides power to that enclosure. Each of the CPU enclosures contain an individual power supply to power that enclosure.

House-keeping power required by the standby logic is available whenever the system is plugged in and AC is available. The standby power for each CPU and IO enclosure is supplied by the power supply within that enclosure. Power to the backplane, clock card and IO connector card is supplied from the core I/O enclosures through the VHDM connector.

The core IO motherboard provides power to components external to the core IO enclosure via analogue switches. The analogue switch contains current limiting circuitry and diode ORing to protect the motherboard from a short circuit.

The following table shows which external components are powered by the core IO enclosure and the supply required.

Component	Supply
ID Prom	VCC5_SBY
USB power	VCC5
Clock board	VCC3_3
Gsync bus termination	VCC5

The following table shows the outputs that are available from the AA-P70100 (250W) power supply and the min/max regulation for voltage and ripple.

Output Voltage	Load Range		Regulation			Ripple & Noise Max
	Min	Max	Min	Max		(mVpp)
+5V	1A	20A	4.75	5.25	+5% -5%	50mVpp
+12V	0.8A	7.5A	11.40	12.60	+5% -5%	120mVpp
+3V3	1A	20A	3.20	3.40	+3% -3%	50mVpp
-12V	0A	0.3A	-10.80	-13.20	+10% -10%	120mVpp
+5Vsby	0.1A	3A	4.75	5.25	+5% -5%	50mVpp

The following table shows the outputs that are available from the AA-P70300 (350W) power supply and the min/max regulation for voltage and ripple.

Output Voltage	Load Range			Regulation			Ripple & Noise Max
	Min	Max	Peak	Min	Max		(mVpp)
+5V	1A	12A		4.8	5.25	+5% -4%	50mVpp
+12V1	1.5A	16A	18A	11.52	12.60	+5% -4%	120mVpp
+12V2	1.5A	16A	18A	12.52	12.60	+5% -4%	120mVpp
+3V3	1.5A	16A		3.20	3.40	+3% -3%	50mVpp
-12V	0A	0.5A		-10.40	-13.08	+9% -5%	120mVpp
+5Vsby	0.1A	2A		4.80	5.25	+5% -4%	50mVpp

7.9 Cooling Subsystem

The CPU and IO enclosures are cooled with forced air-cooling provided by fans located within each enclosure. Each CPU enclosure contains three fan blowers and each Core IO enclosures has five cooling fans. Each of the fans in the system is monitored to ensure the fan is providing sufficient air flow. This is monitored using the tacho outputs from each of the fans. If any of the fans fall below specification,an alarm will be generated. A fan failure in any of the enclosures in the system is highlighted by the BMC status LEDs on the primary core IO enclosure. The fan failure, along with any other system error conditions, is highlighted by a flashing amber LED. Temperature sensors are provided on each of the enclosure motherboards to provide temperature information to the BMC firmware and OS.

There is no forced-air cooling provided for the backplane or backplane components.

Each of the power supplies used in the system contains two internal fans to provide sufficient cooling for that power supply.