ftServer 5400/6500
Technical Service Guide

Revision 0- 9/10/02

Revision History

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Manual Name: *ftServer 5240/6500 Technical Service Guide*

Customer Service Technical Communications Department

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Stratus Technologies, Inc.
111 Powdermill Road
Maynard, Massachusetts 01754-3409

Preface

The *ftServer 52406500 Technical Service Guide* contains technical information pertinent to ftServer systems operating under Microsoft Windows 2000 Advanced Server operating systems.

This document is organized as follows:

Section 1 - Introduction

Section 2 -Operation and Maintenance Procedures

Section 3 - CRU Removal and Replacement Procedures

Section 4 - FRU Removal and Replacement Procedures

Section 5 - DRU Removal and Replacement Procedures

Section 6 - Theory of Operation

Section 7 - Part Numbers

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 Stratus ftServer 5240 and 6500 systems. It covers the following topics:

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

1.1 Overview

The ftServer 52400 is 2-way symmetric multiprocessing (SMP) server for Windows 2000 applications. The system is powered by a high-performance 2.4-GHz, 512 KB iL2 cache Intel Xeon DP processor.

The ftServer 6500 is the initial 4-way system in the ftServer product line. The system is powered by a high-performance 1.6-GHz, 1MB iL3 Cache Intel Xeon processor MP processor

The key characteristics of the ftServer 5240 and 6500 stystems are shown in the following table.

Characteristic	ftServer 5240	ftServer 6500
SMP	1- & 2-way	1-, 2- & 4-way
Intel Xeon Processor	2.4 GHz, 512 KB iL2 cache	1.6 GHz, 1 MB iL3 cache
Front Side Bus	400 MHz	400 MHz
Hardware Availability	DMR	DMR and TMR (2- &4-way only)
Minimum / Maximum Memory	1 GB / 6 GB	1 GB / 6 GB
Memory slots per CPU CRU	12	12
DDR Memory Sizes	256 MB & 512 MB	256 MB & 512 MB
Base Disk Subsystem	14-slot Ultra160 Disk Enclosure	14-slot Ultra160 Disk Enclosure
SCSI Disk Drives Supported	18 GB, 15,000 RPM Ultra160,	18 GB, 15,000 RPM Ultra160,
	36 GB, 10,000 RPM Ultra160	36 GB, 10,000 RPM Ultra160
	73 GB, 10,000 RPM Ultra 160	73 GB, 10,000 RPM Ultra 160
Ultra160 SCSI Disk Shelf Configurations • Maximum SCSI Disk Drives • Maximum SCSI Storage	1 split backplane or 2 joined backplanes 14 or 26 1 TB or 1.8 TB	1 split backplane or 2 joined backplanes 14 or 26 1 TB or 1.8 TB

Characteristic	ftServer 5240	ftServer 6500
Operating System	**Windows 2000 Advanced Server**	**Windows 2000 Advanced Server**
PCI Slots / User Slots: • **32-bit, 33 MHz PCI slots** • **64-bit, 33 MHz PCI slots**	**8 or 16 total; 4 or 12 user-configurable** **8 total; 4 user-configurable** **0 or 8 total; all user-configurable**	**16 total; 12 user-configurable** **8 total; 4 user-configurable** **8 total; all user-configurable**
Standard PCI Adapters: • **ftServer Access Adapters** • **2-port Ultra160 SCSI Adapter**	 **2** **2**	 **2** **2**
Optional PCI Adapters: • **1-port Ultra2 SCSI (tape)** • **10/100BaseTx Ethernet** • **1000BaseSx Ethernet** • **10/100/1000 Base-T Ethernet** • **8-port Asynchronous** • **Fibre Channel**		
Front Panel: • **24 x CD ROM** • **240 MB Super Disk** • **VGA Port** • **USB Ports** • **2 x 24 LCD**	 **1** **1** **1** **2** **1**	 **1** **1** **1** **2** **1**

Characteristic	ftServer 5240	ftServer 6500
Power (maximum)	**> 200 VAC**	**> 200 VAC**
• **DMR ftServer 5240/6500|**	**2,275 Watts**	**2,275 Watts**
• **TMR ftServer 6500**	**N/A**	**2,975 Watts**
• **Additional SCSI Storage Shelf**	**400 Watts each**	**400 Watts each**
• **ftStorage Fibre Channel Storage Enclosure**	**400 Watts each**	**400 Watts each**
• **V125 15”LCD with Keyboard Drawer**	**45 Watts**	**45 Watts**
• **17” VGA Monitor**	**100 Watts (not for rack mounting)**	**100 Watts (not for rack mounting)**
Size:		
• **DMR ftServer 5240/6500**	**16 U (includes initial SCSI disk shelf)**	**16 U (includes initial SCSI disk shelf)**
• **TMR ftServer 6500**	**N/A**	**18 U (includes initial SCSI disk shelf)**
• **Additional SCSI Storage Shelf**	**3 U**	**3 U**
• **ftStorage Fibre Channel Storage Enclosure**	**3 U each**	**3 U each**
• **V125 15”LCD with Keyboard Drawer**	**1 U**	**1 U**
Cabinets:		
• **Customer-Supplied (EIA310D)**	**Yes (refer to site planning guide)**	**Yes (refer to site planning guide)**
• **Stratus-Supplied**	**24 U & 38 U (700 mm wide)**	**24 U & 38 U (700 mm wide)**

The ftServer 5240 and 6500 systems are currently available in standalone cabinets only. No expansion cabinets are supported. The cabinet is a 24U (42") or 38U (66") high, 19" rack enclosure that houses the front panel, two or three independent CPU subsystems in support of DMR configurations in ftServer 5240 systems and both DMR and TMR in ftServer 6500 systems, one I/O subsystem with redundancy (two I/O enclosures), one mirrored disk subsystem (in one or two storage enclosures, each containing up to 14 disk drives), a fault tolerant power subsystem, and a system control and monitoring (M&D) subsystem. A customer-supplied cabinet is also supported.

Tape drives are supported externally to the cabinet.

1.2 Operating System Requirements

The following operating systems are currently supported by the ftServer 5240 and 6500 systems.

- Windows 2000 Advanced Server
- Customer-supplied operating system

1.3 Hardware Components

1.3.1 CPU Enclosure

The CPU enclosure is a 19" rack-mounted unit that contains 1- or 2-way SMP Intel Xeon DP processors in the ftServer 5240 system and 1-, 2- or 4-way SMP Intel Xeon processors in the ftServer 6500 system.. The enclosure has 12 memory module slots. A DMR has two CPU CRUs while a TMR system (ftServer 6500 only) has three.

The ftServer 5240/6500 uses DDR 200Mhz memory in 256-MB and 512-MB DIMMs. The following table lists model numbers of the memory modules currently supported in ftServer 5240 and 6500 systems.

Memory Module	Model Number
256-MB	M866
512-MB	M867

The following table shows the supported memory configurations.

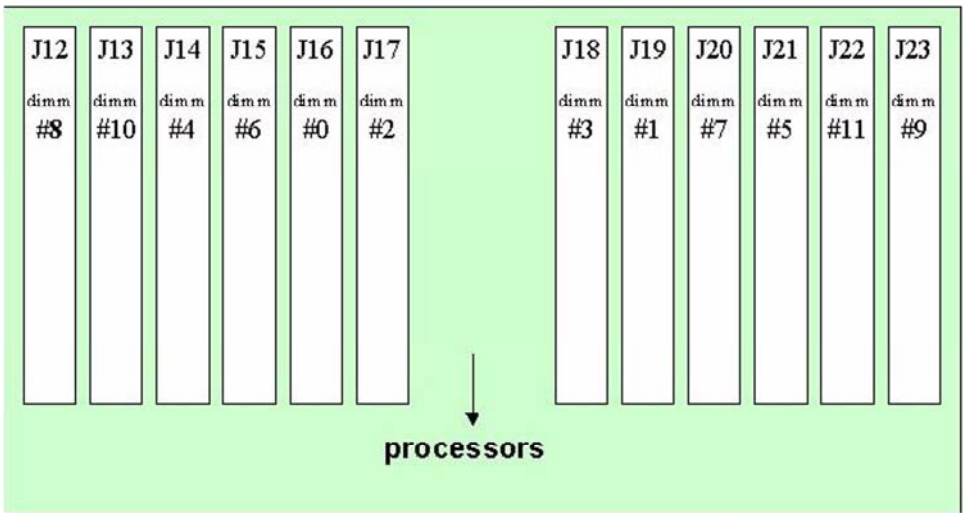
Total Memory in CPU Enclosure	# Memory Modules
1 GB	4 M866 modules
2 GB	8 M866 or 4 M867 modules
3 GB	12 M866 modules
4 GB	8 M867 modules
6 GB	12 M867 modules

The ftServer's two six-slot memory banks are organized into three groups of four memory slots. Each group must be populated with identical memory modules.

Each CPU enclosure must be populated identical to the other CPU enclosures. Mixed vendors are allowed between groups and enclosures.

Memory is always installed starting from outside slots and working towards the middle as shown in the following diagram.

- First Group Populated – J12, J13, J22, J23
- Second Group Populated – J14, J15, J20, J21
- Third Group Populated – J16, J17, J18, J19



For a detailed description of the CPU enclosure, refer to Section 6.1.

1.3.2 PCI Console Shelf

The PCI console shelf consists of the following components:

- LVDS backplane
- LVDS I/O power and distribution PCB
- Core I/O enclosures (2)
- Expansion I/O enclosures (2)
- Power supply unit (2)
- Fault tolerant clock cards (2)
- Front panel

Two core I/O enclosures and two expansion I/O enclosures are required in ftServer 6500 systems. The expansion I/O enclosures are optional in ftServer 5240 systems. Each core I/O enclosure contains four 32-bit, 33 MHz PCI slots. All slots support 5V hot-pluggable PCI cards. Slot 0 is usually the SCSI adapter. Slot 3 is dedicated for the ftServer access adapter. Each core I/O enclosure also supports legacy I/O to the front panel. They support the 2 USB ports, IDE and ISA ports.

Each expansion I/O chassis contains four 64-bit, 33 MHz PCI slots. All slots support PCI 5V or 3.3V hot-pluggable.

The following table lists the PCI adapters/cables supported on ftServer 5240 and 6500 systems.

Note: The PCI cards shown in the following table are based on information available at the time of publication. For current (and more detailed) PCI information refer to the ftServer PCI Adapter Technical Reference.

Model	Description
U461	ftServer Access Adapter (ftSAA)
U486	8-port Asynchronous Adapter
U514	64bit/33MHz ftStorage Fibre Channel Adapter
U515	1-port 10/100BaseTx Ethernet Adapter
U516	1-port Ultra2 SCSI Adapter
U519	2-port Ultra2 SCSI Adapter
U521	2-port Ultra160 SCSI adapter
U525	2-GB Fibre Channel Adapter (attaches to EMC through SAN)
U526	2-GB Fibre Channel Adapter (direct attachment to EMC)
U570	1-port 1000BaseSx Ethernet Adapter
U571	1-port 10/100Base-T Ethernet Adapter

The following table lists the minimum and maximum numbers supported for specific adapters in ftServer 5240 and 6500s.

Model	Min. Core	Max. Core	Min. Expansion	Max. Expansion	Max. Total
U461	2	2	0	0	2
U486	0	2	0	8	10
U514	0	0	0	2	2
U515	0	4	0	8	12
U516	0	2	0	2	2
U519	2	2	0	0	2
U521	2	4	0	2	4
U570	0	4	0	8	8
U571	0	4	0	8	8

The ftServer front panel provides a two-line 24-character LCD, startup switch, two USB ports, one VGA port, and one serial port for system debugging. An optional 4-port USB HUB, which connects to one of the two standard USB ports, can be installed to make a total of five USB ports available.

The front panel also contains two removable-media storage devices:

- A 3.5-inch high-capacity floppy drive uses 240-MB floppy disks for storing large files, or regular floppy (HD) 1.44-MB disks or regular floppy (DD) 720-kilobyte (KB) disks for storing smaller files.
- A 24X CD-ROM drive reads conventional 650 MB CD media.

The front panel is a separate hot-pluggable CRU. It does not have any LEDs.

The ftServer system's duplexed clock cards are customer-replaceable (CRU) and plug into the front of the PCI console shelf. Each clock card provides the system's sequencing and timing control for the CPU enclosures and one core and one expansion PCI chassis. The left clock card is the "master" and controls the two PCI chassis on the left side of the PCI console shelf. The right clock card is the "slave" and controls the two PCI chassis on the right side of the PCI console shelf.

Each clock card has a special red LED to indicate a broken oscillator.

For a detailed description of the PCI console shelf, refer to Section 6.2.

1.3.3 Storage Subsystems

1.3.3.1 Ultra160 SCSI Storage Subsystem

An ftServer 5240/6500 system supports up to two Ultra160 SCSI storage enclosures. A system can also support up to two Ultra2 SCSI enclosures instead, but only if it was upgraded from a 5200 system. In either case, a single ftServer system can support no more than two storage enclosures.

The 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 and blanks.

Each Ultra160 SCSI storage enclosure houses the following components:

- hot-pluggable 3.5"disk drives (2-14)
- enclosure LED module (1)
- advanced cooling modules (ACMs) (2)
- power supply modules (2)
- I/O modules (2)

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)**

A pair of U521 Ultra160 2-port SCSI host bus adapters (HBA) is required for fault tolerant operation.

Stratus operating system 1.3 is the minimum OS required to support the Ultra 160 SCSI subsystem.

The following table shows the configurations supported in the Ultra160 SCSI storage enclosure.

Configuration No.	Ultra160 SCSI Storage Enclosure		Number of Drives	
	Split	Joined	Min	Max
1.	1	0	4	22
2.	1	0	2	14
3.	2	0	4	28
4.	0	2	2	26

For a detailed description of the Ultra160 SCSI storage enclosure, refer to Section 6.4.

1.3.3.2 ftStorage Fibre Channel RAID StorageArray

The optional Fibre Channel RAID (Redundant Array of Inexpensive Disks)disk subsystem consists of a pair of host bus adapters (PCI cards) and at least one Fibre Channel Storage enclosure (maximum of three).

The Fibre Channel RAID diskarray is a complete, fully redundant, rack mountable, Fibre Channel storage solution. Each enclosure is 3U in height and can contain up to14 Fibre Channel disk drives. The first (main) enclosure (D570) contains the following components:

- two RAID controllers (each with 128MB of ECC cache)
- two Advanced Cooling Modules (ACMs), each with battery backup unit (BBU)
- two Power Supply Modules (PSMs)
- two Loop Resiliency and SES Modules (LSMs)
- two to 14 disk drives

The second and third enclosures (D580) are daisy chained to the first. Each D580 contains the following components:

- two I/O modules
- two Advanced Cooling Modules (ACMs), with no battery
- two Power Supply Modules (PSMs)
- two Loop Resiliency and SES Modules (LSMs)
- two to 14 disk drives

The two ACMs in the D570 contain BBUs for maintaining memory content in the RAID Controllers' cache in case of an AC power failure.

One or two D580 Fibre Channel RAID expansion enclosures, each with a maximum capacity of 14 Fibre Channel drives, can also be added to the Fibre Channel RAID disk subsystem. This provides for a maximum capacity of 42 Fibre Channel drives.

A pair of U514 host bus adapters (HBA) is required for fault tolerant operation. The Qlogic 2300 with copper connectors is the fibre channel HBA, along with a Stratus hardened driver. .

The following table lists the fibre channel disk drives supported on ftServer 5240/6500 systems.

Model	Description
D574	36-GB 10K RPM disk drive
D575	73-GB 10K RPM disk drive

1.3.4 Tape Drives

ftServer 5240/6500 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.

> **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 5240/6500 systems.

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

For a detailed description of the tape drives, refer to Section 6.6.

1.3.5 CPU-to-PCI Console Bus

The CPU-to-PCI console bus connects the CPU enclosure to the PCI console shelf and controls all signals between the the CPU/Memory boards and the I/O enclosures. It utilizes LVDS

technology to transmit and receive data. The CPU-to-PCI console bus consists of uni-directional point-to-point links that are 32 bits wide operating at 66 MHz.

For a detailed description of the CPU-to-PCI console bus, refer to Section 6.3.

1.3.6 Power Subsystem

The power system topology consists of multiple integrated AC-DC power supplies. These power supplies are co-located with the major system elements. Due to the overall system redundancy, there is no requirement for an N+1 topology for power within the CPU enclosure or PCI console shelf. The disk storage enclosure has N+1 power because it is a shared system resource.

The system requires two power cords connected to two independent AC sources and two exclusive branch circuits.

For a detailed description of the power subsystem, refer to Section 6.7.

1.4 System Configurations

1.4.1 Configuration Matrix

1.4.1.1 ftServer 5240

Marketing ID	P3502-1D-AS	P3502-2D-AS
Processor	DMR	DMR
Symmetric Multiprocessor Protocol (SMP)	1-way	2-way
Processor speed	2.4 GHz	2.4 GHz
Cache size	512 KB iL2	512 KB iL2
No. CPU Enclosures	2	2
No. physical CPUs	2	4

1.4.1.2 ftServer 6500

Marketing ID	P3603-1D-AS	P3603-2D-AS	P3603-4D-AS	P3603-2T-AS	P3603-4T-AS
Processor	DMR	DMR	DMR	TMR	TMR
Symmetric Multiprocessor Protocol (SMP)	1-way	2-way	4-way	2-way	4-way
Processor speed	1.6 GHz	1.6 GHz	1.6 GHz	1.6 GHz	1.6 GHz
Cache size	1 MB iL3	1 MB iL3	1 MB iL3	1 MB iL3	1 MB iL3
No. CPU Enclosures	2	2	2	3	3
No. physical CPUs	2	4	8	6	12

1.4.2 Cabinet Configurations

The following table lists the unit (U) sizes of the ftServer cabinet components. Sections 1.4.2.1 and 1.4.2.2 show the possible configurations for 38U and 24U cabinets.

Cabinet Component	Size
CPU Enclosure	2U
PCI Console Assembly	9U
Ultra160 SCSI Disk storage enclosure	3U
FtStorage Fibre Channel storage enclosure	3U
V125 Monitor, Keyboard and Mouse Assembly	1U
Filler Panel	1U
CPU Filler Panel	2U

NOTE: The Upgradeable DMR, DMR with Monitor, and TMR configurations require one pair of power strips (each strip contains six plugs) if they have only one storage enclosure. If they have two storage enclosures, they require two pairs of power strips. The TMR with Monitor configuration requires one pair of power strips. The Dual DMR configuration requires two pairs of power strips.

1.5 System Specifications

1.5.1 Physical

24U Cabinet
Height (including casters): 50 in. (1.257m)
Width: 27.5 in. (70 cm)
Depth: 41 in. (1.04m)
Weight, empty: 275 lb (125 kg)
Weight, empty with pallet and shipping container: 436 lb (197.8 kg)
38U Cabinet
Height (including casters): 74 in. (1.9m)
Width: 27.5 in. (70 cm)
Depth: 41 in. (1.04m)
Weight, empty: 344 lb (156 kg)
Weight, empty with pallet and shipping container: 512 lb (232.2 kg)

CPU Enclosure
Height: 3.5 in. (9 cm) (2U)
Width: 17.5 in. (45 cm)
Depth: 26 in. (66 cm)
Weight: 50 lb (23 kg

PCI Console Assembly with Power Supplies
Height: 14 in. (35.5 cm) (8U)
Width: 17.5 in. (44.4 cm)
Depth: 24 in. (60.9 cm)
Weight: 30 lb (13.6 kg)

I/O Enclosure with 4 PCI Adapters
Weight: 9.5 lb (4.3 kg)

Ultra2 SCSI Storage Enclosure
Height: 5.30 in. (13.26 cm) (3U)
Width: 17.70 in. (44.96 cm)
Depth: 17.40 in. (44.20 cm)
Weight, without disks: 22 lb (9.8 kg)
Weight, fully configured: 63 lb (28.58 kg)

Ultra160 SCSI Storage Enclosure
Height: 5.22 in. (13.26 cm) (3U)
Width: 17.5 in. (44.45 cm)
Depth: 20 in. (50.80 cm)
Weight, without disks: 33 lb (14.97 kg)
Weight, fully configured: 75 lb (34.02 kg)

ftStorage Fibre Channel Enclosure
Height: 5.22 in. (13.3 cm) (3U)
Width: 15.5 in. (44.5 cm)
Depth: 20 in. (50.80 cm)
Weight: 59 lb (26.76 kg) maximum

V125 1U Flat-panel LCD Monitor with Integrated Keyboard and Trackpad
Height: 1.75 in. (4.45 cm) (1U)
Width: 19 in. (48.3 cm)
Depth: 27 in. (68.6 cm)
V122 17-inch Color Monitor
Height: 16 in. (41 cm) (11U)
Width: 16 in. (41 cm)
Depth: 16.5 in. (40.8 cm)
Weight: 35.2 lb (16 kg)

V115 Keyboard
Height: 2.5 in. (6.4 cm) (2U)
Width: 19 in. (48.3 cm)
Depth: 8 in. (20.4 cm)

T511 and T512 Tape Drives without Autoloader
Height: 3.7 in. (9.5 cm)
Width: 4.5 in. (11.6 cm)
Depth: 8.6 in. (22.0 cm)
Weight: 5.7 lb (2.6 kg)

T511 and T512 Tape Drives with Autoloader
Height: 5.3 in. (13.5 cm)
Width: 6.5 in. (16.5 cm)
Depth: 10.6 in. (26.9 cm)
Weight: 10.5 lb (4.8 kg)

T513 Tape Drive
Height: 6.5 in. (16.5 cm)
Width: 6.9 in. (17.5 cm)
Depth (including tape eject handle): 12.8 in. (32.5 cm)
Weight: 14 lb (6.35 kg)

1.5.2 Environmental

Operating temperature:

0 ft to 2,000 ft (0m to 609.6m): 41^{o} F to 95^{o} F (5^{o} C to 35^{o} C)

Over 2,000 ft to maximum of 10,000 ft (3,048m): The upper temperature limit is lowered1^{o} C for every 800 ft (243.8m) above 2,000 ft (609.6m).

Operating maximum rate of temperature change: 21.6^{o} F/hr (12^{o} C/hr) or 0.36^{o} F/min (0.2^{o} C/min)

Operating relative humidity: 10% to 80% (noncondensing)

Storage temperature (to 40,000 ft) unvented: -40^{o} F to 158^{o} F (-40^{o} C to +70^{o} C)

Storage temperature (to 40,000 ft) vented: -40^{o} F to 141.8^{o} F (-40^{o} C to +60^{o} C)

Storage relative humidity: 10% to 95% (maximum absolute humidity of 0.024 water per lb of dry air)

1.5.3 Electrical

AC Input Voltage Nominal: 200 to 240 VAC

AC input frequency: 47-63 Hz

Power Requirements (Base System): DMR: 2,375 Watts; TMR: 3,075 Watts

Additional SCSI Storage Shelf: 400 Watts each

ftStorage Fibre Channel Storage Enclosure: 400 Watts each

V125 15"LCD with Keyboard Drawer: 45 Watts

17" VGA Monitor: 100 Watts (not for rack mounting)

2. Operation and Maintenance Procedures

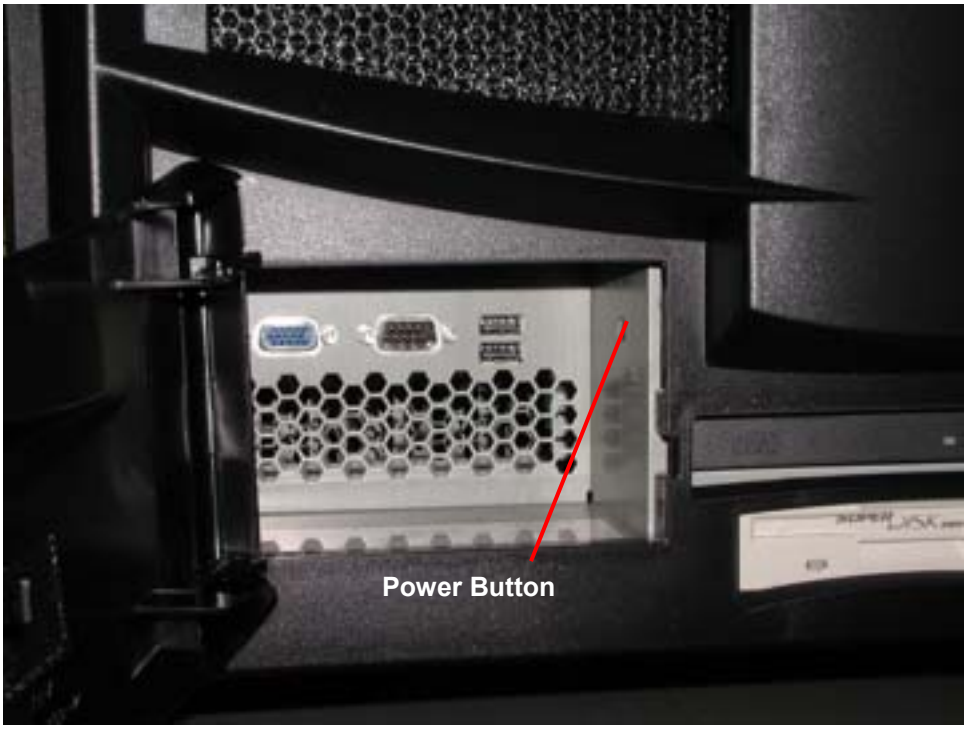
This section describes software procedures related to service maintenance. It covers various topics, including the following:

- System Startup
- System Shutdown
- Device IDs
- System Handling of Hardware Events
- Troubleshooting Failed Components
- Front Panel LCD Messages

2.1 System Startup

Whenever the system is plugged into live AC outlets and the power strips are turned on, the PCI console assembly is powered up. This "standby" power keeps the I/O system operational even when the rest of the system is powered off. If the Windows 2000 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 2000.

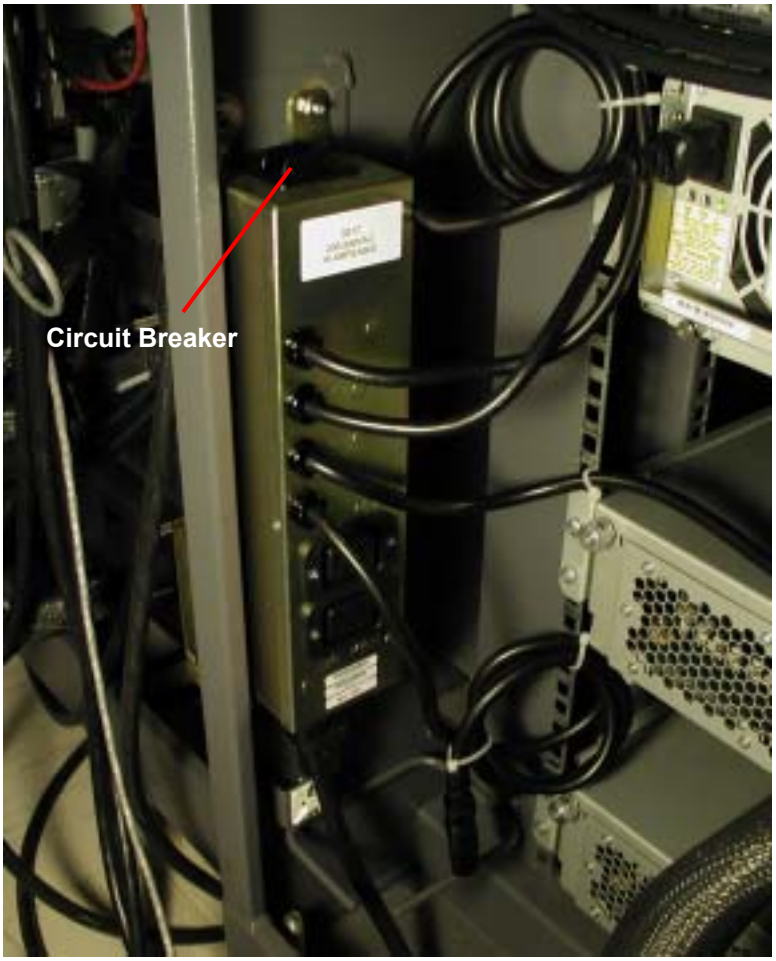
The front panel system power button is recessed on the right side of the front panel port access area as shown in the figure below.



If the system is in a Power Off state, pressing the power button for five seconds powers on the system and starts the FRB sequence. If the system is in a Power On state and the OS is shutdown, pressing the power button for five seconds powers off the system.

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

Make sure the system power cords are plugged into live AC outlets and the circuit breaker on top of each power strip is **ON**.



Make sure the **ON/OFF** switches on the SCSI storage enclosures are **ON**.

Turn on the monitor and any other peripheral devices.

On the front panel, press the system power button and hold it down for a five seconds. This powers on the rest of the system and causes the Windows 2000 operating system to boot.

> **N O T E:** If the system is in a **Power Off** state, pressing the power button for five seconds **powers on** the system and starts the FRB sequence. If the system is in a **Power On** state and the OS is shutdown, pressing the power button for five seconds **powers off** the system.

2.2 System Shutdown

If the ftServer system has a monitor, keyboard, and mouse, use Windows 2000 to shut down the system.

If the ftServer system does not have a monitor, you can access the system remotely through the ftSAC Remote Console or through the Virtual Network Computing (VNC) service, and perform the preceding procedure.

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 2000. 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.

Click the **Start** button on the Windows 2000 desktop and click **Shut Down**.

In the Shut Down Windows dialog box, select **Shut Down** in the dropdown list and then click **OK**.
A message states that your system is shutting down. After the system shuts down, a message appears stating that it is safe to power off the system.

Turn off power to any peripheral devices.

Press the front panel system power button for five seconds to shut down system power. (ftServer standby power remains on.)

To remove power to the rest of the system, open the rear door and place the **ON/OFF** switch on each power strip in the **OFF** position.

> **N O T E:** If the system is in a **Power Off** state, pressing the power button for five seconds **powers on** the system and starts the FRB sequence. If the system is in a **Power On** state and the OS is shutdown, pressing the power button for five seconds **powers off** the system.

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 2000 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, an I/O board would have PCI adapters plugged into it, and if the 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 I/O board) has caused child devices (the PCI adapters) to fail. In this case, the PCI adapters should not be replaced since the Warrior 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 CRU or FRU.

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, front panel, and storage enclosures.

They are shown in the following table.

Level 1 Device	Range of Device IDs	Device Ids Currently Used
CPU Enclosures	**0-9**	**0-2**
Core I/O enclosure	**10-19**	**10, 11**
Expansion I/O enclosure		**12, 13**
Front Panel		**30**
SCSI Storage Enclosure	**Start at 40 and increment by 1.**	**40 for Ultra160 SCSI Storage enclosure: split-bus.** **41 and 42 for Ultra160 SCSI Storage enclosures: two joined-bus.**
Uninterruptible Power Supply (UPS)		**32, 33**

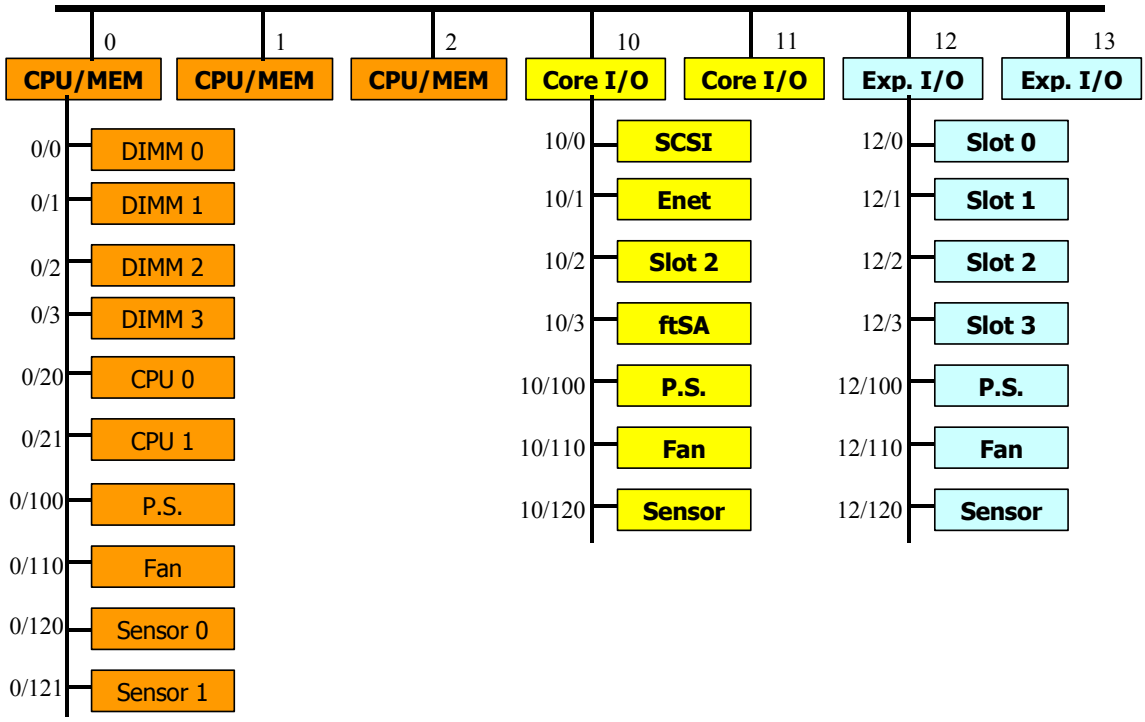
2.3.2 Level 2 Devices

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

Level 2 devices are shown in the following table.

Level 2 Device	Range of Device IDs	Device Ids Currently Used
Core I/O enclosure Slots	**0-99**	**10/0-10/3, 11/0-11/3**
Expansion I/O enclosure Slots		**12/0-12/3, 13/0-13/3**
CPU-to PCI Console Cables		**0/0, 1/1, 2/2**
CPU Enclosure processors	**20-39**	**0/20, 0/21, 1/20, 1/21, 2/20, 2/21**
CPU Enclosure Memory Modules	**0-19**	**0/0–0/11, 1/0-1/11, 2/0-2/11**
CPU Enclosure Power Supplies	**100-109**	**0/100-2/100**
PCI Console Fans	**110-119**	**10/110-13/110**
Front Panel Clock Cards	**20-29**	**30/20, 30/21**
Front Panel LCD		**30/0**
Front Panel System IDPROM		**30/180**
Ultra160 SCSI Storage Enclosure Fans		**40/110-40/112, 41/110-41/112, 42/110-42/112**
Ultra160 SCSI Storage Enclosure Power Supplies		**40/100, 40/101, 41/100, 41/101, 42/100, 42/101**
Ultra160 SCSI Enclosure Slots (Disk Drives)	**0-99**	**40/1- 40/14, 41/1-41/14, 42/1-42/14**

The following diagram is a pictorial representation of the device Ids of the Level 2 components in the CPU and I/O enclosures.



2.3.3 Level 3 Devices

Level 3 devices include SCSI buses and Ethernet ports on a PCI adapter. These are assigned addresses of 1 and 2. Fan speed sensor is a level 3 device under Fans and always has a device path ID of 140.

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 would typically be 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 would NOT be displayed for end users but may be used internally where appropriate.

2.4 System Handling of Hardware Events

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* (R001W).

All odd numbered CRUS/FRUS are powered by the A power strip (on left as viewed from rear of cabinet) and even numbered CRUS/FRUS are powered by the B power strip (on right as

viewed from rear of cabinet). Odd components have a shaded background on the label and even components have a white background.

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. If the ftServer Manager 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 2000 Event Log.

An alarm message is displayed on the front panel LCD.

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

In addition, ftServer Manager continuously copies the ftServer Windows 2000 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.

2.5 Troubleshooting Failed Components

Use the ftSMC to accomplish tasks related to:

- Windows Not Responding
- Determining that a unit failed
- Taking a Component Offline
- Bringing a Component Online

2.5.1 Windows Not Responding

If the Windows 2000 operating system does not respond, that is, the system appears hung, use **ftServer Access** to reset or reboot. For information about using ftServer Access, see *the Stratus ftServer Access User's Guide* (R003W).

2.5.2 Determining that a unit failed

In **ftSMC**, expand the **System Inventory** by clicking the **ftServer** node in the Console tree and pressing the asterisk **(*)** key on the numeric keypad.

Look for **Warning** or **Error** icons. If you see a **Warning** icon, click on the plus sign (+) in front of nodes that have a **Warning** icon until you see an **Error** icon.

For example, **Warning** icons appear in these three nodes and the **Error** icon appears beside the SCSI slot that has a problem, as follows:

Enclosure ID → / Drive Slot ↓	0	1	2
Slot 0	3	18	33
Slot 1	4	19	34
Slot 2	5	20	35
Slot 3	6	21	36
Slot 4	7	22	37
Slot 5	8	23	38
Slot 6	9	24	39
Slot 7	10	25	40
Slot 8	11	26	41
Slot 9	12	27	42
Slot 10	13	28	43
Slot 11	14	29	44
Slot 12	15	30	45
Slot 13	16	31	46

Click on 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, 2000 15:07:24
MTBF: Threshold 300 seconds
MTBF: Number of Faults 2
MTBF: Current 220 seconds
```

2.5.3 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 2000 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 2000 **Disk Management**. The logical disks that have the same drive letter are a mirrored pair. If the mirrors are set as Stratus recommends, then the disks in slots 1 and 5, 2 and 6, 3 and 7, and 4 and 8 are mirrors.

4. If the component is a field-replaceable unit (FRU) or distributor-replaceable unit (DRU) remove the failed component and replace it with a new FRU or DRU. See Section 4A or Section 4B.

5. Bring the replaced component back online. See the next subsection.

2.5.4 Bringing a Component Online

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

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

2.6 Front Panel LCD Messages

The LCD (liquid crystal display) is located on the front panel of the system. The ftServer Access Console (ftSAC) displays the contents of the LCD. The LCD messages indicate the state of the system. When the system is running, ftServer Access handles the LCD display contents. When ftServer Manager is running, it handles the LCD display contents.

The following table describes the messages that appear in the LCD.

LCD Message	Description
Power Off	**The host system power is off.**
SYSTEM POST CODE: ***nnnn*** **CPU *N*: IO *n***	**The host system is running its BIOS.** ***nnnn* is the POST code value, *N* is a number that identifies the active CPU enclosure, and *n* is s a number that identifies the active PCI chassis.** **For a description of each of the POST codes, refer to *Stratus ftServer Access User's Guide* (R003W).**
BIOS POST COMPLETE **CPU *N*: IO *n***	**After the BIOS has handed control to the boot loader, the LCD briefly displays this message.** ***N* is a number that identifies the active CPU enclosure, and *n* is a number that identifies the active PCI chassis.**
BOOT LOADER **CPU *N*: IO *n***	**The host system has booted.** ***N* is a number that identifies the active CPU enclosure, and *n* is a number that identifies the active PCI chassis.**
OS LOADING **CPU *N*: IO *n***	**The host operating system has started to load.** ***N* is a number that identifies the active CPU enclosure, and *n* is a number that identifies the active PCI chassis.**

OS UP **CPU *N*: IO *n***	**The host operating system has successfully loaded.** ***N* is a number that identifies the active CPU enclosure, and *n* is a number that identifies the active PCI chassis.**
System_name ***IP_Address***	**ftServer Manager is running and the system is in normal operation.** ***System_name* indicates the name of the host system, *IP_Address* specifies the system's primary IP address, and a spinner indicates that the system is running.**
ftSA Gateway Driver Up	**The ftSA Gateway driver, an interface between the ftServer Access PCI Adapter and the host system operating system, is running.**
ERROR ***Error_description***	**ftServer Access detected an error, for example, a failure to run a normal (fault-resilient) boot.** ***Error_description* is text that describes the error.**
SYSTEM CRASH **State Sensitive Recovery**	**ftServer Access detected a system crash and is running a state sensitive recovery.**
Previous_message ***Alarm_message*** **-or-** ***IP_Address***	**ftServer Manager detected a system error condition.** ***Previous_message* is the message displayed before the error condition occurred.** ***Alarm_message* is text that describes the error and indicates the the device ID of the component that committed the error.** **Alarm messages indicate failures of components such as a CPU or memory board; disk; fan or power supply; ftServer Access, host Ethernet, and SCSI connector; I/O bus; ftServer Manager software; or another connector.** **The alarm message text alternates with *IP_Address*, the system's primary IP address; a spinner indicates that the system is running.** **The capacity of the LED is 24 characters; as a result, the alarm message text scrolls continuously to display the full message.** **The LCD displays an alarm message until you use the ftServer Management Console to dismiss it.** **The LCD displays only the most recent alarm message. If a second alarm condition occurs prior to the user dismissing the first, the second alarm message replaces the first on the LCD.**

3. CRU Hardware Removal and Replacement Procedures

This section lists the Customer Replaceable Units (CRUs) in the ftServer 5240/6500 systems and describes the removal and replacement procedures for each one. CRUs are duplexed and may be removed and replaced without total removal of power, and thus, without loss of continuous processing.

3.1 List of CRUs

The following table lists the CRUs in the ftServer 5240/6500 system.

Component	Part Number
CPU Enclosure	**AA-G91300**
CPU-to-PCI Console Cable	**AW-020085**
PCI Console Power Supply	**AA-P41000**
Clock Card	**AA-E83100**
Front Panel	**AA-E83300**
Core I/O Chassis	**AA-E83400**
Expansion I/O Chassis	**AA-E83410**
PCI Adapter Card	**AA-UXXXX0**
Disk Drive	**AA-D52X00**
Advanced Cooling Module (ACM)	**MF-000041**
SCSI Storage Enclosure Power Supply Module	**AA-P57000**
I/O and Cluster Services Module	**AA- E52200**
Joiner Module	**AA-E52300**
SCSI Cable	**AW-001046-01**

3.2 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, also called an ESD

strap. The system cabinet has two grounding plugs (or banana jacks): one in the right front and one in the right rear. Insert the adapter end of the ground strap into the grounding plugs. Snap the other end of the strap into the wrist piece. (There is also a grounding plug on the rear of the CPU enclosure.)

3.3 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.

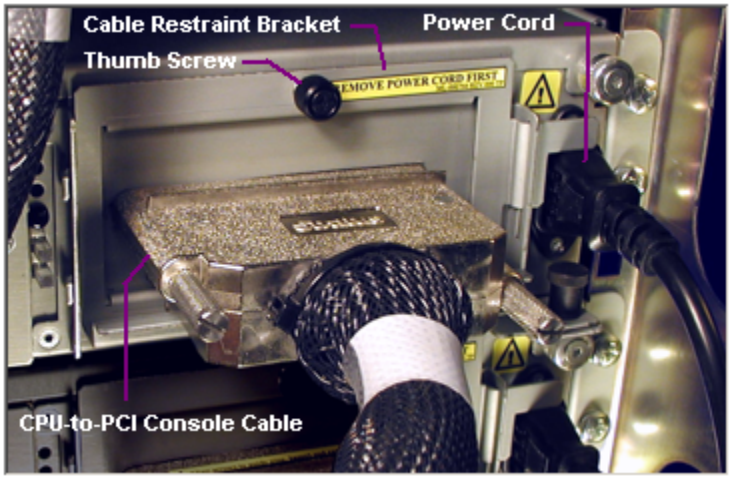
To perform the replacement procedure for each CRU, reverse the removable procedure. If any special replacement considerations are necessary, a replacement note is included.

3.3.1 CPU Enclosure

Warning: Two people are required when removing the CPU enclosure, due to the weight of the CPU Enclosure.

1. Remove the CPU from service with **ftSMC**. The **initiate bringdown** request will cause the CPU to go offline.

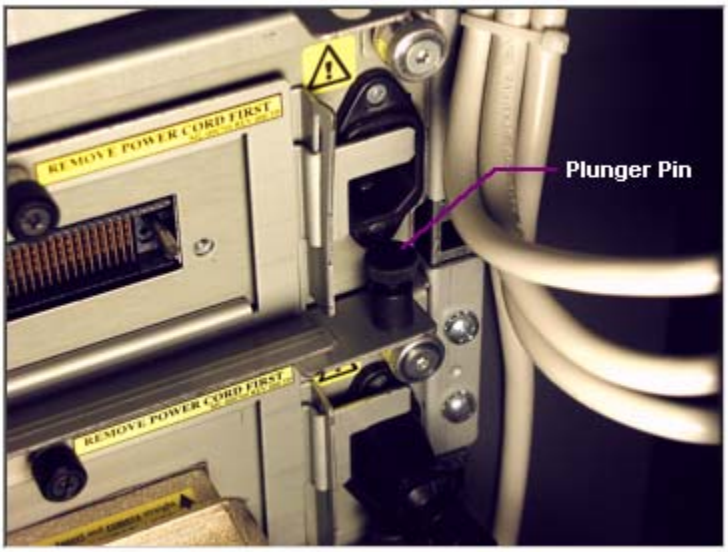
2. From the back of the cabinet, disconnect the power cord and CPU-to-PCI Console cable. The power cord simply pulls out. The CPU-to-PCI console cable is attached with two captive screws. Before the CPU-to-PCI console cable can be removed from the CPU enclosure, the cable restraint bracket must be removed. The cable restraint bracket is held in place by a single captive screw.



3. Grip the recessed areas on each side of the CPU bezel and pull both sides simultaneously to release it from the enclosure.

4. From the front, remove the two screws at the top of the enclosure that mount the CPU enclosure to the cabinet.

5. From the back, unlock the plunger pin holding the CPU enclosure in place, and slide the CPU enclosure slightly forward. The plunger pin is located in front of the power supply in the right rear of the CPU enclosure. Slide the CPU enclosure slightly forward.



6. With one person on either side, slide the CPU enclosure out from the front of the cabinet. There are catches that stop the enclosure one-half way out. Press the releases located in the holes on either side of the enclosure, and pull the rest of the way out.

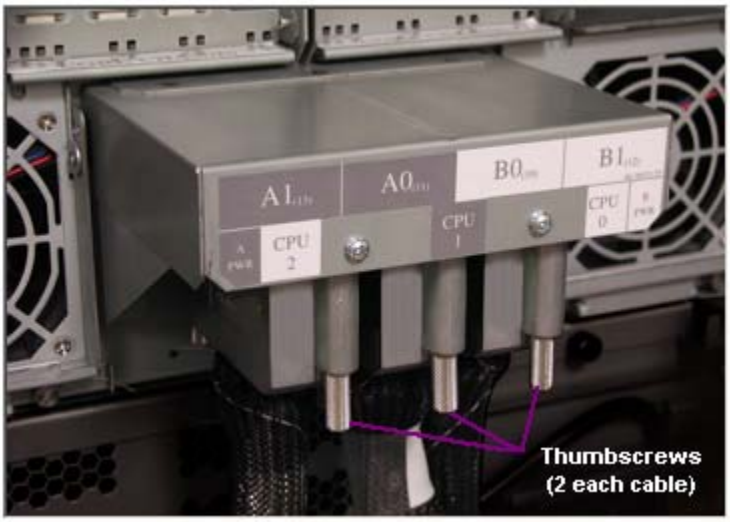
3.3.2 CPU-to-PCI Console Cable

Important: Verify which CPU-to-PCI cable you want to remove.

1. Disconnect the cable at the CPU enclosure end. The CPU-to-PCI console cable is attached with two captive screws.

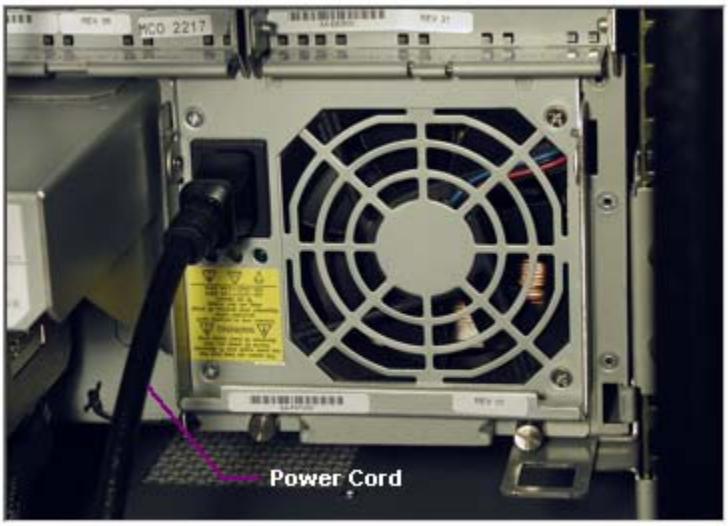
   Before the CPU-to-PCI console cable can be removed from the CPU enclosure, the cable restraint bracket must be removed. The cable restraint bracket is held in place by two captive screws.

2. Disconnect the cable at the PCI console end by loosening the two screws on the connector. Pull the connector away from the PCI console.

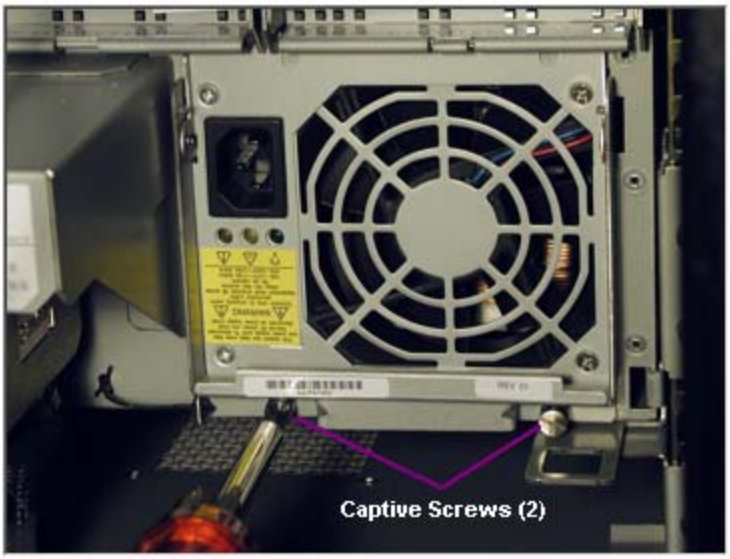


3.3.3 PCI Console Power Supply

1. Remove the power cord from the back of the power supply.



2. Unscrew the two (2) captive screws located on the bottom edge of the retaining bracket. Move the retaining bracket out of the way.



The retaining bracket is on a nylon tether, to keep it from being lost.

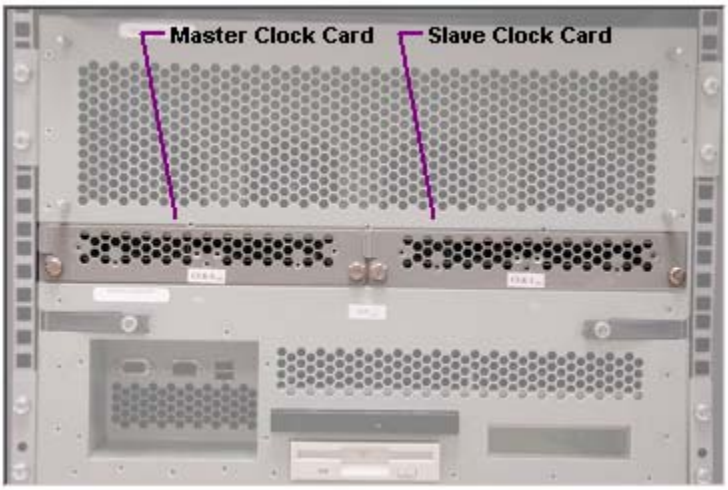
3. Pull the power supply out of the PCI Console.

3.3.4 Clock Card

Warning: Removing the Master clock card will cause a system interruption. Replacement of the Master clock card can only be performed off-line.

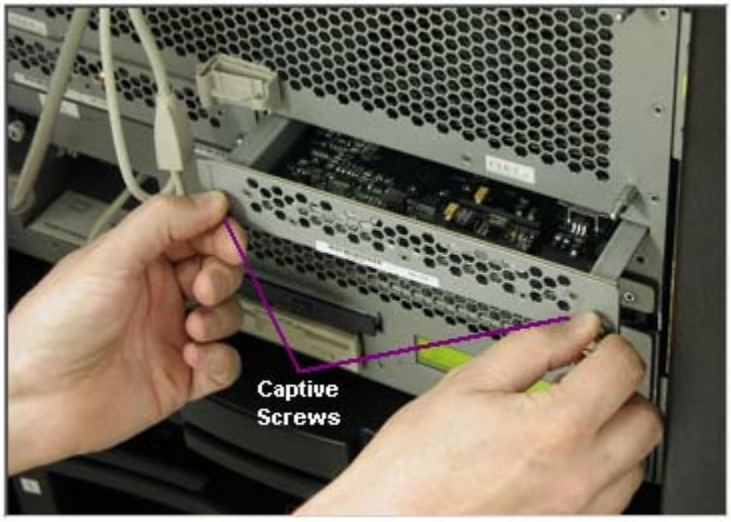
Note: The slave clock card must be removed before the master clock can be removed.

Note: There is no difference between Slave and Master clock cards, other than the location in the system.



1. Grip the recessed areas on each side of the PCI Console bezel and pull both sides simultaneously to release it from the enclosure.

2. Loosen the captive screws on either side of the clock card assembly.

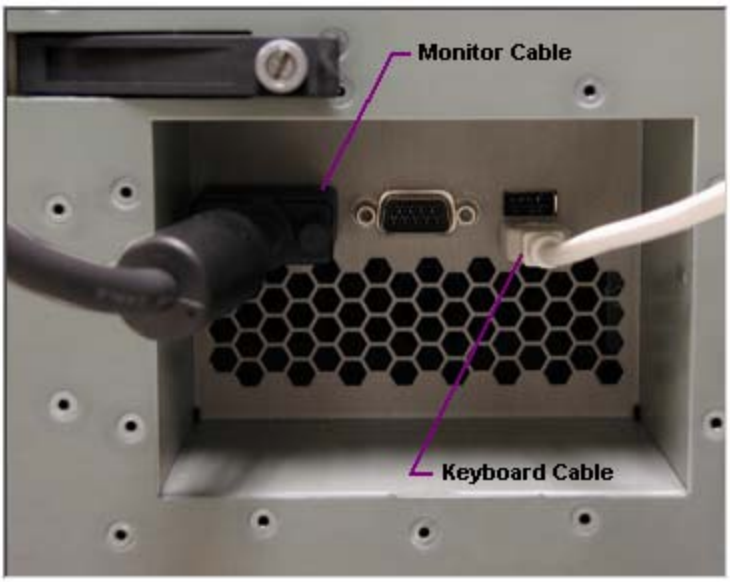


3. Pull the captive screws until the clock card freely slides out.

3.3.5 Front Panel

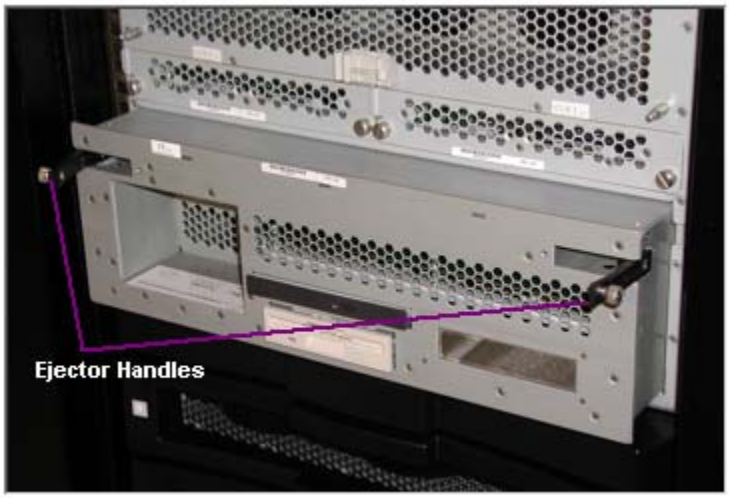
1. Grip the recessed areas on each side of the PCI Console bezel and pull both sides simultaneously to release it from the enclosure.

2. Remove the USB and VGA cables attached to the front panel connectors.



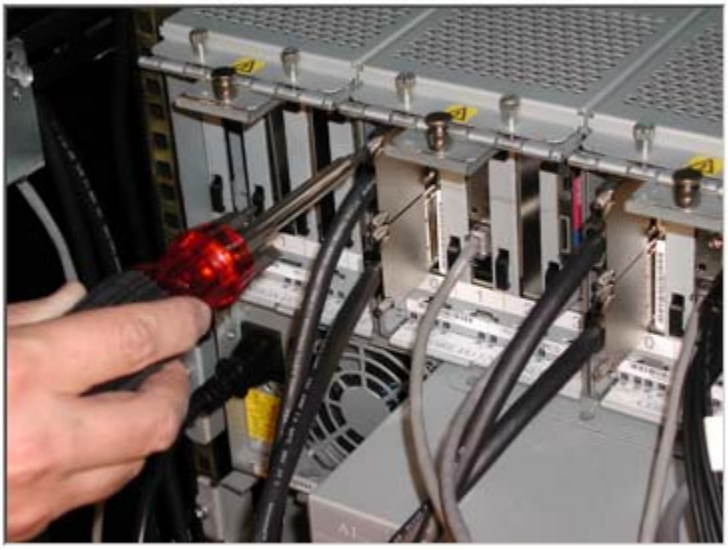
3. Loosen the captive screws on the ejector handles on either side of the front panel assembly.

4. Pull the ejector handles until the front panel freely slides out.

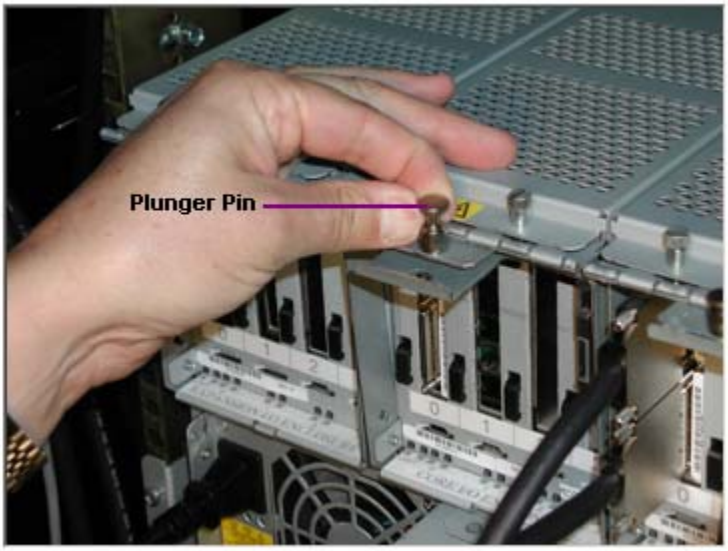


3.3.6 Core/Expansion I/O Chassis

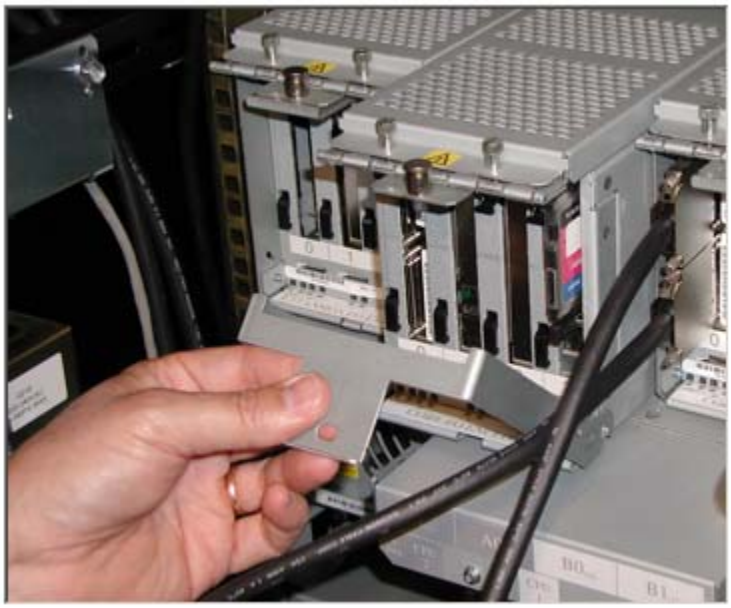
1. Disconnect all PCI cables from the PCI adapters and temporarily move the cables out of the way to permit unobstructed access to the I/O enclosure



2. From the back of the system, locate the PCI chassis to be removed. Unlock the plunger pin holding the retaining bracket in place. Pull the retaining bracket toward you.



3. Slide the I/O chassis toward you until fully removed.

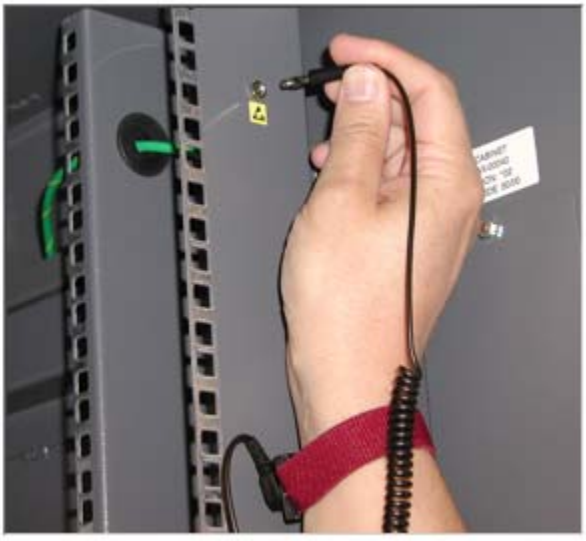


NOTE: When installing the replacement chassis it is important that the alignment slot at the bottom of the chassis line up with the alignment rail on the console.

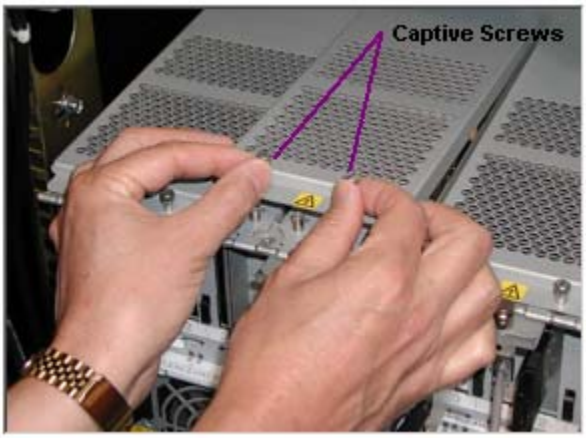
3.3.7 PCI Adapter Card

Before removing a PCI card, use **ftSMC** to take the card offline.

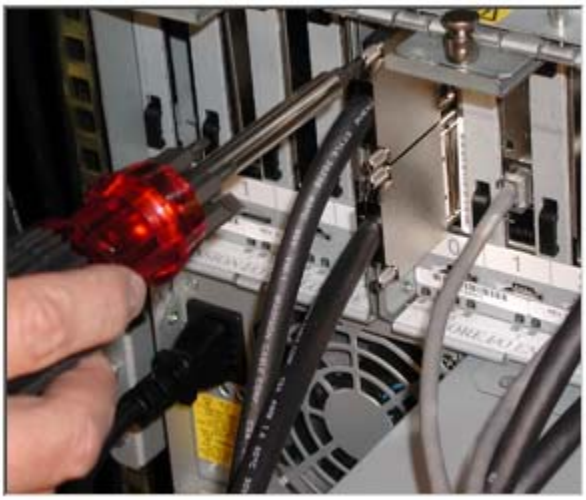
1. Use a grounding strap to prevent electrostatic damage.



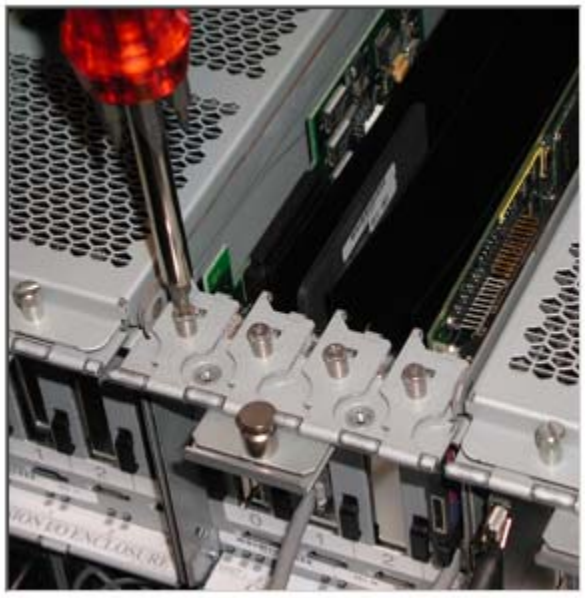
2. Remove the I/O chassis cover.
    a. Loosen the two captive screws of the I/O chassis cover.
    b. Lift the cover up by holding on to the captive screws, and then slide the cover out toward you.



3. Disconnect the PCI card's cables. When you disconnect cables from a PCI card, note the cable connections to the card.



4. Open the PCI card slot.
    a. Loosen the captive screw above the appropriate PCI card slot.



    b. Swing the screw-hinge up and out toward you.

    Important: The hinge activates a plunger which enables/disables power to the PCI slot. Proper alignment is necessary to enable the PCI slot to receive power.

5. Lift out the PCI card from between the PCI card dividers.

3.3.8 Disk Drive

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. Grasp the handle of the disk drive, then slide the disk drive out of the storage enclosure. Be sure to support the bottom of the drive while you are sliding it out.

3.3.9 SCSI Storage Enclosure Advanced Cooling Module (ACM)

1. Unscrew the two captive screws located on either side of the ACM.

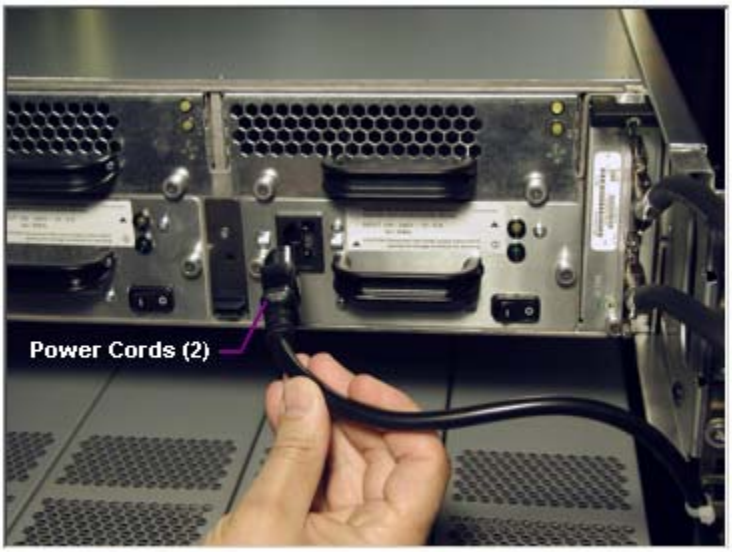
2. Pull the ACM out of the disk enclosure.

Both ACMs (per enclosure) can be removed at once without turning off the enclosure.

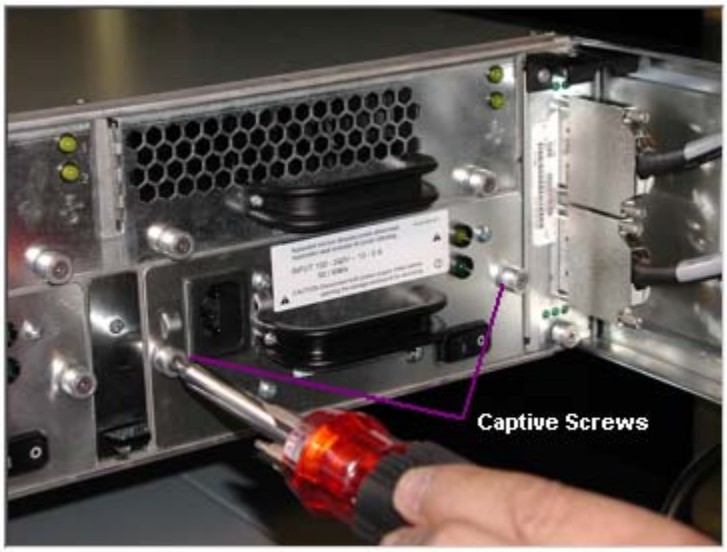
3.3.10 SCSI Storage Enclosure Power Supply Module

1. Turn the power switch to the OFF position.

2. Remove the power cord from the back of the power supply.



3. Unscrew the two captive screws located on either side of the power supply module.



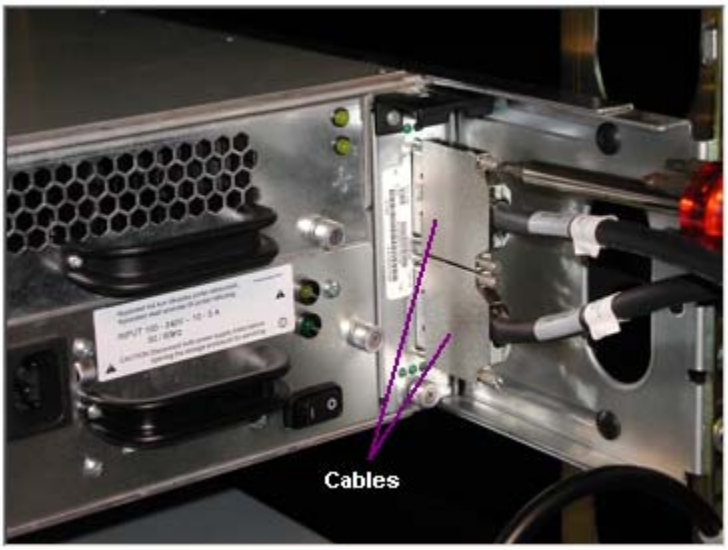
4. Pull the power supply module out of the disk enclosure.

One power supply module per enclosure can be removed without bringing down any drives in the enclosure.

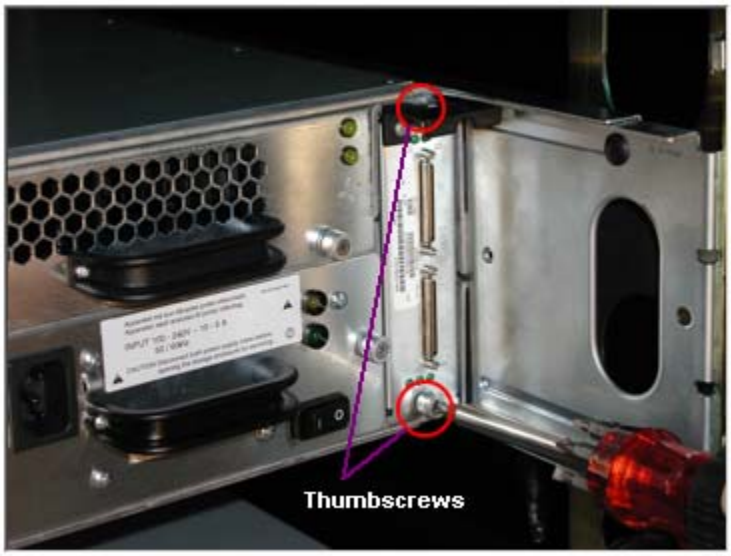
3.3.11 I/O and Cluster Services Module/Joiner Module

Removal/replacement of the I/O and Cluster Services Module and the Joiner Module are similar. The Joiner Module does not have any cable connections, while the I/O and Cluster Services Module has two SCSI connectors.

1. At the rear of the cabinet, remove any cables connected to the module that is being replaced at the rear of the storage enclosure. (Applies only to I/O and Cluster Services Module)



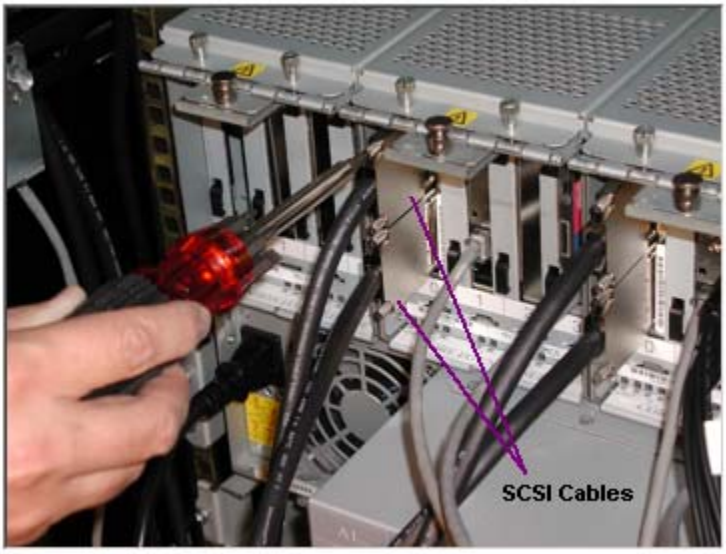
2. Loosen the thumbscrew that secures the module in place.



3. Grasp the handle on the module and slowly pull the module out of the storage enclosure.

3.3.12 SCSI Cable

1. Ensure that the SCSI devices for the affected enclosure are not in service.
2. Loosen the two captive screws on each of the 2 connectors.



3. Remove the connectors, noting which connector is attached to which port on the SCSI card.

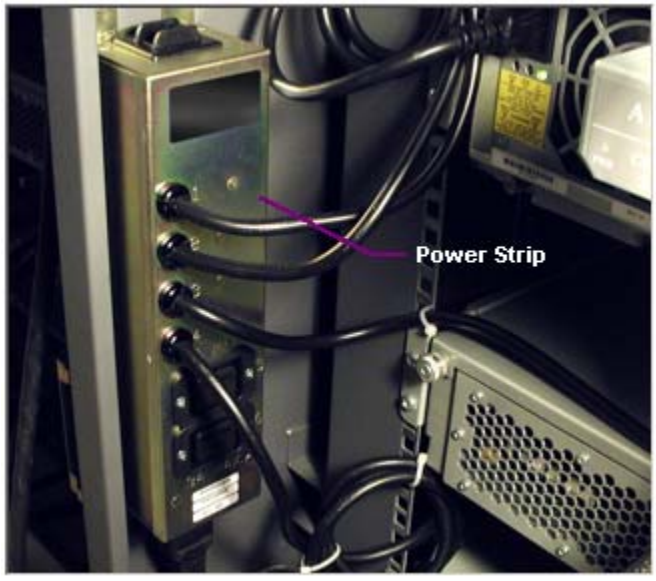
   NOTE: The connectors are keyed, and will only attach one way when installing the replacement cable.

3.3.13 LCD Monitor

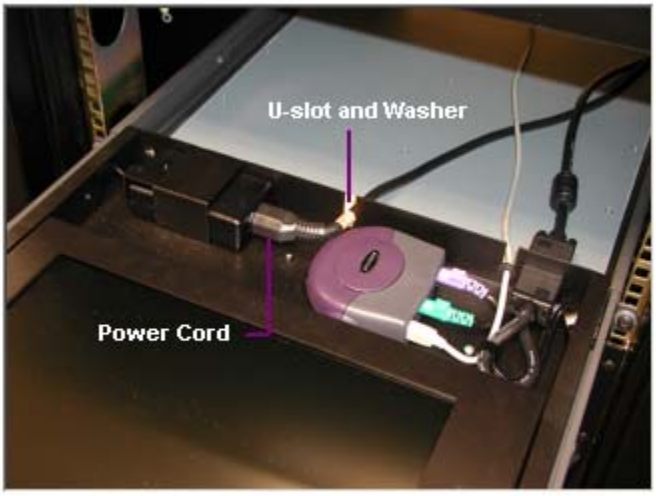
Warning: Stratus recommends that the V125 monitor unit be handled by two people during removal. Failure to do so could result in personal injury and damage to the monitor.

1. Turn off the monitor with the power switch on the front of the monitor.

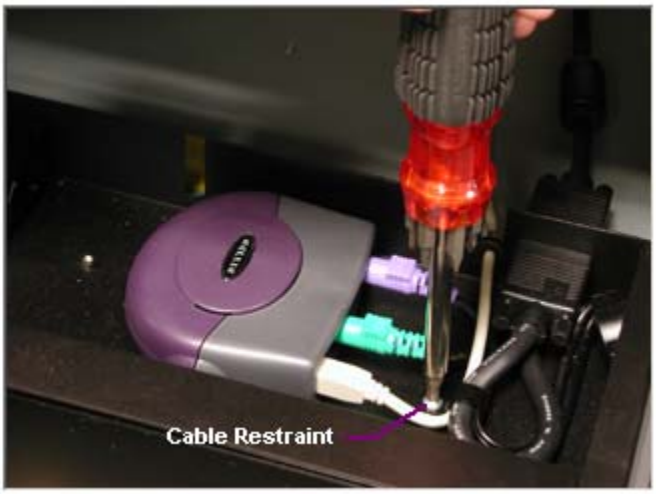
2. Put the monitor in the down position.
3. Open the rear door.
4. At the back of the system, unplug the V125 monitor unit's AC power cord from the cabinet's power strip.



5. Lift the power cord and its washer out of the u-slot. Then unplug the power cord from the built-in power supply at the back of the enclosure.



6. Remove cable restraint.



7. Disconnect the VGA and USB cables that connect at the back of the enclosure. At the front of the system, gently pull the enclosure out until it locks in place.

8. Press the stop buttons on the sides of the enclosure's mounting rails and, with one person supporting the enclosure on each side, remove the enclosure from the cabinet.

4. FRU Hardware Removal and Replacement Procedures

This section lists the Field Replaceable Units (FRUs) in the ftServer 5240/6500 systems and describes the removal and replacement procedures for each one. In most instances, FRUs are duplexed and may be removed and replaced without total removal of power, and thus, without loss of continuous processing. However, in some instances, the system must be shut down and both main power switches turned off prior to removal and replacement of the FRU.

4.1 List of FRUs

The following table lists the FRUs in the ftServer 5240/6500 system.

Component	Part Number
Memory Module	**AA-M86X00**
CPU Fan Pack	**AA-E83800**
Memory Power Board	**AA-E95500**
PCI Console	**AA-P41000**
Ultra160 SCSI Storage Enclosure	**AA-D5200X**
ftStorage Fibre Channel Array	**AA-D57000**

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. Refer to Section 2 for the shutdown procedure.

Power is removed from one side of the system by turning off the circuit breaker at the top of the power strip(s) on that side of the cabinet as shown in the following figure. This will simplex the system. If the system must be powered down completely, turn off the circuit breakers on both sides.

CAUTION: If the system needs to be simplexed (power removed from one side of the cabinet), verify that there are no red LEDs or system messages indicating a failed duplexed component on the side of the system that will remain powered on. If both components in a duplexed pair are removed, a system crash will occur.

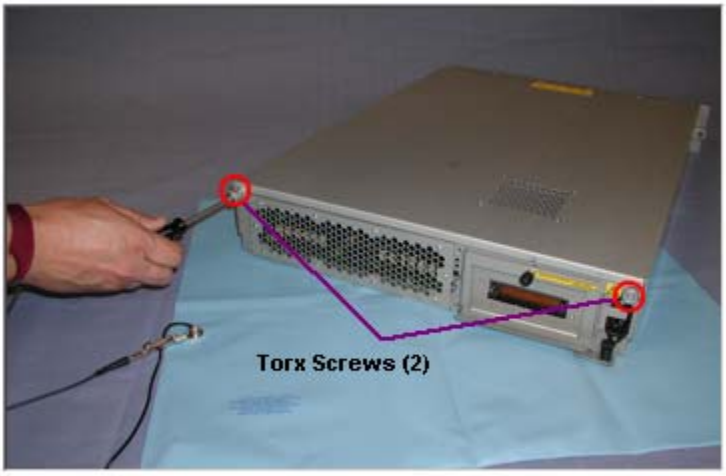
4.3 Hardware Removal Procedures

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

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

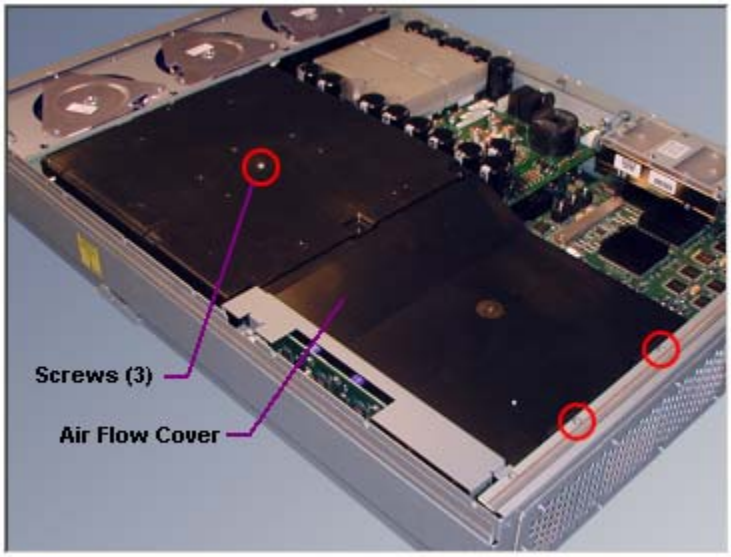
4.3.1 Memory Module

1. Remove the CPU Enclosure (CRU).
2. Loosen the two Torx screws securing the cover at the rear of the CPU enclosure. Slide the cover toward the rear to disengage the catches, then lift the cover off the enclosure.

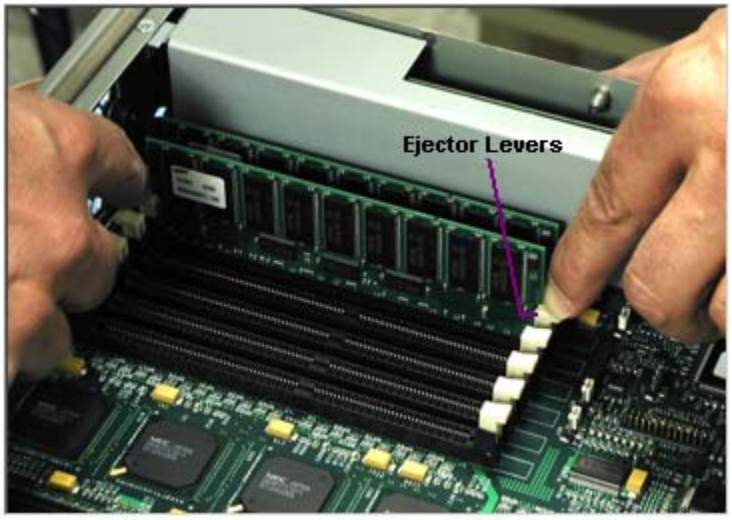


NOTE: A banana jack is provided at the rear of the chassis to connect the ESD strap.

3. Remove the black plastic air duct that covers the motherboard. The air duct is secured with three screws, one in the center and two at the rear of the enclosure.



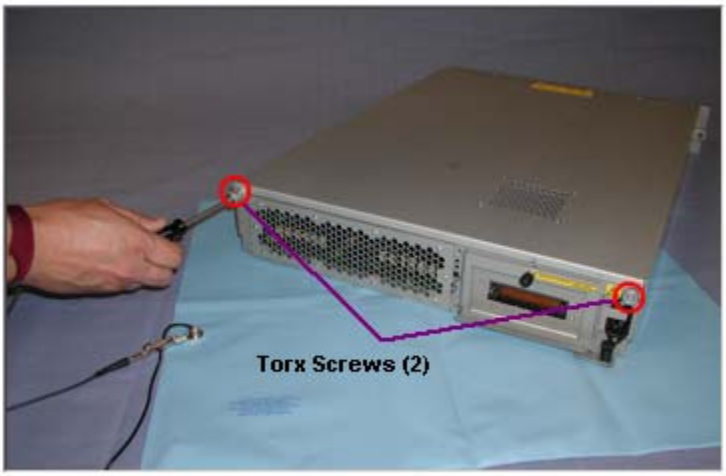
4. Push down to release the memory module's ejector levers and pull the module straight out from the connector.



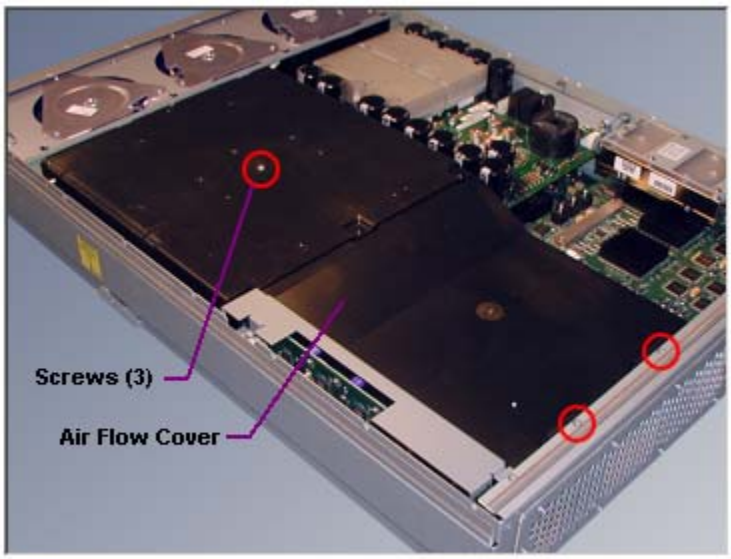
5. Carefully insert the new module into the connector making sure it is seated properly.

4.3.2 CPU Fan Pack

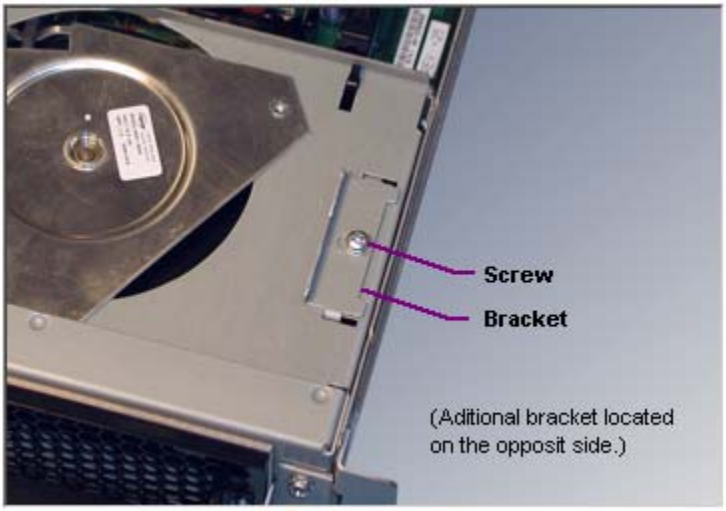
1. Remove cover from CPU CRU.



2. Remove the air duct that covers the motherboard.

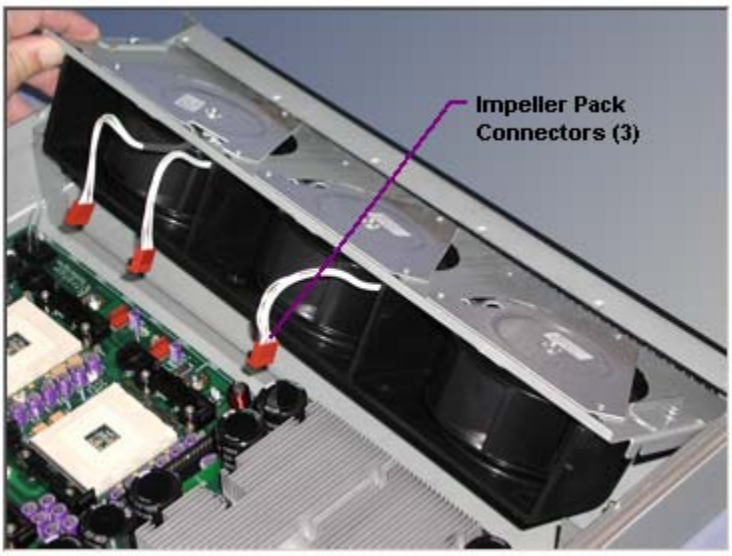


3. Locate the fan. Locate the two screws at each end of the top of the fan pack. Loosen, but do not remove each of these screws.



4. Slide the brackets secured by the previously loosened screws toward the middle of the fan pack.

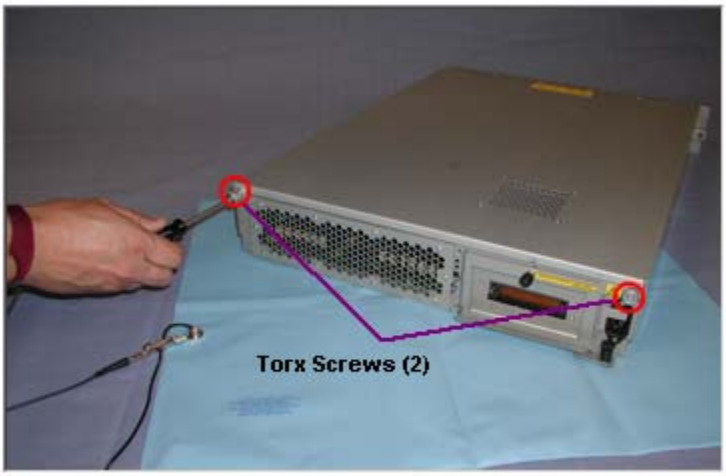
5. Remove the three (3) fan pack connectors from the motherboard.



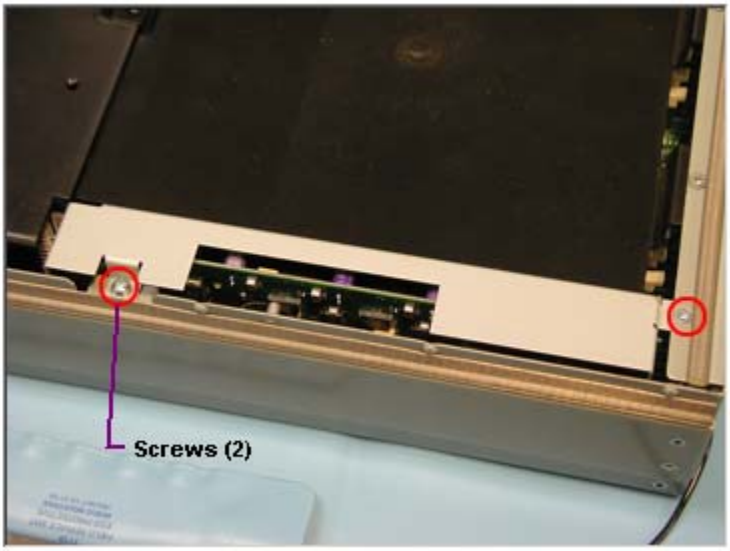
6. Slightly raise the rear of the fan pack and slide out of the chassis.

4.3.3 Memory Power Board

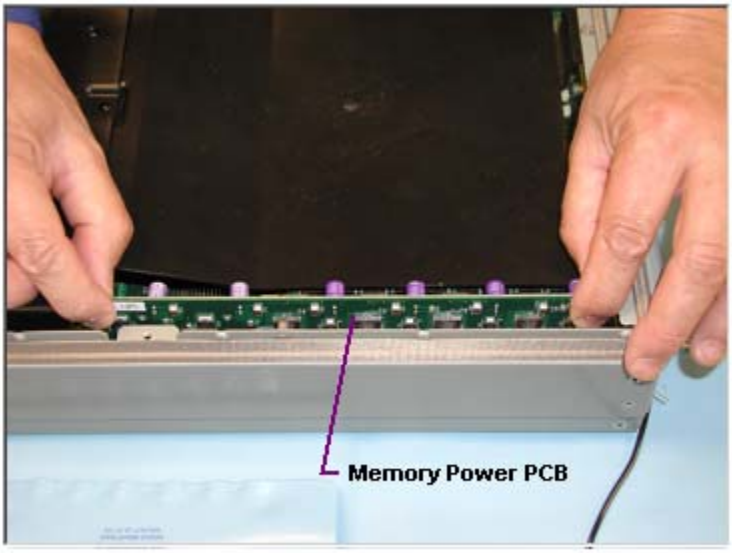
1. Remove the CPU CRU cover.



2. Locate the sheet metal cover at the rear of the enclosure. There are 2 screws securing the cover. Remove the 2 screws.

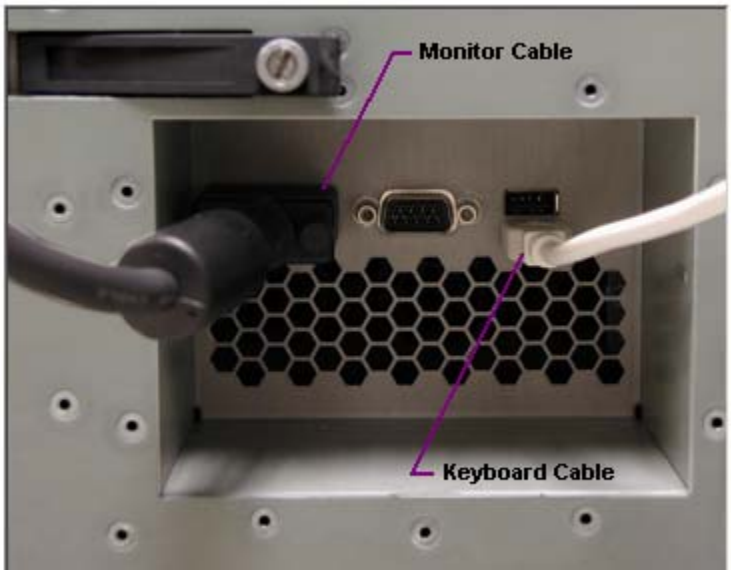


3. The Memory Power PCB is plugged into a socket mounted on the motherboard. Grasp the Memory Power PCB with two hands and pull straight up.



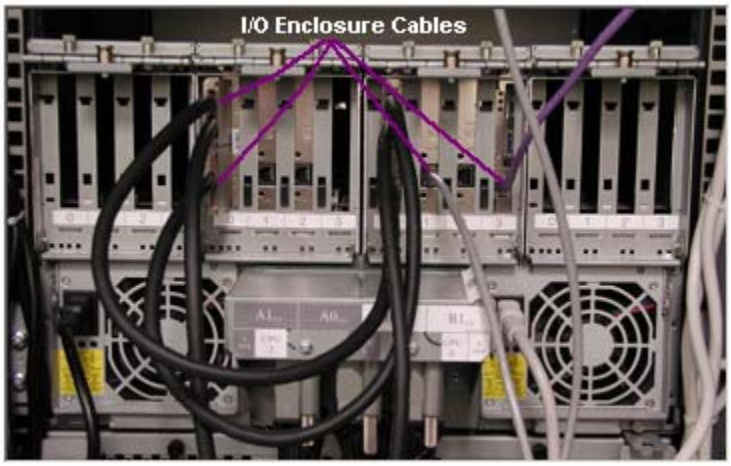
4.3.4 PCI Console

1. At the front of the cabinet, disconnect the monitor and keyboard cables from the front panel.

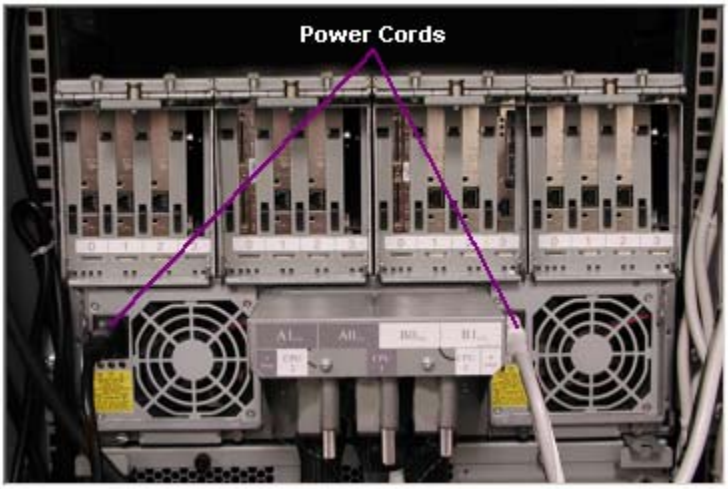


2. Remove the eight screws securing the PCI console shelf at the front of the cabinet.

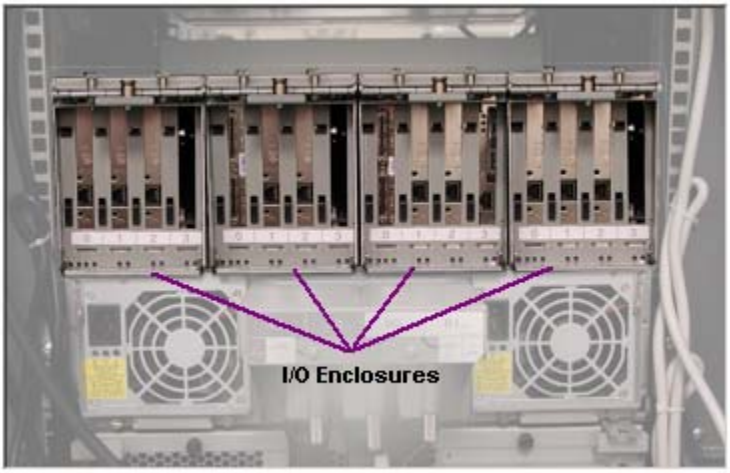
3. At the rear of the cabinet, disconnect all cables from both I/O enclosures.



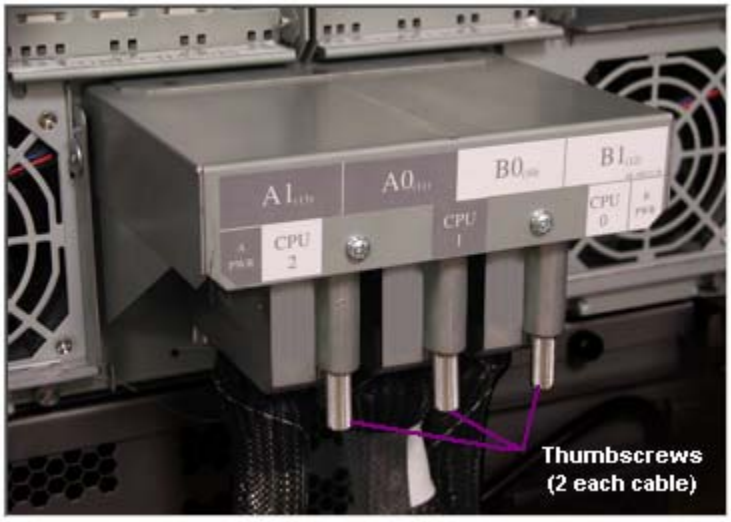
4. Disconnect the power cords from the PCI power supplies.



5. Remove all four I/O enclosures (CRUs).



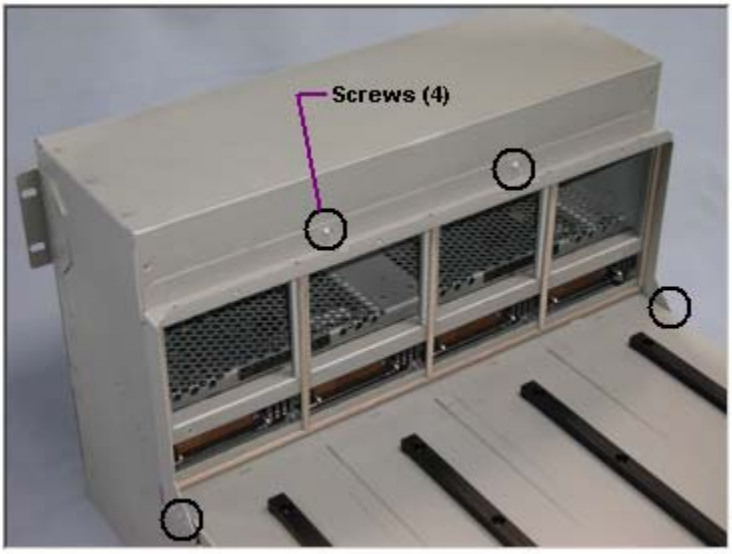
6. Loosen the two thumbscrews securing each CPU-to-PCI cable at the rear of the PCI console shelf and remove the cables.



7. At the rear of the cabinet, push the PCI console forward a few inches so that it protrudes out the front of the cabinet.

8. At the front of the cabinet, carefully pull the PCI console shelf out of the cabinet and set it on a table.

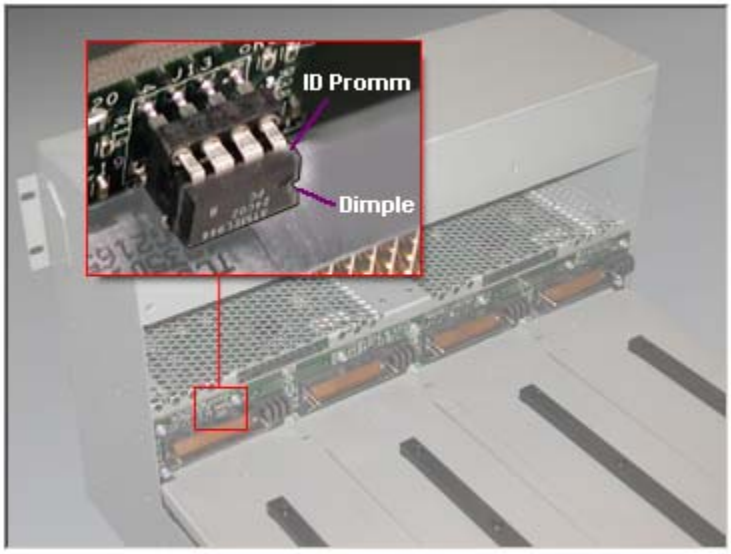
9. Remove the four screws securing the EMI shield. (Two of the screws are on the side.)



10. To remove the ID PROMM from the faulty PCI Console Shelf, perform the following steps:

    a. Note the orientation of the ID PROMM on the faulty PCI Console Shelf because it will have to be inserted exactly the same way on the replacement PCI Console Shelf. (The dimple in the upper right hand corner is on pin 1.)

    b. Very carefully pull the ID PROMM straight out of its socket, being careful not to bend its pins.

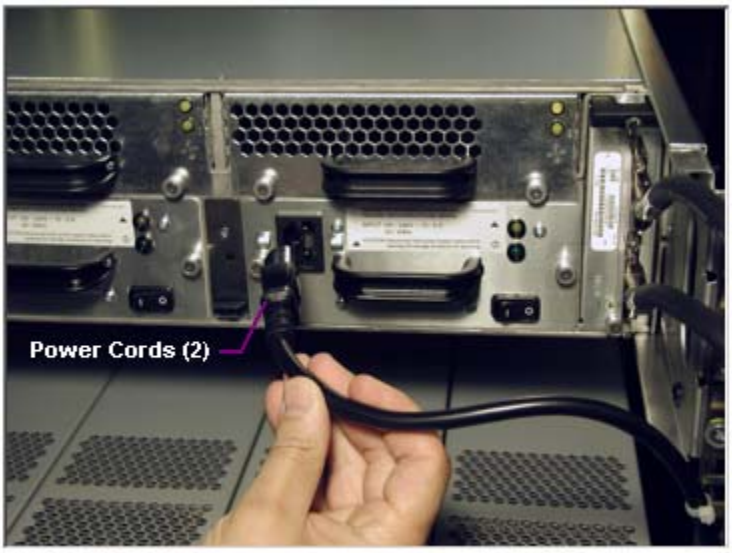


    c. Install the ID PROMM on the replacement PCI Console Shelf, making sure you install it in the same orientation as it was on the faulty PCI Console Shelf.

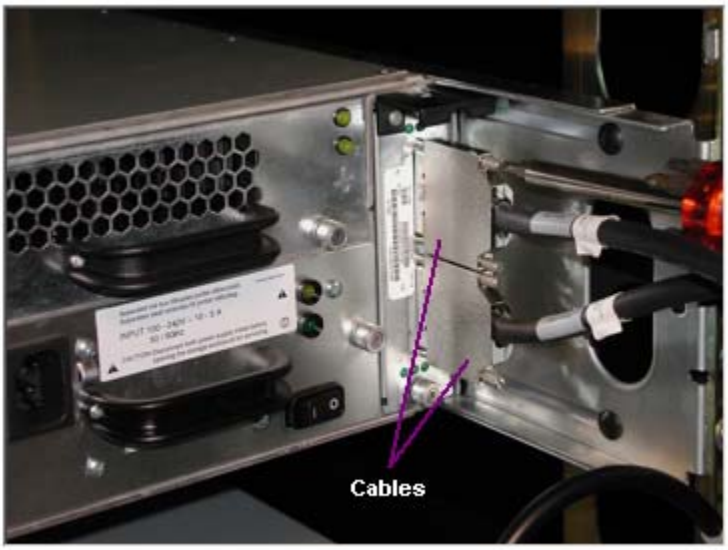
4.3.5 Ultra160 SCSIStorage Enclosure

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

2. Disconnect the power cords from the rear of the enclosure.



3. Disconnect the cables on the I/O and Cluster Services Module(s).



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

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

5. DRU Hardware Removal and Replacement Procedures

This section lists the Distributor Replaceable Units (DRUs) in ftServer 5400/6500 systems and describes the removal and replacement procedures for each one. In some instances, DRUs are duplexed and may be removed and replaced without total removal of power, and thus, without loss of continuous processing. However, in many instances, the system must be shut down and both main power switches turned off prior to removal and replacement of the DRU.

5.1 List of DRUs

The following table lists the DRUs in ftServer 5400/6500 systems. It shows the location of each DRU.

5.1 List of DRUs

The following table lists the FRUs in the ftServer 5240/6500 system.

Component	Part Number
CPU	**AK-000388**
CPU Power PCB	**AA-P64000**
CPU Daughterboard	**AA-E95400**
Motherboard	**AA-G90000**
LVDS I/O Power and Distribution	**AA-E83000**
Peripheral Bus Interconnect PCB	**AA-E15300**
IDE Bus CD-ROM Adapter	**AA-E15600**
High-capacity Floppy Drive	**AA-D56002**
CD-ROM Drive	**AA-D55001**

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. Refer to Section 2 for the shutdown procedure.

Power is removed from one side of the system by turning off the circuit breaker at the top of the power strip(s) on that side of the cabinet as shown in the following figure. This will simplex the system. If the system must be powered down completely, turn off the circuit breakers on both sides.

> **CAUTION:** If the system needs to be simplexed (power removed from one side of the cabinet), verify that there are no red LEDs or system messages indicating a failed duplexed component on the side of the system that will remain powered on. If both components in a duplexed pair are removed, a system crash will occur.

5.3 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 for the DRU.

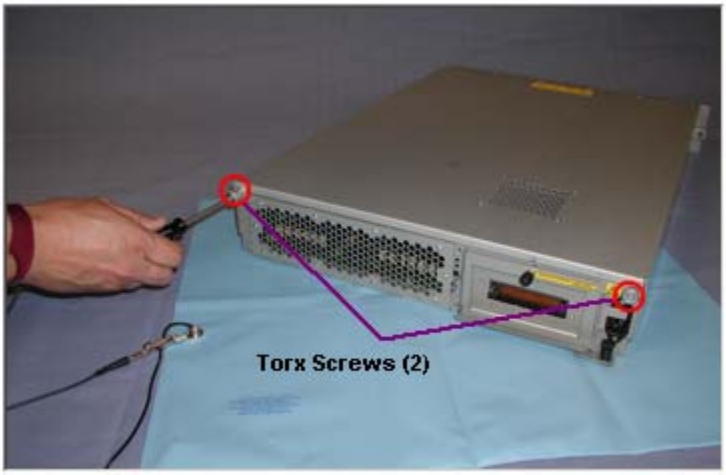
To perform the replacement procedure for each DRU, reverse the removable procedure. If any special replacement considerations are necessary, a replacement note is included.

NOTE: A banana jack is provided at the rear of the chassis to connect the ESD strap.

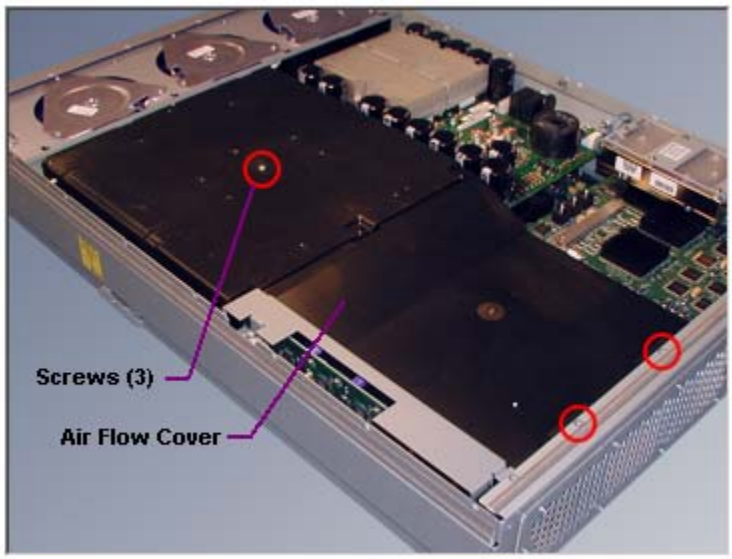
5.3.1 CPU

1. Remove CPU Enclosure (CRU).

2. Loosen the two Torx screws securing the cover at the rear of the CPU enclosure. Slide the cover toward the rear to disengage the catches, then lift the cover off the enclosure.

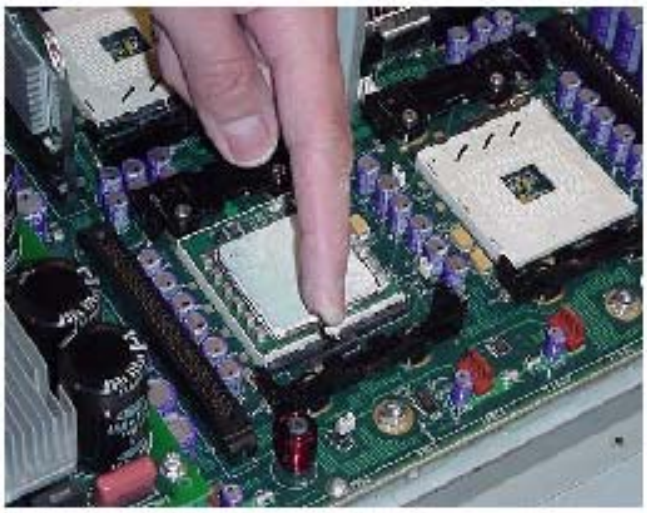


3. Remove the air flow cover from the CPU enclosure. It is held in place with 2 screws.

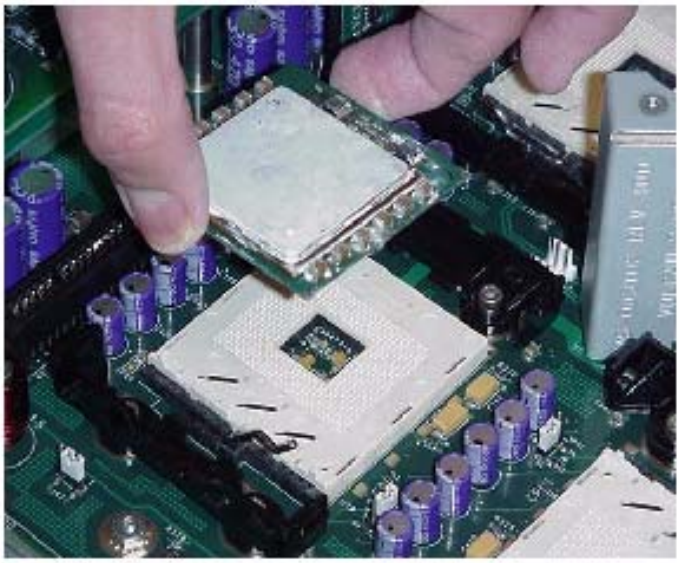


4. The heat sink must be removed before the CPU is removed. This is done by pushing down on the heat sink clip and using the special heat sink clip tool to remove it. Using any other tool will damage the motherboard. The heat sink must then be heated with a heat gun to allow it to be removed from the processor.

5. Release the processor's ejector levers and pull the processor straight up and out from the connector.



6. Open the new processor's ejector levers. Make sure the ejector levers' lower ends engage the tabs at the top of the processor connector such that, when lowered, the levers will secure the processor in place.
7. Carefully insert the new processor into the connector making sure it is seated properly.



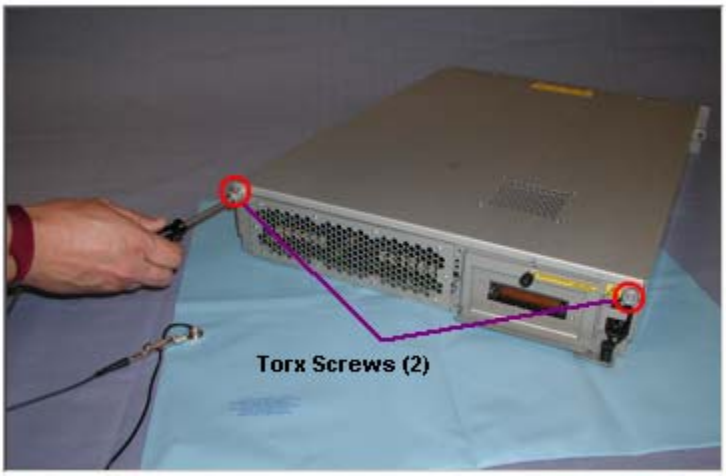
8. Close the ejector levers completely, making sure the levers engages the top of the processor to ensure secure connection.

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

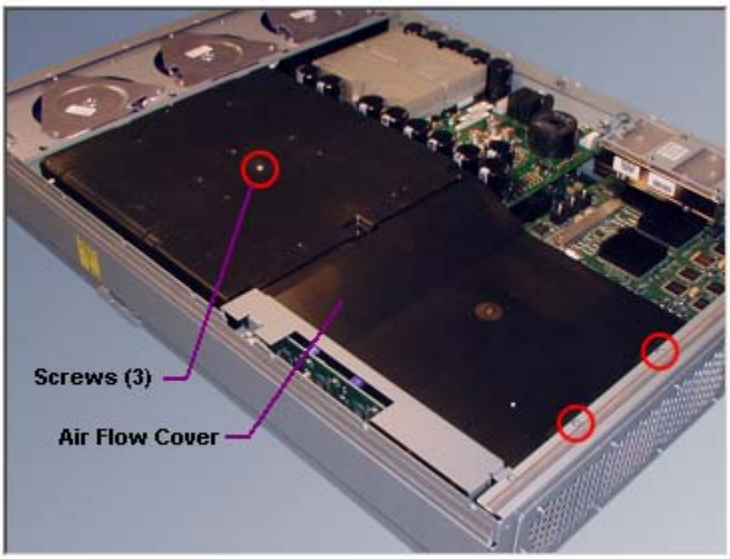
5.3.2 CPU Power PCB

CAUTION: Be sure that power is not applied to the CPU enclosure when removing the CPU Power PCB. High voltage is present on this card when power is applied.

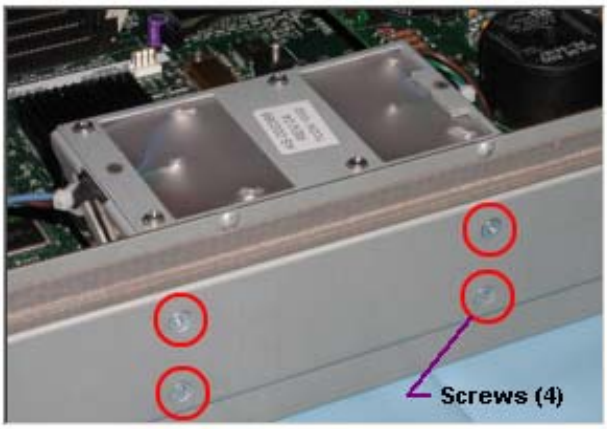
1. Remove the cover from the CPU enclosure using a Torx driver.



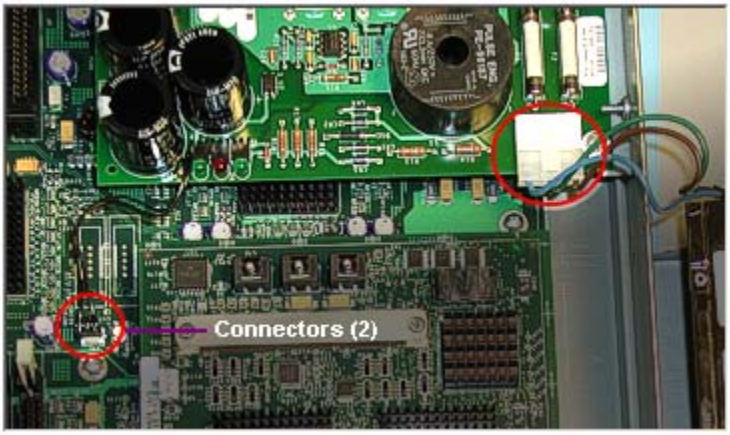
2. Remove the air flow cover from the CPU enclosure. It is held in place with 2 screws.



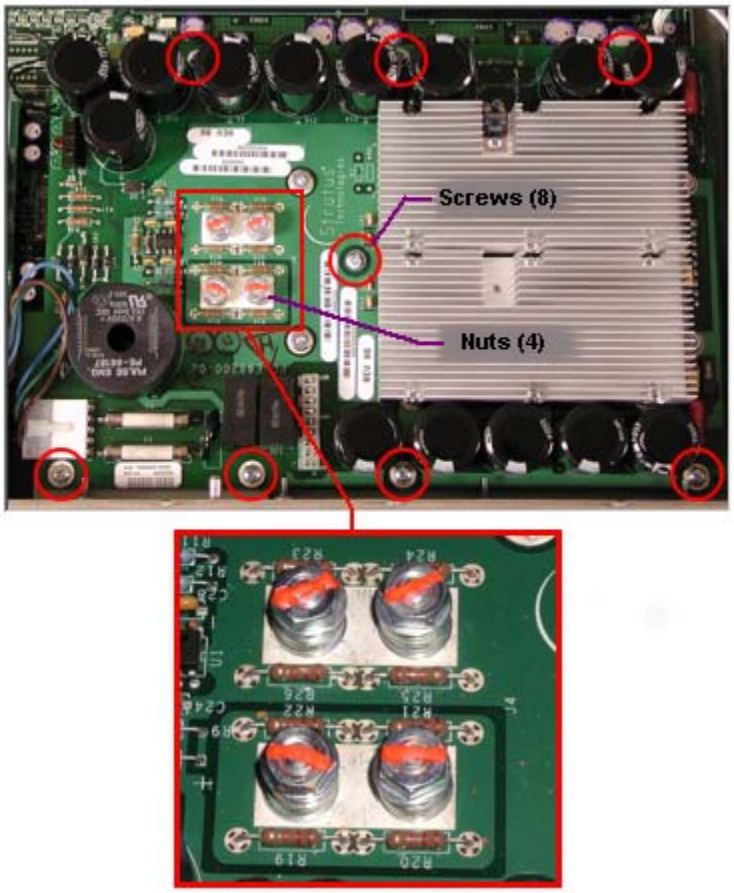
3. Remove the screws holding the line filter and move to the outside of the enclosure.



4. Remove the 2 connectors.



5. The CPU Power PCB is held in place by 8 screw and 4 nuts.

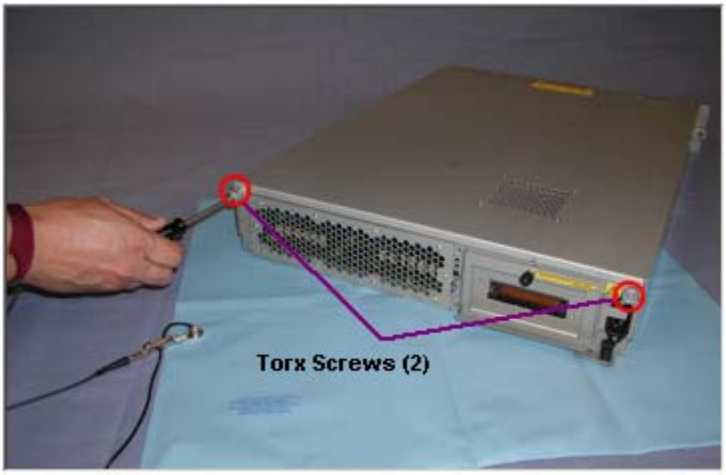


Screw positions: 4 along the the side of the enclosure, 3 on the inside of the board, and one in the center.

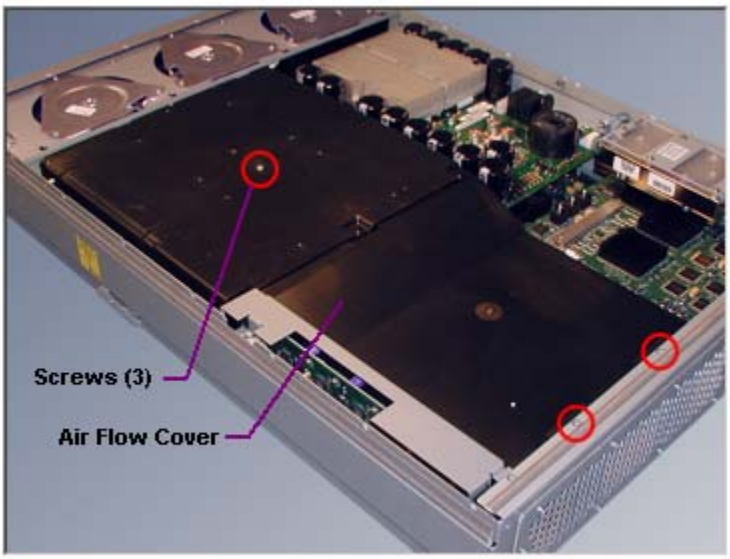
The nuts are positioned near the center of the PCB.

5.3.3 CPU Daughterboard

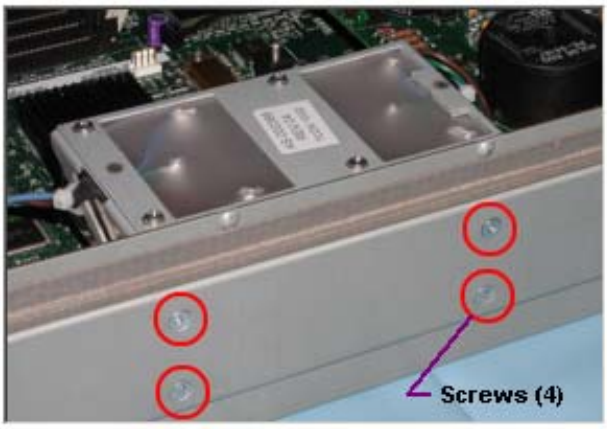
1. Remove the cover from the CPU enclosure using a Torx driver.



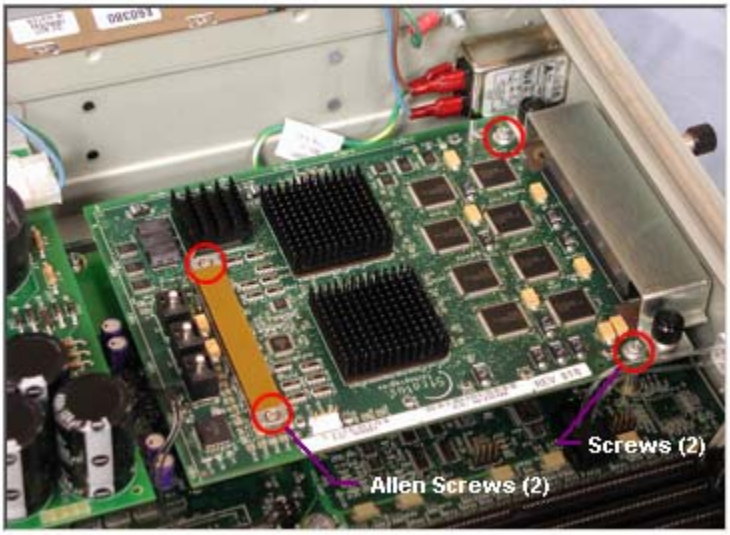
2. Remove the air flow cover from the CPU enclosure. It is held in place with 2 screws.



3. Remove the screws holding the line filter by removing 4 screws on the side of enclosure, and and move to the outside of the enclosure. Note that there are 2 lengths; the top screws are shorter.



4. Remove the 2 phillips screws and 2 allen screws holding the PCB in place. The stiffener bar held in place by the allen screws will be used on the replacement PCB.



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

5.3.4 Motherboard

Removal of the Motherboard requires that you first remove the CPU Daughter Card and the CPU Power PCB, move the line filter out of the way, and then remove the Memory Power PCB and the CPU Fan Pack.

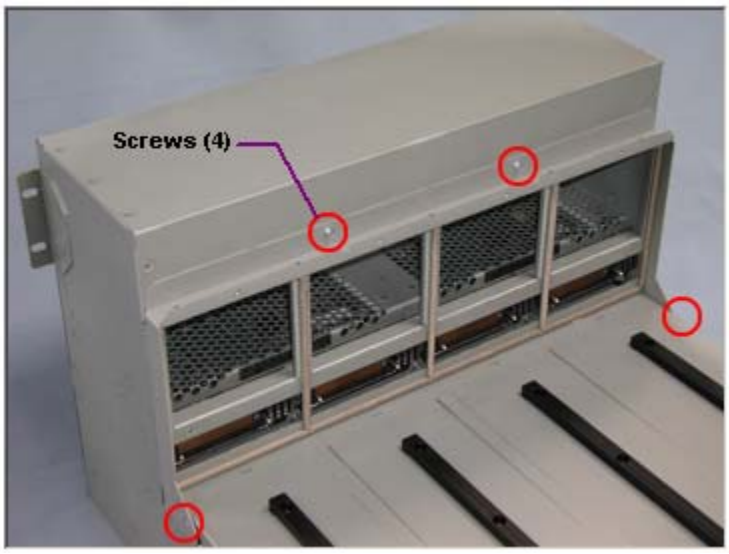
The Motherboard can then be removed. There are two (2) nuts and eight (8) screws securing the Motherboard to the enclosure. Do not remove any other screws! Removal of other screws will loosen or remove the stiffener, and damage to the Motherboard may result.

5.3.5 LVDS I/O Power and Distribution Board

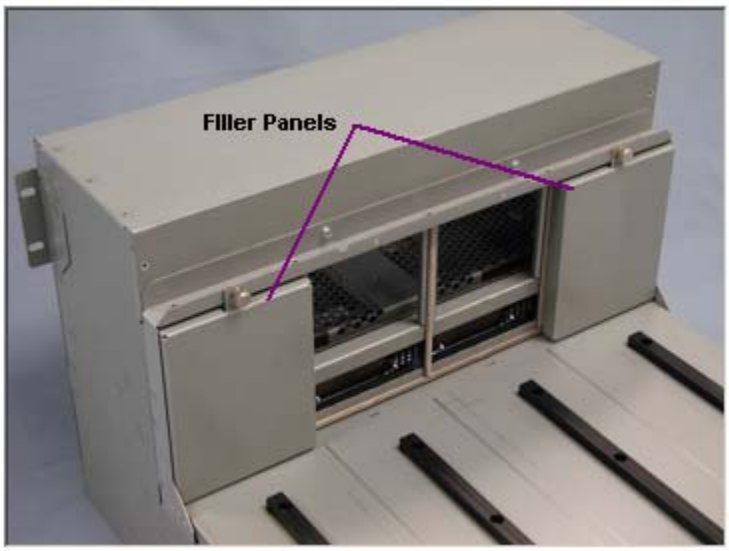
1. At the rear of the cabinet, remove the PCI power supplies (CRUs) from the PCI console shelf.

2. Remove the PCI console shelf and place it on a flat surface. (FRU)

3. Remove the four screws securing the EMI shield. (two of the screws are on the side).



4. Remove the filler panels from the expansion I/O enclosure slots, if present in an ftServer 5240 system.

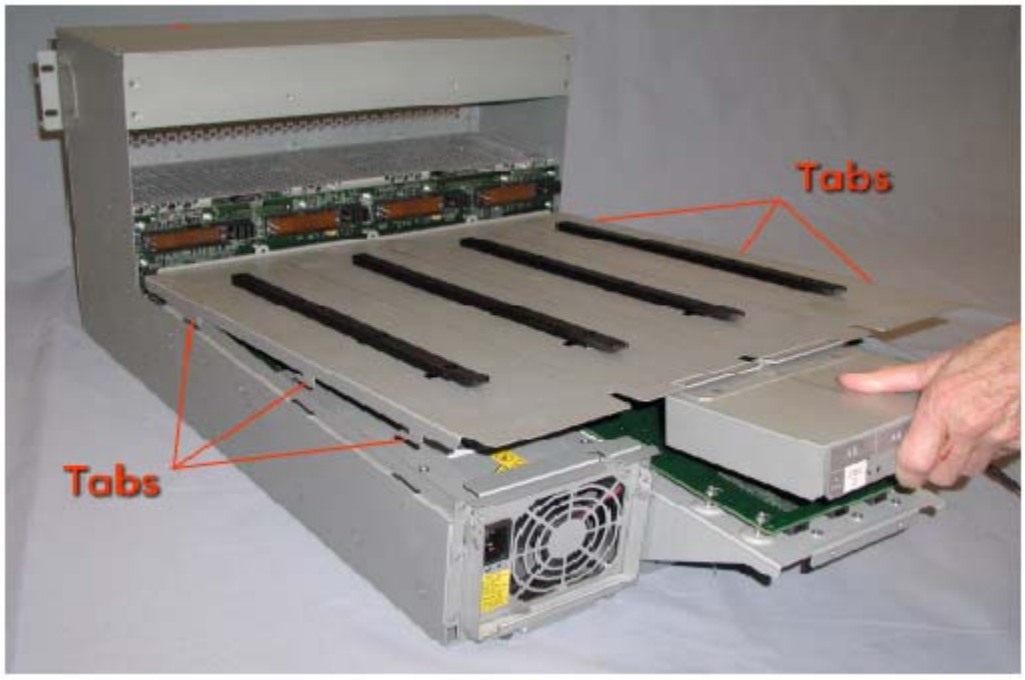


.

5. Remove the clock cards (CRUs).

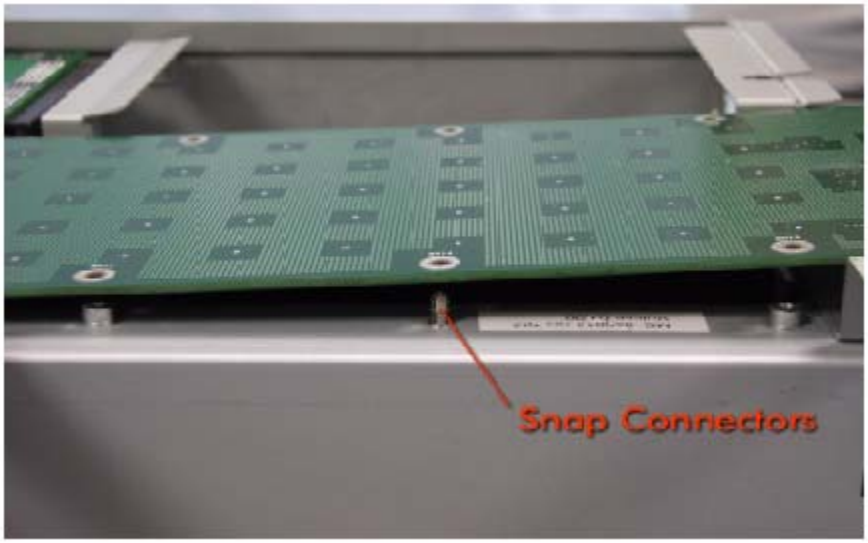
6. Remove the five screws securing the cover over the LVDS I/O Power and Distribution Board.

7. Slide the cover slightly toward the rear to release the tabs and then carefully lift it off.



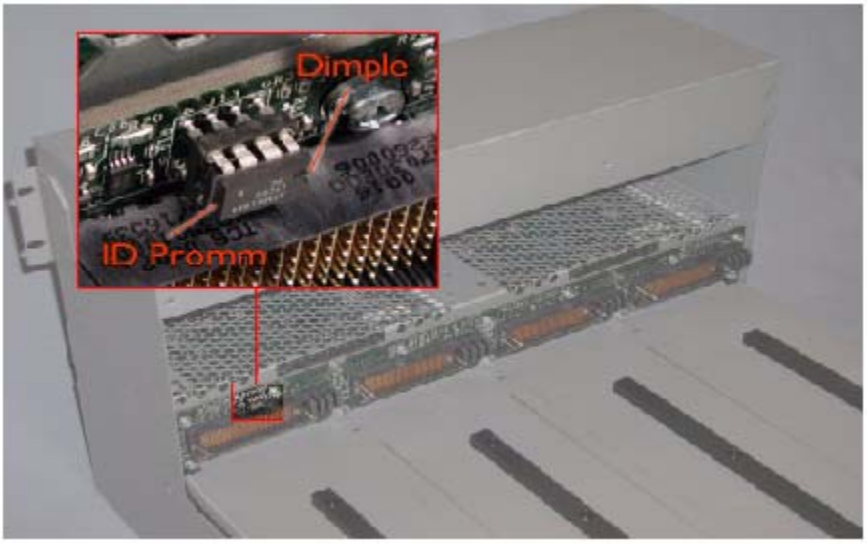
NOTE: The four screws over the CPU-PCI cable connectors are longer than the others.

8. Carefully pull the LVDS I/O Power and Distribution Board up and off the two snap connectors and then remove it.



9. Remove the ID PROM as follows and install it on the replacement LVDS I/O Power and Distribution Board prior to installing the board. (For more information on this procedure, see Stratus alert-1868)

    a. Note the orientation of the ID PROM on the faulty LVDS I/O Power and Distribution Board because it will have to be inserted exactly the same way on the replacement board. (The dimple in the upper right hand corner is on pin 1.)

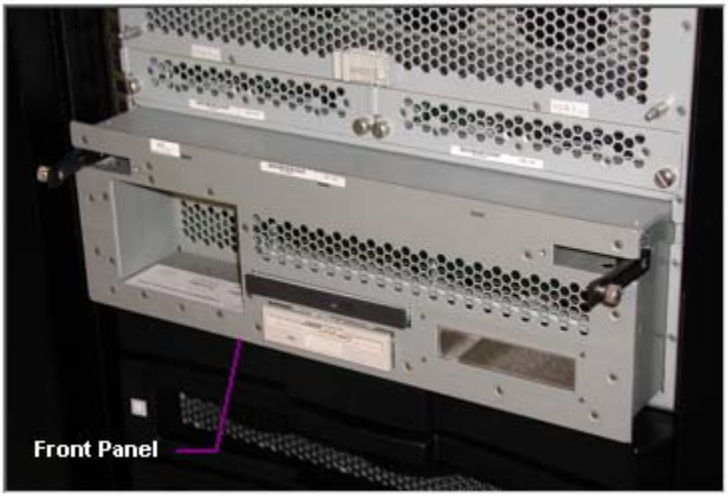


    b. Very carefully pull the ID PROM straight out of its socket, being careful not to bend its pins.

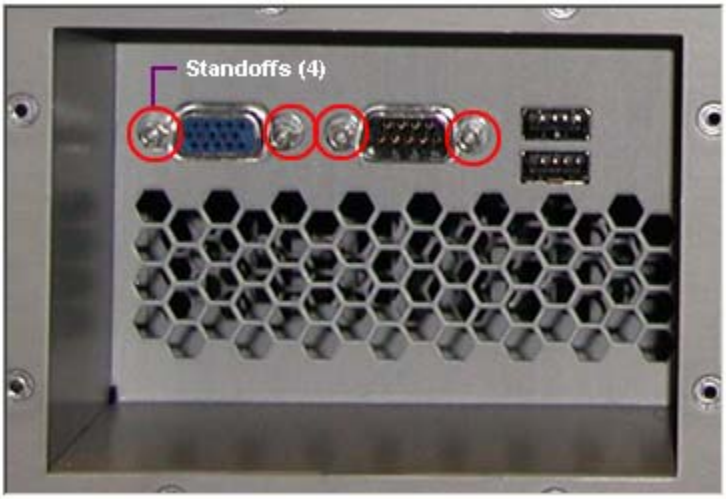
    c. Install the ID PROM on the replacement board, making sure you install it in the same orientation as it was on the faulty board.

5.3.6 Peripherial Bus Interconnect PCB

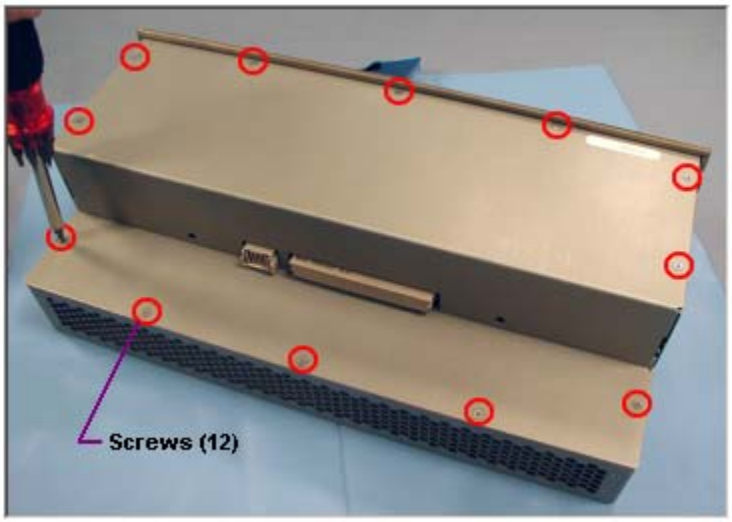
1. Remove the Front Panel (CRU).



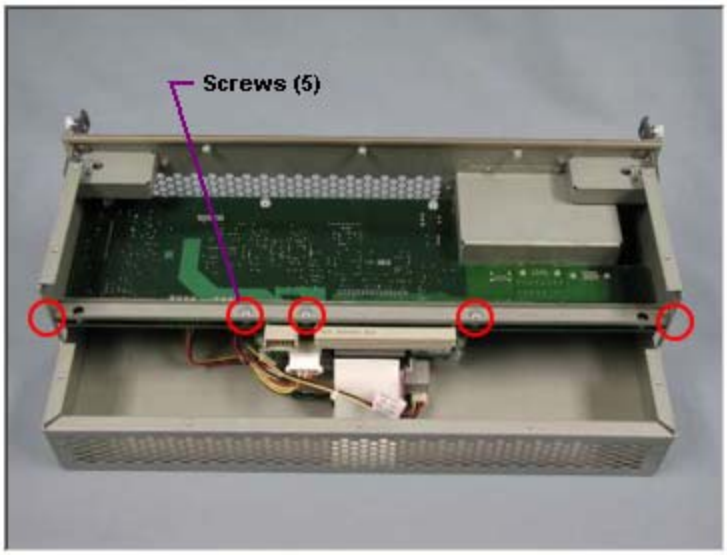
2. At the front of the Front Panel remove the standoffs from the connectors.



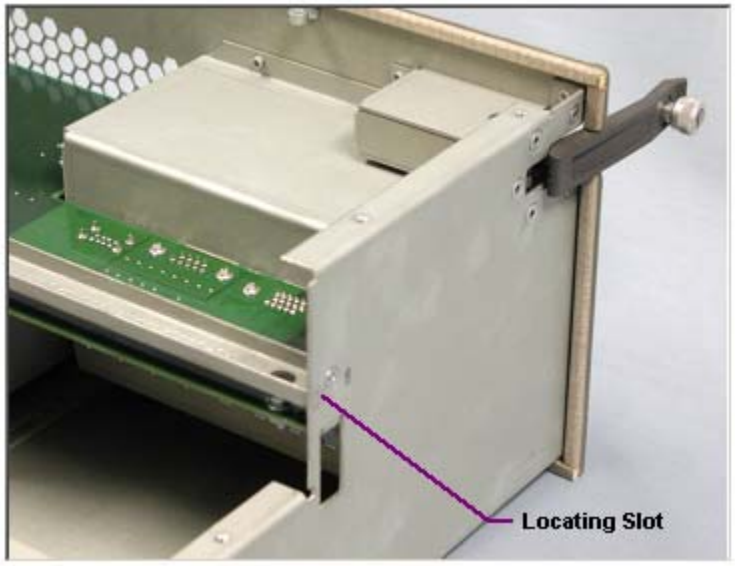
3. Remove the 12 screws securing the Front Panel cover.



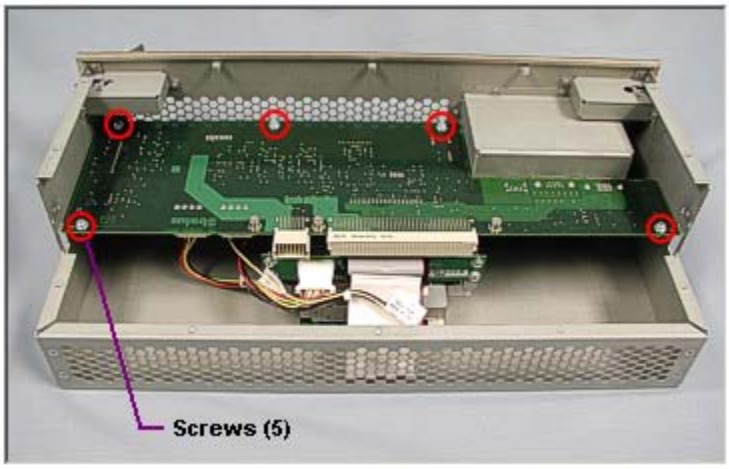
4. Remove the five screws securing the Peripheral Bus Interconnect PCB stiffener (two are on the sides of the Front Panel).



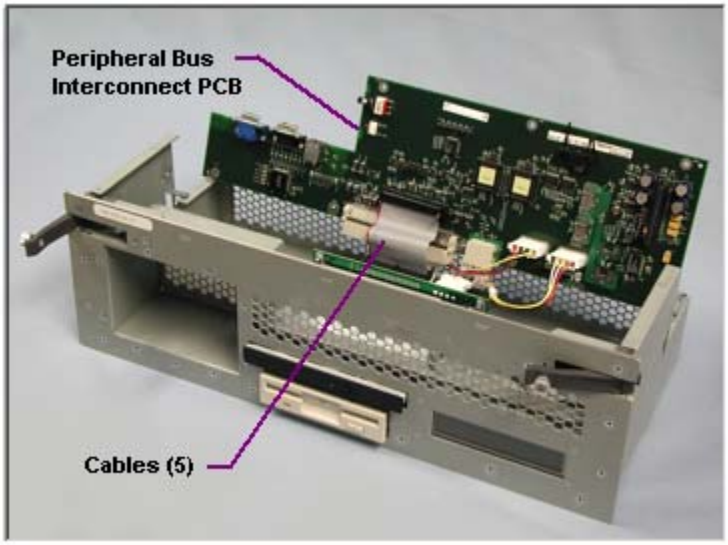
5. Pull the tabs on the board stiffener out of the locating slots on the Front Panel sides. Carefully remove the stiffener.



6. Remove the five screws securing the Peripheral Bus Interconnect PCB.



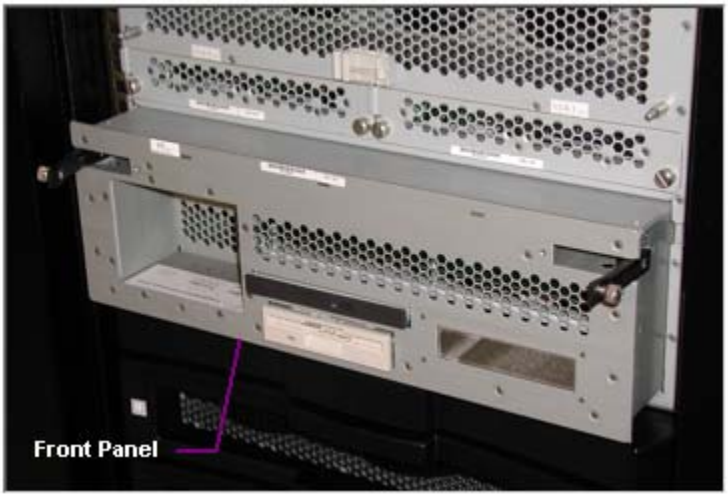
7. Carefully turn the Peripheral Bus Interconnect PCB upward and disconnect all the cables from it.



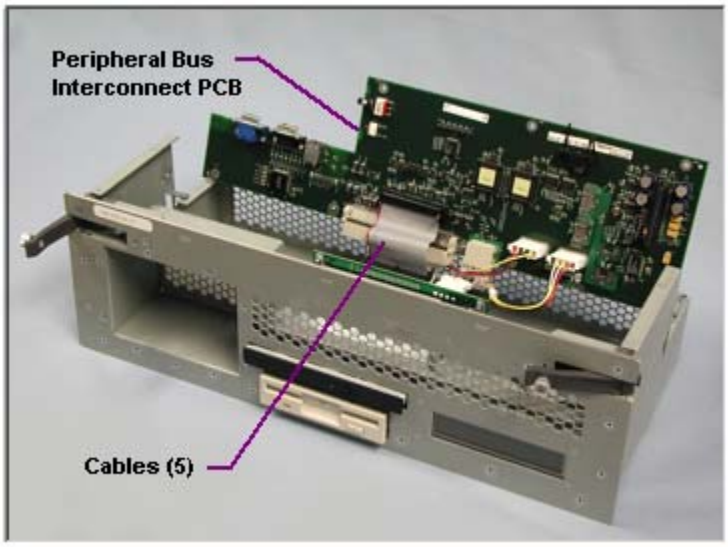
8. Carefully lift the Peripheral Bus Interconnect PCB out of the Front Panel.

5.3.7 IDE Bus CD-ROM Adapter

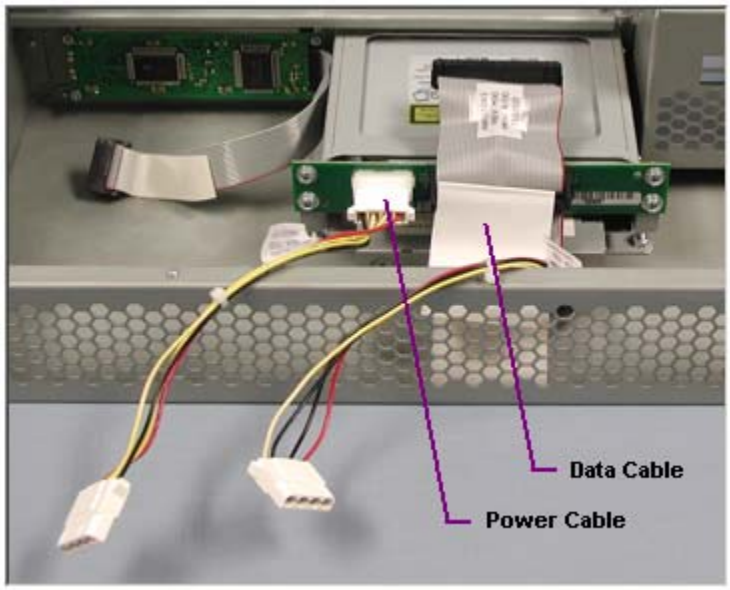
1. Remove the Front Panel (CRU).



2. Remove the Peripheral Bus Interconnect PCB.



3. Disconnect the data and power cables from the IDE Bus PCB.

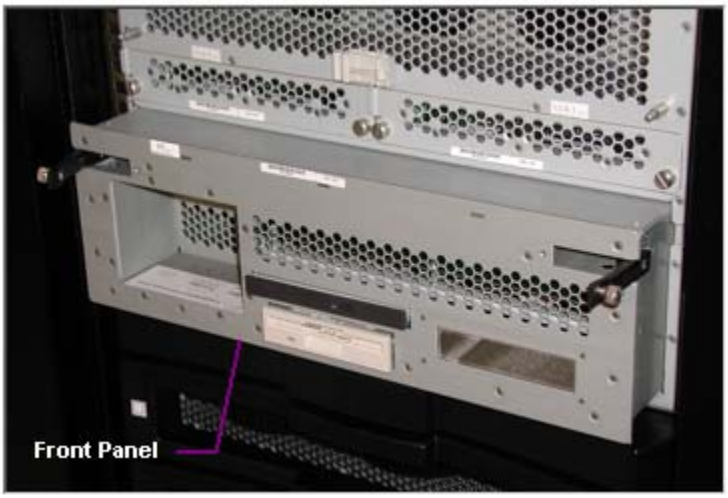


4. Remove the four screws securing the IDE Bus PCB.

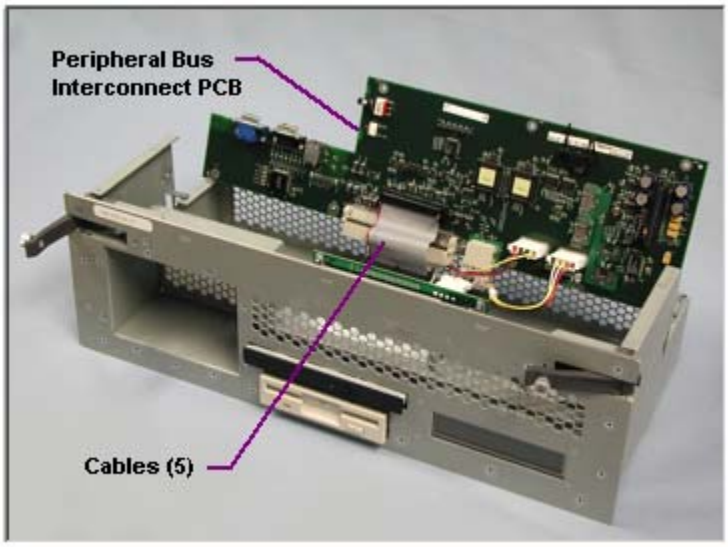
5. Carefully lift the IDE Bus PCB out of the Front Panel.

5.3.8 High-capacity Floppy Drive

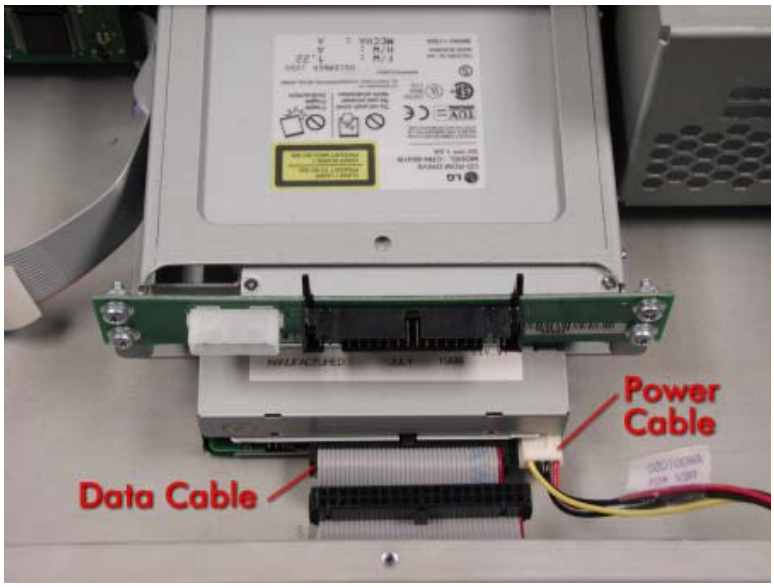
1. Remove the Front Panel (CRU).



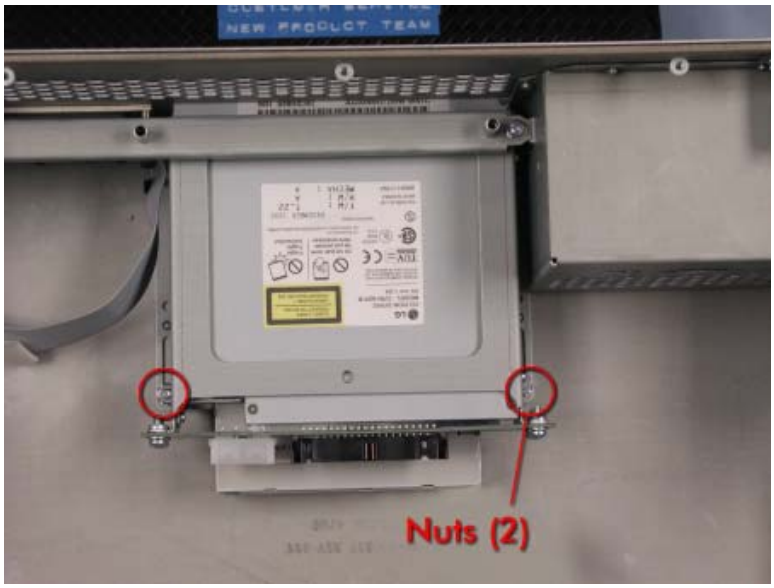
2. Remove the Peripheral Bus Interconnect PCB.



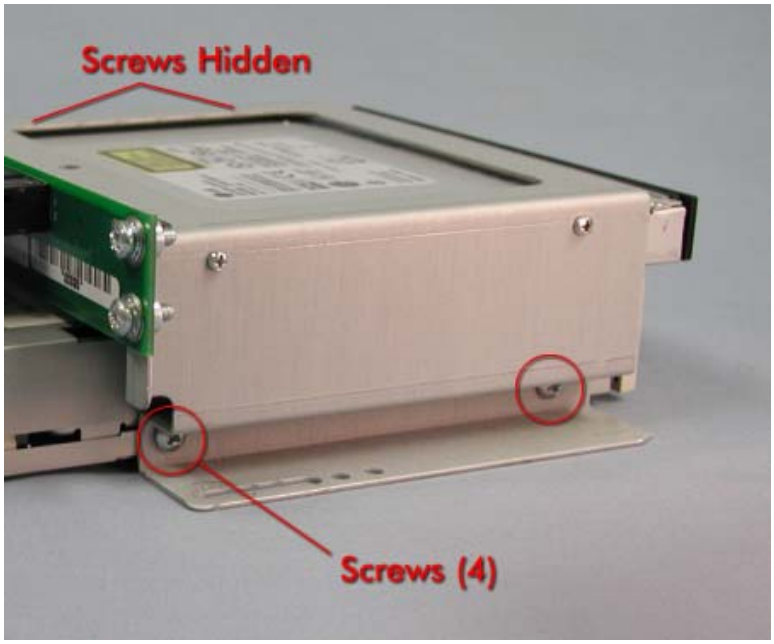
1. Disconnect the data and power cables from the IDE Bus PCB and rear of disk drive.



2. Remove the two nuts securing the disk drive cage to the bottom of the Front Panel. Remove the drive cage.



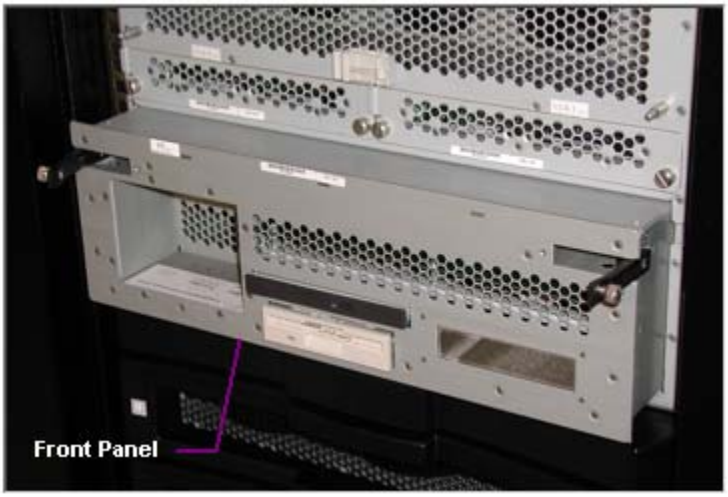
3. Remove the screws securing the High-capacity Disk Drive to the cage.



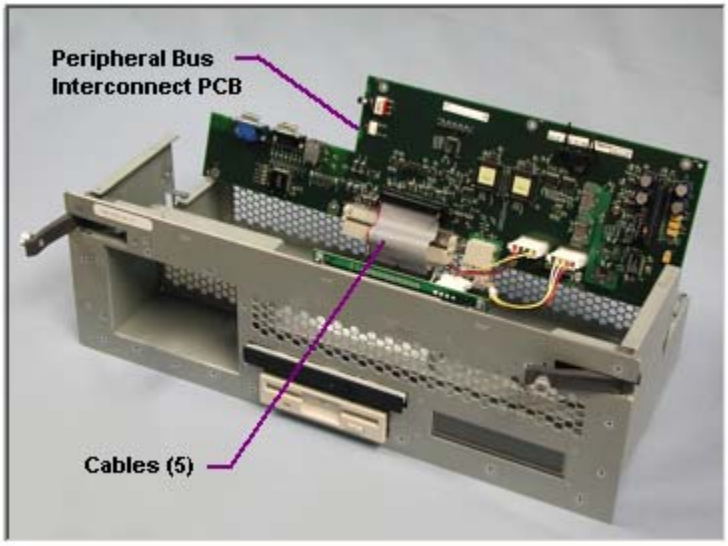
4. Carefully pull the High-capacity Disk Drive out of the cage.

5.3.9 CD-ROM Drive

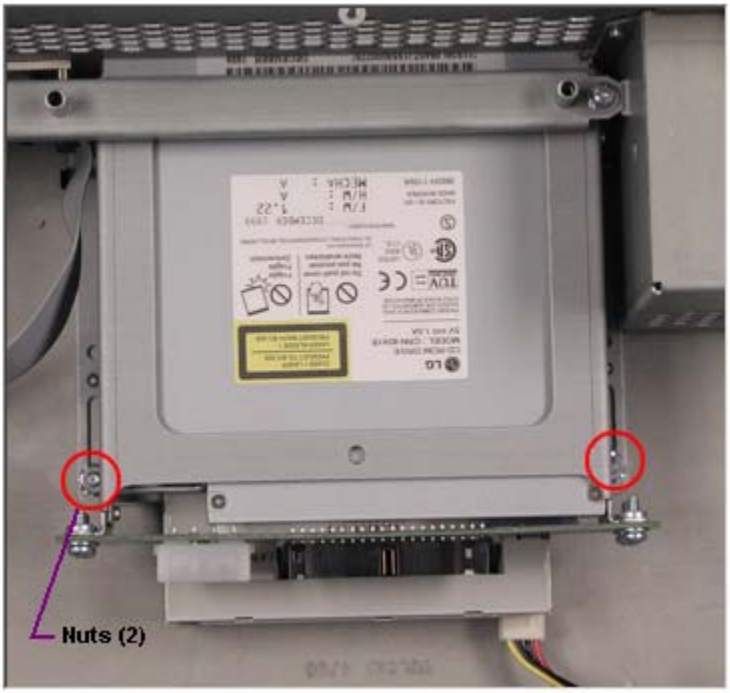
1. Remove the Front Panel (CRU).



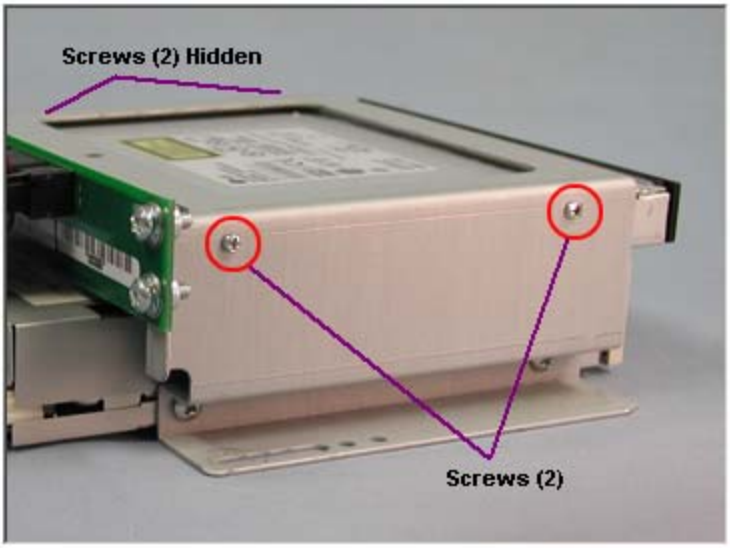
2. Remove the Peripheral Bus Interconnect PCB.



3. Remove the two nuts securing the disk drive cage to the bottom of the Front Panel. Remove the drive cage.



4. Remove the screws securing the CD-ROM drive to the cage.



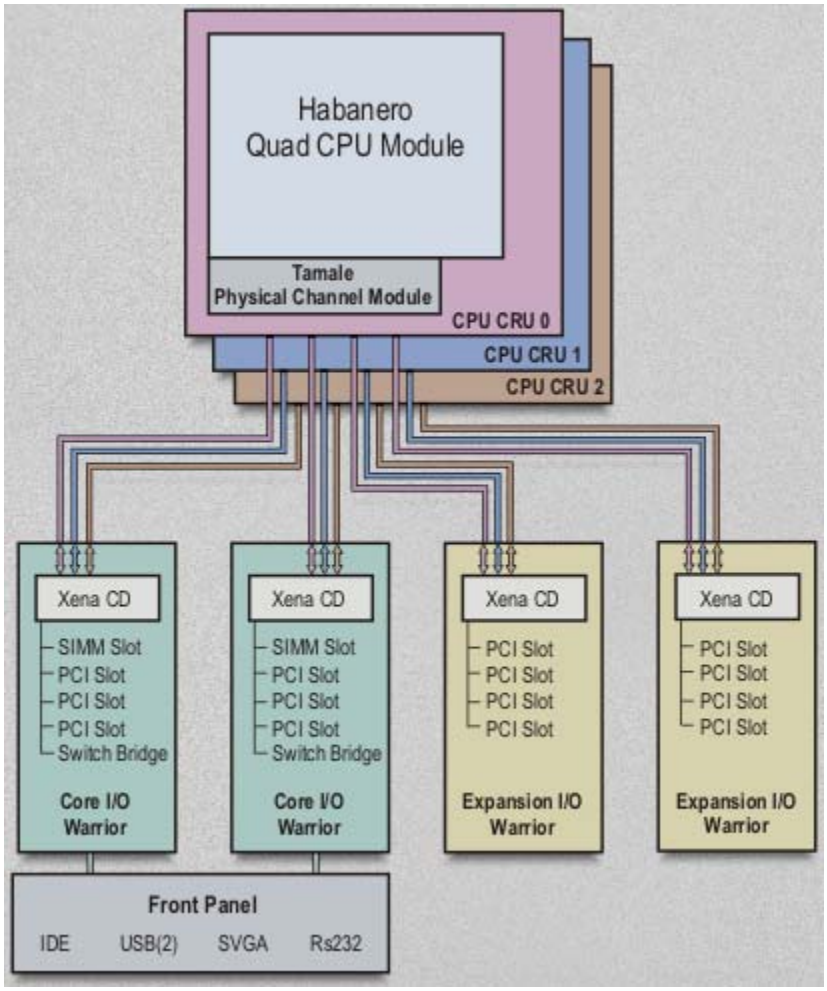
5. Carefully pull the CD-ROM Drive out of the cage.

6. Theory of Operation

This section contains an overview of the theory of operation for the ftServer 5240 and 6500 systems. It provides information on how the system operates and includes a description of each of the following major assemblies/subsystems.

- CPU Enclosure
- PCI Subsystem
- CPU-to-PCI Console Bus
- SCSI Ultra160 Storage Subsystem
- FtStorage Fibre Channel RAID Subsystem
- Tape Subsystem
- Power Subsystem

The following figure is a block diagram of the ftServer 5240/6500 system.



6.1 CPU Enclosure

The CPU enclosure contains 1- or 2-way SMP Intel Xeon DP processors in the ftServer 5240 system and 1-, 2- or 4-way SMP Intel Xeon processors in the ftServer 6500 system.

The ftServer 5240/6500 systems provide scalable fault tolerance supporting Dual Mode Redundancy (DMR), and Triple Mode Redundancy (TMR) using a processor module containing up to four Foster CPU processors.

The Foster processor is the next generation IA-32 processor that is based on a new microarchitecture. The processor maintains full software compatibility with the current IA-32 processors.

The Foster processor uses a new bus architecture that is not compatible with the previous P6 processor family system bus. The Foster processor transfers data four times per 100Mhz bus providing a data bus bandwidth of up to 3.2 GBytes/sec.

Two ASIC devices provide the interface to/from the CPU-to-PCI Console interconnect. One ASIC resides in the CPU enclosure while the other is in the I/O enclosure. Together they form a CPU to PCI bridge which performs voting on the I/O transactions from the lockstepped CPU modules. The north side ASIC in the CPU enclosure is called Buffy while the south side ASIC in the I/O enclosure is called Xena. The Buffy ASIC contains the north PCI core, north-to-south data path and the PCI ordering logic while the Xena ASIC contains the south PCI core, south-to-north data path, ordering logic, data mover, error registers and scatter/gather functionality. Each CPU enclosure contains two Buffy ASICs. Buffy-0 connects to the Core I/O subsystems while Buffy-1 connects to the Expansion I/O subsystem.

The CPU enclosure has the following features:

- 400 MHz Front Side Bus (FSB)
- 200 MHz DDR memory bus – 6.4Gbyte/sec peak
- 1GB to 6GB DIMM memory
- 2.4 Ghz (512KB iL2 cache) processors (ftServer 5240 systems)
- 1.6 Ghz (1 MB iL3cache) processors (ftServer 6400 systems)
- Two and three level caching
- HyperThreading Technology

The major components contained in the CPU enclosure are the following:

- Habanero board (CPU enclosure motherboard)
- Tamale (BIOS, Buffy, Crossbow connection)
- Ancho (240 VAC. to 12 VDC power supply)
- Poblano (DC/DC converters/regulators)
- VRMs (one per processor), shared
- Processors (up to 4 physical parts, each with hyperthreading technology (2x) = 8 logical processors)
- Memory (3 rows of 4 = up to 12 DIMMs)

The GCHE SystemSet is a fourth generation product in Serverwork's Champion ServerSet technology. The GCHE SystemSet is designed to support 100 MHz Foster family processors and

100 Mhz DDR SDRAM memory. The chipset is comprised of four components, they are the Champion Memory and I/O Controller (CMIC), Reliability Enhanced Memory Controller (REMC), Champion I/O Bridge (CIOB30), and the Champion South Bridge (CSB5).

The CMIC interfaces to the Foster front-side bus and acts as the memory controller and I/O interface. The CMIC provides an Inter Module Buses (IMB) operating at 1.6Gbyte/sec and interfaces to the CIOB30 I/O bridges.

The REMC components provide the address and data path to the DDR SDRAM memory. Four REMC devices provide the data path, while the fifth component is used for address and control. The REMC devices provide:

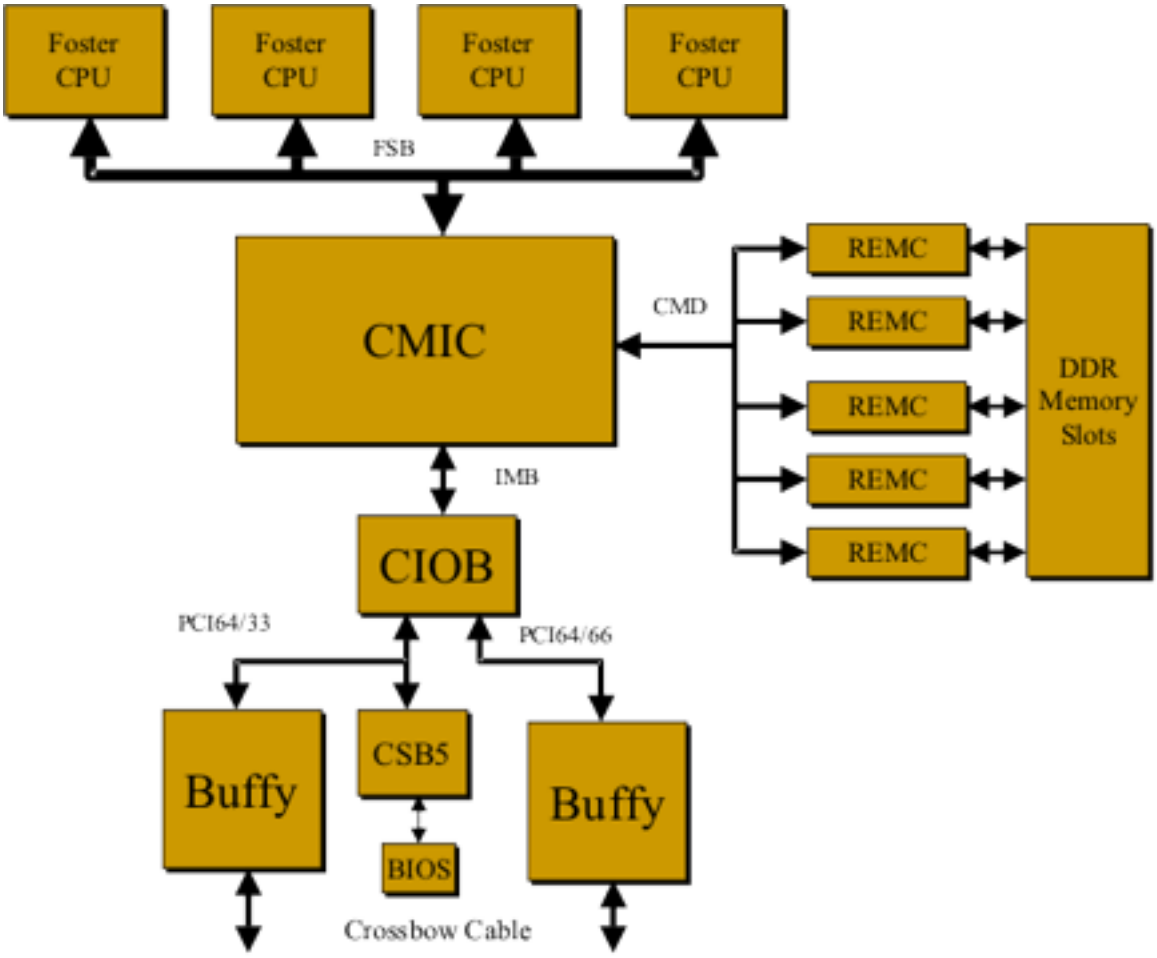
- . 32 Gbyte of memory addressing
- . 288 bit wide data path
- . ECC
- Concurrent read and write access
- Supports x4 and x8 based registered DDR DIMMs

The CIOB is an I/O bridge between the IMB and two 64 bit PCI(X) buses. The CIOB supports speeds of 33Mhz or 66Mhz in PCI mode. The ports are PCI 2.2 compliant.

The CSB5 South Bridge primarily functions as a PCI or Thin IMB to Low Pin Count (LPC) bus. The device connects to any 32 bit 33Mhz PCI bus to subtractive decode the BIOS and XIOAPIC address spaces that are not claimed by the Buffy ASIC. The device also supports the following functions:

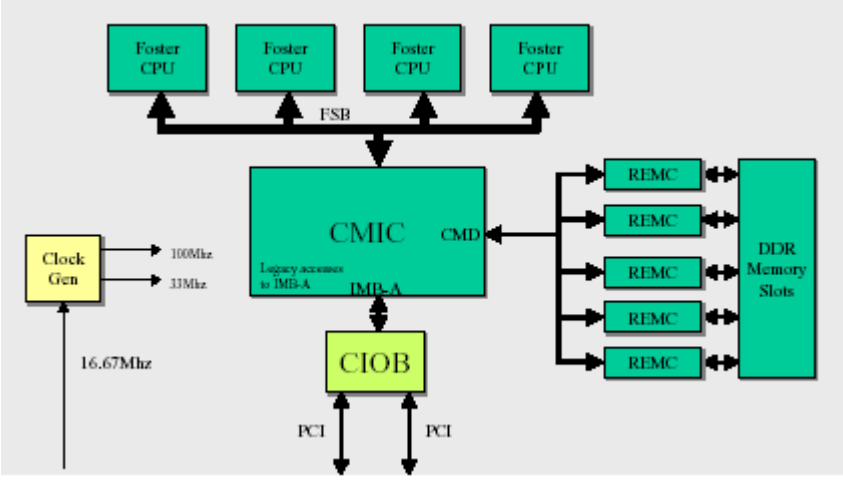
- Seven channel DMA controller
- 8253 counter/timer
- DMA66 (IDE)
- . Enhanced ACPI
- USB
- SMBus
- XIOAPIC and Programmable Interrupt Controller
- LPC port for SIO chip and BIOS interface

The following figure shows the CPU enclosure architecture.



The block diagram of the Habanero quad CPU module is shown in the next figure. This module consists of:

- Four Foster processors
- CMIC memory and I/O interface
- Two CIOB30 PCI-X bridges
- Four REMC data path and one REMC address path devices
- 12 DDR DIMM slots
- Server management logic
- Power Monitoring and Reset logic
- System Clock generator



6.2 PCI Subsystem

The major components in the PCI subsystem are contained in the PCI console shelf, which consists of the following components:

- LVDS I/O power and distribution board
- Front panel
- I/O enclosures (2 core/2 expansion)
- Clock cards (2)
- Power supply units (2)

6.2.1 LVDS I/O Power and Distribution Board

The LVDS I/O Power and Distribution board provides the interconnection between the CPUs and the other components in the console (clock cards, front panel, I/O enclosures). It interfaces with the CPUs via two or three CPU-to-PCI console bus cables.

The LVDS I/O Power and Distribution board contains the system ID PROM.

The LVDS I/O Power and Distribution board is supplied 12 VDC by the 450-watt power supply.

6.2.2 Front Panel

The front panel supports an Ultra2 SCSI-based IDE CD-ROM drive and an optional IDE-based high-capacity floppy drive that supports both floppy and 120-MB floppy cartridges.

The peripheral interconnect bus is a front panel board that performs the bus isolation to the front panel peripheral devices and houses the system ID PROM. It also contains the I2C bus and the front panel LCD. The I2C subsystem includes an A and B bus, which are used to monitor the system and to control certain aspects of the system. For the front panel, the I2C polls the front panel IDPROM and controls the LCD.

The LVDS backplane supplies the 12 VDC power to the front panel.

The buses going into the front panel are duplexed, and the outputs from the front panel are simplexed. These buses include the following connectors to attach peripheral devices:

- USB port (2) - for mouse, keyboard, other optional devices
- Serial port - for debug
- VGA port - for monitor
- IDE port - for CD-ROM drive and high-capacity floppy drive

6.2.3 I/O Enclosure

ftServer 5240 systems support two core I/O enclosures and two optional expansion I/O enclosures. ftServer 6500 systems support two core I/O enclosures and two expansion I/O enclosures. The core I/O enclosures are labeled 10 and 11. The expansion I/O enclosures are labeled 12 and 13. The slots within each enclosure are labeled 0, 1, 2, and 3.

The core I/O enclosure is unique in that, in addition to four 32-bit/33-MHz hot-plug PCI slots, it contains a PCI compatibility bridge to ISA to support legacy I/O. It's PCB has IDE and USB interfaces to front panel devices.

The core I/O enclosure houses the ftServer Access adapter, which contains the VGA interface and communicates with a front panel device through the core I/O enclosure.

Each core I/O enclosure can support four 5-volt PCI cards. Slot 3 is reserved for the U460 ftServer Access adapter and the U518 differential SCSI adapter should be located in slot 0. The remaining slots are customer configurable.

The expansion I/O enclosure supports four 5-volt 32-bit/33-MHz PCI cards. All slots (0-3) are customer configurable.

6.2.3.1 PCI Adapters

PCI adapters are listed in the following table:

Model	Description
U461	**ftServer Access Adapter (ftSAA)**
U486	**8-port Asynchronous Adapter**
U514	**64bit/33MHz ftStorage Fibre Channel Adapter**
U515	**1-port 10/100BaseTx Ethernet Adapter**
U516	**1-port Ultra2 SCSI Adapter**
U519	**2-port Ultra2 SCSI Adapter**
U521	**2-port Ultra160 SCSI adapter**
U570	**1-port 1000BaseSx Ethernet Adapter**
U571	**1-port 10/100Base-T Ethernet Adapter**

U461 ftServer Access adapter

Each PCI core chassis houses a ftServer Access adapter. The ftServer Access adapter is a Web-based interface that allows an authorized person to remotely control, monitor, and diagnose problems on ftServer 5240/6500 systems. It can call home if the ftServer 5240/6500 server crashes; that is, the ftServer Access adapter automatically contacts the Stratus Support Network (SSN) if the server crashes. The card enables an authorized person to access the ftServer 5200 console and keyboard remotely through the SSN or a local network, providing access that is independent of the states of the host power and operating systems. The ftServer Access adapter also implements the Stratus System Controller (SSC), which a central part of the Maintenance and Diagnostics subsystem of a ftServer 5240/6500 system.

The ftServer Access adapter can operate independently of the host system because it contains its own processor and memory, and it has access to a backup power supply for housekeeping power (receives constant 5VDC input). The ftServer Access adapter contains its own Motorola ® PowerQUICC ® processor, an integrated PowerPC ® microprocessor and peripheral controller. It also contains 16 MB of parity-protected Synchronous Dynamic Random Access Memory (SDRAM). The ftServer Access adapter includes subsystems for video, monitoring, and power.

The ftServer Access adapter supports dual independent I^2C bus connections, UART and debug ports, network/telecommunication interfaces including a local 10/100 connector with pass-thru functionality. It also implements the system's VGA subsystem as well as providing a real time clock, NVRAM for logging OS state, and local voltage/temperature sensing capabilities. The I^2C bus is a 2-bit standard serial interface to all the boards which allows the ftServer Access

adapter to obtain their status. It also allows the adapter to power on and off components in the system.

Each ftServer 5240/6500 system requires two ftServer Access adapters for fault tolerance. One ftServer Access adapter must reside in slot 3 in one core I/O enclosure; the second ftServer Access adapter must reside in slot 3 of the second core I/O enclosure. If one ftServer Access adapter fails or is removed, or if the core I/O enclosure that contains the ftServer Access adapter is removed, the second ftServer Access adapter detects the problem and takes over monitoring the server. The ftServer Access adapter cannot reside in an expansion I/O enclosure.

The ftServer Access adapter contains a reset button, which is intended primarily for debugging.

> **WARNING:** The U461 ftServer Access adapter contains a battery. Do not remove the battery. Danger of explosion exists if the battery is incorrectly replaced. Replace only with the same or equivalent type of battery recommended by the manufacturer. Dispose of used batteries according to the manufacturer's instructions.

U514 Fibre Channel Adapter

The U514 is a Qlogic 2200/33 64bit/33MHz fibre channel card with one external HSSDC copper connector (or a Qlogic 2300 fibre channel card 64bit/66MHz). This card can support one Eurologic Channel storage enclosure.

The U514 is a standard PCI card that conforms to PCI Local Bus Specification 2.2, Sbus-IEEE 1496-1993. Power consumption for the card is <2 Watts.

U515 1-port 10/100BaseTx Ethernet Adapter

The U515 Ethernet PCI adapter is a single-port, Intel ® Network Interface Card (NIC), based on the Intel 82559 Local Area Network (LAN) controller. The U515 supports 10BASE-T and 100BASE-TX Ethernet network topologies for data rates of 10 and 100 megabits-per-second (Mbps) with a data-path width of 32 bits. It uses auto-negotiation and/or automatic sensing to automatically select half- and full-duplex line speeds of 100BASE-TX or 10BASE-T. The U515 contains 6 kilobytes of on-board memory. It uses standard RJ-45 Category-5 unshielded twisted pair (UTP) cable connections.

The U515 ethernet adapter can reside in a core I/O enclosure or an expansion I/O enclosure.

U516 QLA1080 SCSI Controller

The U516 QLA1080 SCSI controller is a single-port Ultra 2 SCSI adapter (HBA) board manufactured by Qlogics.. The QLA1080 is configured as a single-initiator supporting tape drive operation. This means that a single controller is connected to a SCSI bus. Each QLA1080 can support two tape drives.

The QLA1080 has a 64-bit Direct Memory Access (DMA) bus master. Its Instruction Set Processor (ISP) chip provides intelligence and high performance by combining a Reduced Instruction Set Computing (RISC) processor, a SCSI executive processor (SXP), and a peripheral component interconnect (PCI) local bus.

The QLA1080 supports transfer rates up to 80 MB/sec of Ultra2 Low Voltage Differential (LVD) Signalling. It is compatible with SCSI-2, SCSI-3, Ultra SCSI, and Ultra2 SCSI peripherals. The card supports both 32-bit and 64-bit PCI buses at 33 megahertz (MHz).

The U516 can reside in a core I/O enclosure or an expansion I/O enclosure. If two are used, they should reside in different chassis.

The SCSI ID of the U516 is 7.

U525 and U526

The U525 and U526 are Optical Fibre Channel PCI adapters used for connection to EMC Clarion and Symmetrix RAID storage systems.

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

The U526 provides a 2-Gb direct attachment to the storage system.

Each optical 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.

6.2.4 Clock Card

There are two clock cards in the system. One is the master, the other is a slave. Each has clock drivers that drive clocks to half the system. A failure of a clock buffer on either card will shut down ½ the system. A failure of the master oscillator will crash the whole system. Each card is capable of being used as a master, so there is a redundant oscillator shipped with every system. The A position is the slave. It supports CPU enclosure 1, core I/O enclosure 11, and expansion I/O enclosure13. The B position is the master. It supports CPU enclosures 0 and 2, core I/O enclosure 10, and expansion I/O enclosure 12. The cards are auto configured by position.

The clock cards have 5V standby power for the LED. The LVDS backplane supplies the 12V power to the clock cards.

6.2.5 Power Supply Unit

Power is supplied to the PCI console through two two 450-watt power supply units, which are labeled A and B. Each power supply receives AC input and outputs 5 VDC, 3.3 VDC,12 VDC, and -12 VDC power for a core and expansion I/O enclosure.

6.3 CPU-to-PCI Console Bus

The CPU-to-PCI console cables connect the CPU enclosures to the PCI console shelf via the CPU-to-PCI console bus, which utilizes LVDS technology to transmit and receive data. Each CPU enclosure has one connection to each I/O enclosure. The CPU-to-PCI console cables are labeled 0, 1, and 2.

Each core ASIC in the CPU enclosure interfaces to two ASICs in the PCI console over half of the CPU-to-PCI console bus, which consists of point-to-point LVDS links, forming two separate PCI-to-PCI bridges. The point-to-point links are uni-directional, 32 bits wide, and operate at 66 MHz

These PCI bridges connect to their counterparts across the CPU-to-PCI console bus, one to the Core 0 I/O enclosure and the other to the Core 1 I/O enclosure. The core ASIC 0 link feeds a

LVDS receiver/transmitter pair as does the core ASIC 1. The core ASIC passes the I/O interrupts and the Intel sideband signals from the core I/O enclosure through the CPU-to-PCI console bus. The Intel sideband signals are a set of signals that are used in legacy Intel architecture. These signals originate in the I/O subsystem and need to be passed to the processor for compatibility purposes.

The CPU-to-PCI console bus is source synchronous. This means that the clock used to transmit the data is also sent with the data. The data is then clocked into the receiving device using the transmitted clock. The data must then be re-synchronized to the local receive clock.

Each expansion ASIC in the CPU enclosure interfaces to two ASICs in the PCI console over the other half of the CPU-to-PCI console bus. This 443GX AGP/PCI bus supports 32-bit, 66Mhz transactions and is Rev 2.1 compliant. The expansion ASIC-to-PCI console ASIC PCI bridge reconfigures the 32-bit, 66-MHz PCI into a 64-bit, 33-MHz PCI in the expansion I/O enclosure to support the four 64-bit, 33-MHz expansion slots. The 66-MHz PCI clock for this bus is generated by the 443GX.

6.4 SCSI Disk Subsystem

6.4.1 Ultra160 SCSI Storage Enclosure

The major component in the disk subsystem is theUltra160 storage enclosure, which is installed in a 19-inch rack mount configuration. It consists of the following major components:

- I/O modules - Carerra Cluster Enclosure Services Module (CCESM) and Joiner Module (JM)
- Power Supply Module (PSM)
- Advanced Cooling Module (ACM)
- Enclosure LED Module
- Disk Drives (up to 14)

The CCESM provides four primary functions for the system enclosure. It serves as a SCSI bus pass through from external cabling to the internal busses. Second it terminates the end of the bus in joined mode. Third, the CCESM provides monitoring, reporting, and control of the system storage enclosure. The CCESM reports status and receives control information via the SCSI bus per the SCSI-3 Enclosure Services specification. And finally, the CCESM supports enclosure clustering capabilities. When a CCESM 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 CCSEM 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 CCESM 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 CCESM module has 5 LED indicators and two external SCSI connectors. The CCESM 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 CCESM 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. The Bus A and Bus B LEDs show which bus each connector is associated with, e.g., in single (joined) bus mode both Bus A LEDs will be on, and in dual (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 CCESM is hot-swappable in a split bus configuration.

The Joiner I/O module is used in the joined bus configurations only. It joins the two individual physical SCSI buses within a single enclosure to effectively make it a single SCSI bus. There are no active components (i.e. terminators, ES processor etc.) used on the joiner module. It simply completes the connection of the two physical buses without any SES functionality, termination functionality or IO functionality.

The Ultra160 SCSI enclosure consists of two Power Supply Modules (PSM). 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 (ACM). Each of the ACM units contains two variable speed 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 Ultra160 SCSI enclosure has two ACMs, each containing two variable speed fans providing a total of four fans. 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 table below 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.

	Description	Color	Indication
LED 1	**Enclosure Power On**	**Green**	**Normally ON indicates power is applied to the enclosure. OFF indicates no power is applied.**
LED 2	**SCSI Bus Split/Joined**	**Green**	**When on the Green LED indicates that the SCSI bus is Split, when off the bus is joined.**
LED 3	**Enclosure Fault**	**Amber**	**Normally OFF indicates no faults exist in the enclosure. ON indicates that the 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 CCESM module controls

There are 4 LED scenarios that define the state of the drive. They are listed in the following table:

State of Disk	LED Indication	Condition
INITIALIZED and MIRRORED	**Green**	**Set**
INITIALIZED but NOT MIRRORED	**Amber**	**Set**
UNINITIALIZED (Good but novolumes or partitions)	**Blinking Green 500 ms on, 500 ms off**	**N/A**
BROKEN	**Blinking Amber 500 ms on, 500 ms off**	**Set**

6.4.2 SCSI Bus

The SCSI backplane supports two system configurations:

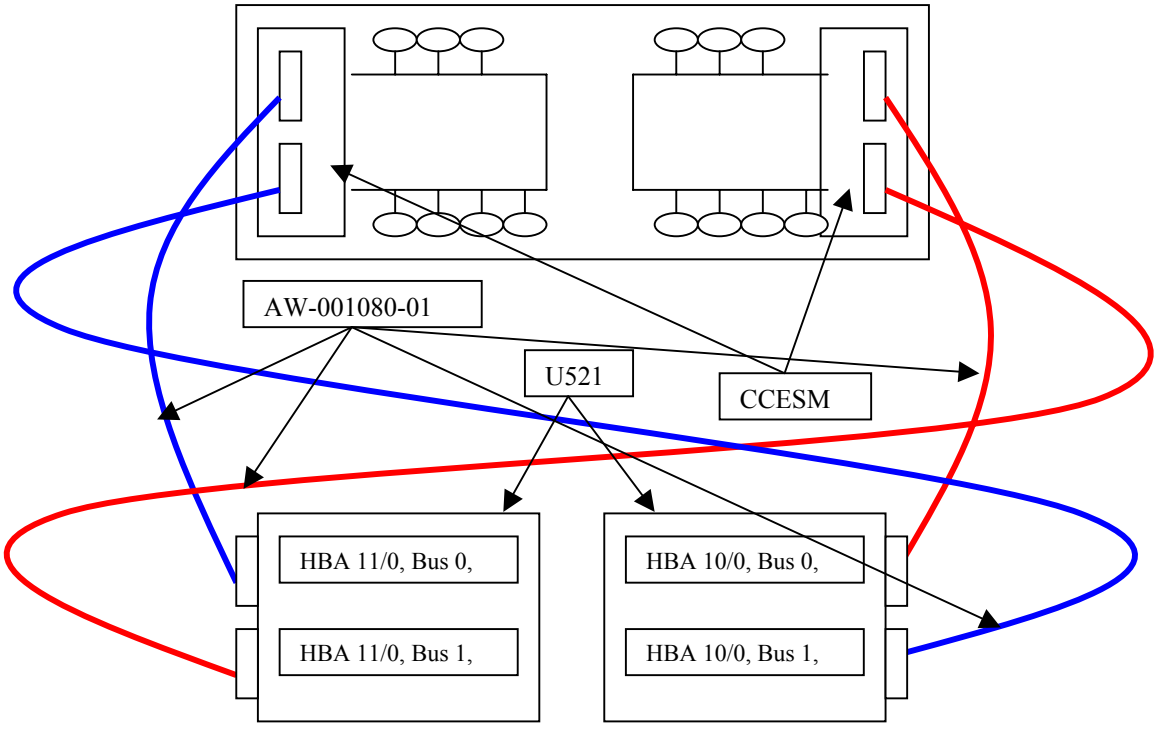
- Split bus
- Joined bus

6.4.2.1 Split Bus

The **split (or dual)** bus configuration consists of two virtual, independent, dual initiated SCSI buses. It requires both I/O modules to be CCESMs. 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 CCESM (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 CCESM via SCSI cable, one from the CCESM through the internal SCSI bus back to the CCESM, and one from the CCESM 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.

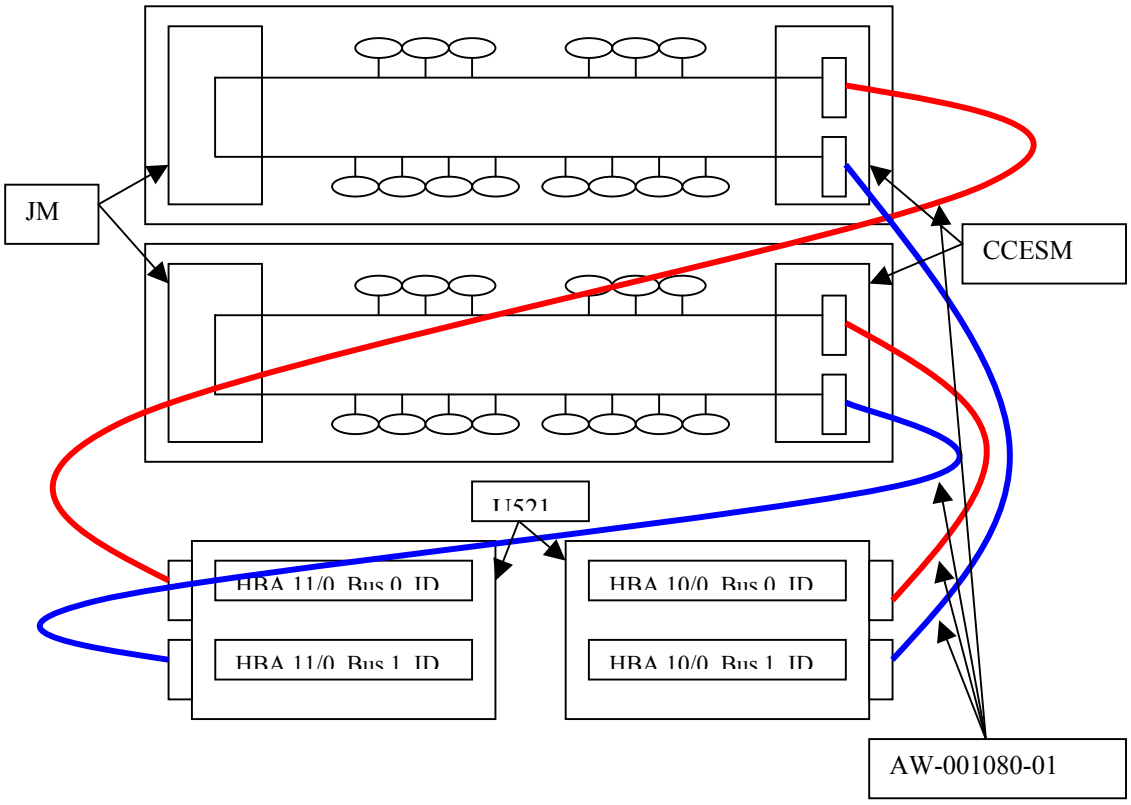
The following figure shows how the SCSI controllers are connected in a split bus configuration.



6.4.2.2 Joined Bus

The **Joined (or single, or straight)** bus configuration consists of a virtual, single, dual initiated SCSI bus. It requires one I/O module to be a CCESM and the other I/O module to be a JM. There are two SCSI bus connections on the CCESM, one for each Host Bus Adapter (HBA). In this configuration two enclosures are required to achieve mirrored redundancy. SCSI IDs available for disks are 0 through 6 and 8 through 14. A slot needs to be sacrificed (SCSI ID slot 6) in a dual initiated configuration to accommodate HBA ID 6 (where ID 15 is the ESM and IDs 6 & 7 are the HBAs). SCSI ID 7 has already been designed into the backplane as reserved. A locking slot blocker is used in the slot pertaining to SCSI ID 6 to prevent an end user from inserting a disk drive into the given slot.. In this configuration there are actually three separately terminated buses (one virtual bus) per enclosure, one connecting from one HBA to the CCESM via SCSI cable, one from the CCESM through the internal SCSI bus back to the CCESM, and one from the CCESM to the other HBA via SCSI cable. Each HBA port (two per card) also supplies termination and termination power. The internal physical bus is terminated separately and the two external physical buses are terminated separately.

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



6.4.3 SCSI ID Slot Assignments

Split Bus – 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

Joined Bus – 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	**X**	5	4	3	2	1	0

X = SCSI ID 6 conflicts with HBA SCSI ID 6 therefore slot cannot be used and requires blocker.

6.5 ftStorage Fibre Channel (FC) Array

The ftStorage Fibre Channel (FC) Array is the Stratus RAID (Redundant Array of Inexpensive Disks) ftServer option. ftStorage FC array provides fully redundant, rack-mountable fibre-channel storage that can accommodate up to 42 Fibre Channel drive slots. It includes:

- The D570 ftStorage Fibre Channel Array Enclosure - supports up to 14 hot-pluggable disk drives.
- Optionally, one or two daisy-chained D580 ftStorage Fibre Channel Array enclosures. Each D580 contains up to 14 hot-pluggable disk drives. Both enclosures support 36-GB (10K-rpm) and 73-GB (10K-rpm) Fibre Channel disk drives.
- Two U514 Fibre Channel PCI Adapters are required to attach an ftStorage FC array to an ftServer system.

The following are the main features of the ftStorage FC array.

- One or two Fibre Channel RAID Controllers
- Redundant, hot swappable AC power supply modules.
- Redundant, hot swappable Cooling System.
- Two redundant LS Modules (Loop Resiliency and SES Module)
- Enclosure Services via in-band SES
- Enclosure events notified through LEDs and audible alarm (with software or manual disable)
- ID switch module to set enclosure ID
- Support for 14 Fibre Channel 1" disk drives
- Dual fibre channel loop support with two LS modules
- 2-GB ready midplane
- Disk drive hot plug supported
- Optional Fibre Channel optical interface support on I/O module

6.5.1 ftStorage Fibre Channel Array Enclosure

The major component in the ftStorage FtServer Fibre Channel arrayis the storage enclosure, which is installed in a 19-inch rack mount configuration. It can accommodate up to 14 1-inch disk drives.

The following subsections describe the components in the Fibre Channel storage enclosure.

The following subsections describe the components in the ftStorage Fibre Channel storage enclosure.

6.5.1.1 RAID Controller

The RAID Controller is a Eurologic FC2500 Series high performance Fibre Channel disk RAID controller, providing one fibre host channel and two fibre disk channels conforming to the Fibre Channel Arbitrated Loop (FC-AL) standards. The logical protocol used for both host and disk communications is 100MB/s Fibre Channel Protocol (FCP) SCSI over fibre.

The RAID controller implements scalable data cache memory on the controller and utilizes 128 MB of ECC protected SDRAM. A single DIMM location accepts Eurologic qualified, 168-pin, 72-data bit, 100MHz, 3.3V, SDRAM DIMMs. Cache memory is also protected by the Battery Backup Unit (BBU).

The RAID controller provides FC_AL host performance and fault tolerant RAID disk operations for Fibre Channel (FC) disk environments. The controller is an intelligent, caching controller that supports RAID levels 0, 1, 3, 5, 0+1, JBOD, 30 and 50. The controller allows multiple hosts to access the array of disk drives, which can be configured as one or more virtual devices (logical units).

The RAID controller permits continuous access to the data in the event of a disk drive failure. The controller also provides continuous access to data in the event of a controller failure. This capability comes with a dual active controller system, using two RAID controllers that share access to the same array of disk drives. In the event of a controller failure, the surviving controller through a *fail-over* process assumes controller operations. The failed controller can then be removed and replaced while the system is still online. The new controller resumes processing array operations in a *failback* process. During fail-over and fail-back, write cache coherency is maintained with the disk drives.

The RAID controller is capable of monitoring a customer provided UPS. The controller fault management features are based on the SCSI-3 Enclosure Services (SES) device interface.

An SES firmware process handles all enclosure fault management. The process polls the environment every ten seconds. Failures with disk drives are handled by the RAID controller firmware with other failures such as fans, power supplies, and temperature sensors being handled directly by the SES device. The controller firmware communicates with the SES device via Send Diagnostics and Receive Diagnostics SCSI commands. The device elements supported by the SES process include: device (disk drive), power supply, cooling, temperature, Enclosure Services, controller electronics, audible alarm, and uninterruptible power supply.

The RAID controller uses the 233MHz Intel SA 110 StrongARM processor and implements separate control store and data cache memory. The control store memory is dedicated to the processor and is located on the processor local bus. The control store memory includes a 32MB 100 Mhz 36-bit parity-protected SDRAM

One 2-MB flash PROM is provided on the controller board for non-volatile storage of the operating program. The SA100 boots from this flash PROM space. The flash PROM device is preprogrammed in manufacturing, but can be updated via firmware download utilities.

6.5.1.2 Advanced Cooling Module (ACM)

Cooling is provided by the two Advanced Cooling Modules (ACMs) located at the rear of the enclosure. Each of the ACMs contain two variable speed fans. The enclosure requires four fans for normal operation, but will operate correctly with one fan failed (redundancy is lost if one fan is failed in either ACM); therefore, it is recommended that the failed fan be replaced as soon as possible.

The storage enclosure provides front to back airflow cooling. The ACMs are hot swappable. Each fan RPM is monitored and each ACM has two amber fault indicators located on the ACM assembly. Within an ACM, each fan receives its own power, control, and I/O independent of the other fan. Fan cabling and logic are fan specific and allow the system as a whole to function as four independent fans.

The ACMs can be hot swapped. The LSM monitors and controls the speed of each fan. The speed is set depending on the ambient temperature and failed status. The fans are set to full speed if one fan is failed. The following table shows how the fan speed relates to temperature change.

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

The ACM accommodates an optional battery back-up unit (BBU) for maintaining memory content in case of an AC power failure. The principle purpose of the BBU is to provide ride-through during a power glitch.

The BBU is designed to work with SDRAM memory, and supports both the processor control store and ASIC cache memory SDRAM. The BBU logic detects power loss on the controller and switches the SDRAM to a self-refresh mode while transparently switching the power input from +5V to battery. The BBU can sustain memory content for at least 72 hours under typical operating conditions.

6.5.1.3 Loop Resiliency and SES Module (LSM)

The Loop Resiliency and SES Module (LSM) is the main monitoring and control device of the ftServer Fibre Channel array. The module reports status and receives control information over the Enclosure Services Interface (ESI) port of any of the fourteen disk drives installed in the enclosure. The LSM also provides loop resiliency for the Fibre Channel loop (in the form of Port Bypass Circuits).

The ftServer Fibre Channel array contains one LSM as standard. However, a second optional LSM is available to provide active/passive fail over for the enclosure services communication, and to provide a second Fibre Channel Loop. Only one LSM communicates (using ESI communication) with the host system at any one time, but both LSMsl continuously monitor the system. If the active LSM fails, then the ESI communication with the host system will be taken over by the passive LSM.

The following are features of the LSM:

- Monitoring/Control for 2 power supplies and 2 ACMs
- Reports status and receives control information via the FC loop
- Microcontroller for data processing, control and communications
- Volatile and non-volatile memory for the microcontroller
- Temperature sensor
- Audible alarm with manual and software disable
- FC link monitoring and status information
- Firmware download capability
- Reporting of PSU, LSM, I/O module, and backplane serial number and revision
- I/O module and backplane type reporting

- Control of 6 front LEDs for enclosure and module status
- I/O option slot status monitoring

6.5.1.4 I/O Module

The I/O module is used to provide device expansion from the RAID controller. It has two HSSDC connectors. The first is the primary FC loop input port and the second is available for Fibre Channel loop expansion/input. A loop back terminator is not required since the I/O module will automatically enable the expansion HSSDC connector when valid Fibre Channel signals are present on the expansion connector.

6.5.1.5 Power Supply Module (PSM)

The FtServer Fibre Channel array has two power supply modules (PSMs) for normal operation, providing redundancy of the power system. The PSMs provide 673 Watts continuous output power and 853 Watts peak output power. They have a universal input voltage range, and active current sharing. Power factor correction, over current and over voltage protection is also provided, along with AC voltage brown-out detection.

6.5.2 Enclosure/Disk IDs

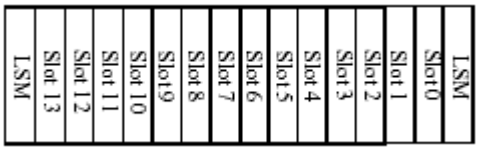
Each of the fourteen disk drive slots in the enclosure has a unique identifier assigned to it. This identifier is assigned using a combination of the slot number and the enclosure ID.

The enclosure ID is set using the enclosure ID switch, which is located on the rear of the enclosure. For Stratus systems the enclosure ID switch can be set to 0, 1 or 2. The D570 (first enclosure) has ID 0, the first D580 (second enclosure) has ID 1, and the second D580 (third enclosure) has ID 2.

Each enclosure must have a separate ID when daisy chained together.

NOTE: The enclosure ID must be set prior to powering on the enclosure.

The following figure shows the slot numbers and locations of the disk drives when viewed from the front of the enclosure.



The fourteen disk drive slots (0 to 13) are assigned an identifier based on the enclosure ID and the slot number as shown in the following table.

Enclosure ID → / Drive Slot ↓	0	1	2
Slot 0	3	18	33
Slot 1	4	19	34
Slot 2	5	20	35
Slot 3	6	21	36
Slot 4	7	22	37
Slot 5	8	23	38
Slot 6	9	24	39
Slot 7	10	25	40
Slot 8	11	26	41
Slot 9	12	27	42
Slot 10	13	28	43
Slot 11	14	29	44
Slot 12	15	30	45
Slot 13	16	31	46

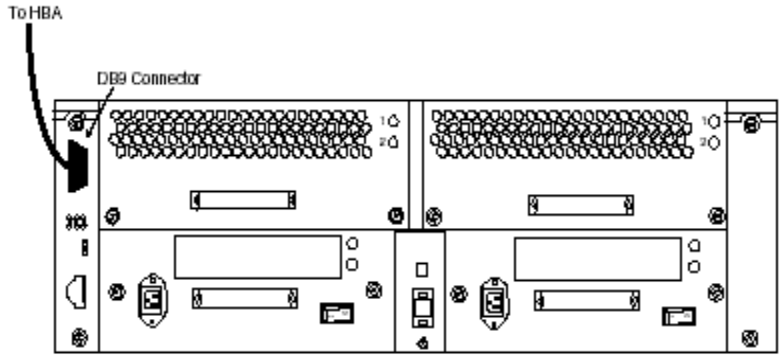
6.5.3 RAID Configurations

There are two main RAID configurations: single RAID Controller and dual RAID Controller (fully redundant).

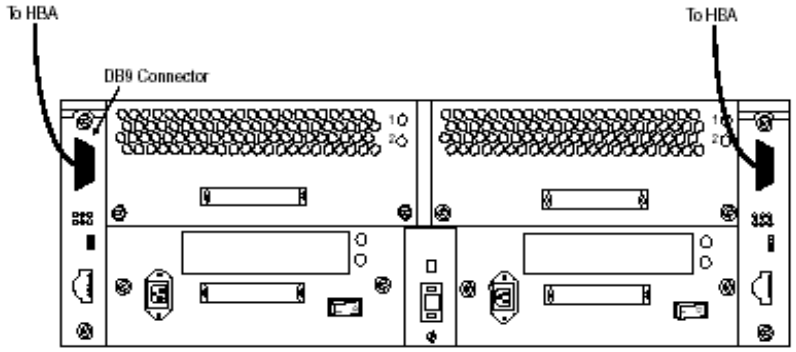
The following subsections describe the possible configurations for single and dual RAID controllers.

NOTE: HBA (host bus adapter) is the U514 adapter.

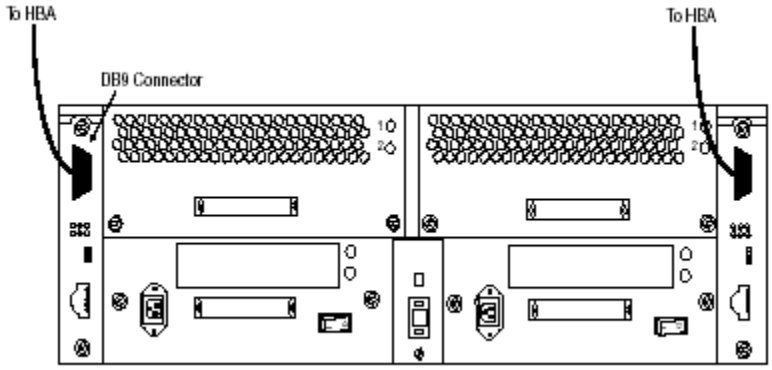
6.5.3.1 Single RAID Controller



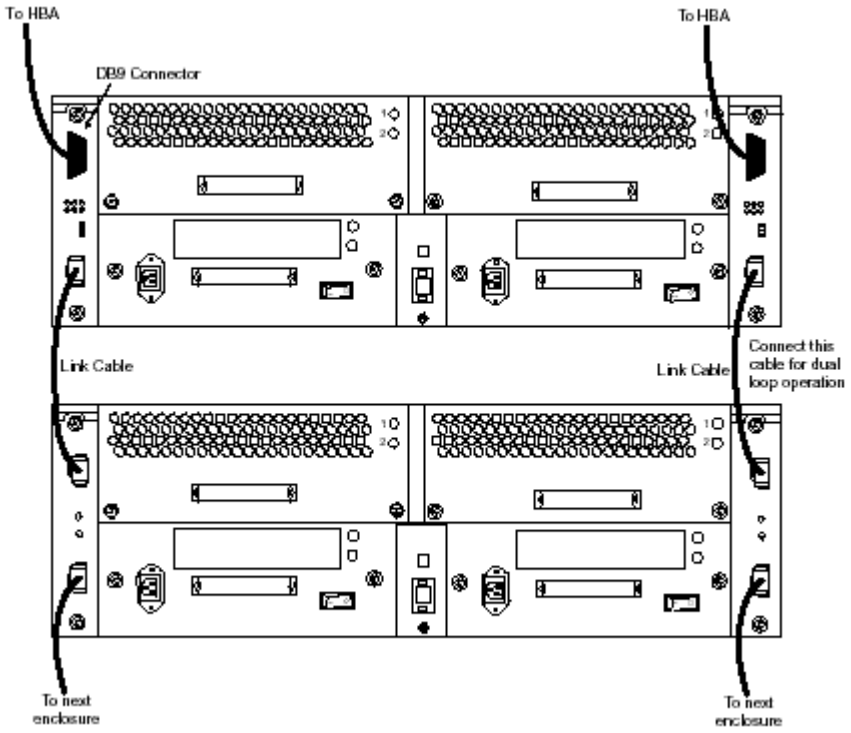
6.5.3.2 Daisy Chained Single RAID Controller



6.5.3.3 Dual RAID Controllers



6.5.3.4 Daisy Chained Dual RAID Controllers



6.6 Tape Subsystem

ftServer 5240/6500 systems support DLT 8000 and DDS-4 tabletop tape drives. No drives are mounted in the storage enclosure. Tape drives are controlled by the U516 QLA1080 SCSI controllers configured as a single-initiators. Each U516 can support two tape drives daisy chained together..

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

6.6.1 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 5240/6500 systems in both a single-cartridge mechanism and a 6 to 8-cartridge magazine autoloader configuration.

6.6.2 DLT 8000 Tape Drive

DLT 8000 is the 4th generation of DLT products. Native transfer speed for the DLT 8000 product is 6MB/s native (up to 10MB/s w/compression). Cartridge capacity is 40MB per cartridge native (80MB 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 5240/6500 systems in both a single-cartridge mechanism and autoloader configurations.

6.6.3 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.

6.6.4 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.

6.6.5 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.

6.7 Power Subsystem

The power system topology consists of multiple integrated AC-DC power supplies. These power supplies are co-located with the major system elements. Due to the overall system redundancy, there is no requirement for an N+1 topology for power within the CPU enclosure or PCI console shelf. The disk shelf has N+1 power because it is a shared system resource. The power for the PCI console shelf is partitioned into A SIDE and B SIDE power. Each side provides power for a core and expansion I/O enclosure.

The power system operates from 180VAC -256VAC**,** 47 to 63 Hz.

The power strips have 250V / 16 amp input circuit breaker protection.

The power cords support 250V / 20A Input

The power connection to the AC mains is made by use of detachable "country cord kits." In the base configurations of a DMR and TMR system, this requires two power cords connected to two independent AC sources and two exclusive branch circuits. A system configuration that consists of a DMR or TMR and a storage expansion cabinet requires four power cords connected to two independent AC sources and four exclusive branch circuits.

The following table shows the power requirements and number of power cords required for various configurations.

SYSTEM CONFIGURATION	CABINET POWER	NUMBER of POWER CORDS
DMR	**2300 W (7,843 BTU / HR)**	**2**
TMR	**3000 W (10,230 BTU / HR)**	**2**
DMR + 3 Fiber Channel Storage	**3500 W (11,935 BTU / HR)**	**4**
TMR + 3 Fiber Channel Storage	**4200 W (14,322 BTU / HR)**	**4**
DUAL DMR	**4600 W (15,686 BTU / HR)**	**4**

7. 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 5200 systems.

7.1 CPU Enclosure

Description	CRU/FRU/DRU	Part Number
1.6 GHz CPU Enclosure (NO MEM OR CPU)	CRU	AA-G91300
256-MB Memory Module	FRU	AA-M86600
512-MB Memory Module	FRU	AA-M86700
PCB, CPU Daughter Card (Tamale)	DRU	AA-E95400
PCB, Motherboard (Habenero))	DRU	AA-G90000
Kit, High Performance 1.6 GHz CPU, Heatsink, clip and VRM	DRU	AK-000388
CPU Fan	FRU	AA-E83800
Assy, Ancho Power CPU Power Supply	DRU	AA-P64000
Assy, CPU, Habenaro Memory Power	FRU	AA-E95500
CPU-to-PCI Console Cable	CRU	AW-020085

7.2 PCI Console Shelf

Description	CRU/FRU/DRU	Part Number
Front Panel	CRU	AA-E83300
PCI Console Shelf Power Supply	CRU	AA-P41000
Clock Card	CRU	AA-E83100
Core I/O Enclosure	CRU	AA-E83400
Core-X3 I/O Enclosure	CRU	AA-E83410
Expansion I/O Enclosure	CRU	AA-E83500
PCI Slot Filler Panel	CRU	F9-000583
ftServer Access Adapter (Catbert II SMM)	CRU	AA-U46010
ftServer Access Adapter (Catbert w/D4)	CRU	AA-U46100
1-port Fibre Channel Adapter	CRU	AA-U51410
1-port Ethernet Adapter	CRU	AA-U51500
1-port Ultra2 SCSI Adapter	CRU	AA-U51600
2-port Ultra2 SCSI Adapter	CRU	AA-U51900

Ultra160 SCSI Adapter	**CRU**	**AA-U52100**
PCB, Intel pro/1000 F Server Adapter 1000base-sx	**CRU**	**AA-U57000**
PCB, Intel pro/1000 T Server Adapter (Copper Gigabit)	**CRU**	**AA-U57100**
PCB, 2-Port Sync Adapter	**CRU**	**AA-U48000**
PCB, 4-Port Sync Adapter	**CRU**	**AA-U48500**
PCB, 8-Port Async Adapter	**CRU**	**AA-U48600**
Ultra160 SCSI 66-inch Cable	**CRU**	**AW-001080-01**
Ultra160 SCSI 178-inch Cable	**CRU**	**AW-001080-02**
CBL, V.35 Sync Cable	**CRU**	**AW-B40000**
CBL, V.24/EIA-232 Sync Cable	**CRU**	**AW-B40100**
CBL, EIA-530 Sync Cable	**CRU**	**AW-B40200**
CBL, V.36/EIA-449 Sync Cable	**CRU**	**AW-B40300**
CBL, V.11/X.21 Sync Cable	**CRU**	**AW-B40400**
ftServer Access Adapter 56K Modem	**CRU**	**AA-C51900**
LVDS I/O Power and Distribution Board	**DRU**	**AA-E83000**
Peripheral Bus Interconnect PCB	**DRU**	**AA-E15300**
IDE Bus PCB	**DRU**	**AA-E15600**
High-capacity Floppy Drive	**DRU**	**AA-D56002**
CD-ROM Drive	**DRU**	**AA-D55001**
Keyboard (USB)	**CRU**	**AA-V11510**
Mouse (serial)	**CRU**	**AA-V11610**
VGA 17" Color Monitor with Power Cord	**CRU**	**AA-V10610**
1U Monitor, Keyboard, Mouse Assembly	**CRU**	**AA-V12500**
CBL, UL/CSA 6 ft VGA Cable	**CRU**	**AW-B20240**
CBL, UL/CSA 6 ft USB Cable	**CRU**	**AW-B51100**
SCSI cable (68 Pos. SCSIU to 0.8 mm VHD Ext. SCSI)	**CRU**	**AW-001046-01**

7.3 Ultra160 SCSI Storage Subsystem

Description	CRU/FRU/DRU	Part Number
Ultra160 SCSI Disk Storage Enclosure -Initial Split	**FRU**	**AA-D52003**
Ultra160 SCSI Disk Storage Enclosure -Initial Joined	**FRU**	**AA-D52004**
I/O & Cluster Services Module	**CRU**	**AA-E52200**
Joiner Module	**CRU**	**AA-E52300**

LED Module - Right	**CRU**	**AA-000385**
LED Module - Left	**CRU**	**AA-000386**
Locking Slot Blocker	**CRU**	**AA-000388**
36-GB 10K Disk Drive	**CRU**	**AA-D52200**
73-GB 10K Disk Drive	**CRU**	**AA-D52300**
18-GB 15K Disk Drive	**CRU**	**AA-D52400**
Power Supply Module (PSM)	**CRU**	**AA-P57000**
Advanced Cooling Module (ACM)	**CRU**	**MF-000041**
Empty Disk Slot Filler	**CRU**	**AA-000382**
Kit, Rackmount Rail	**CRU**	**AK-000385**

7.4 ftStorage Fibre Channel Array

Description	CRU/FRU/DRU	Part Number
FC RAID Storage Enclosure	**FRU**	**AA-D57000**
FC RAID Controller Module	**CRU**	**AA-D57100**
FC LS Module (LSM)	**CRU**	**AA-D57200**
FC Power Supply Module (PSM)	**CRU**	**AA-P57000**
FC ACM/Battery Assembly	**CRU**	**AS-000387**
FC Battery	**DRU**	**BA-000014**
FC Expansion Storage Enclosure	**FRU**	**AA-D58000**
FC Input/Output Module (IOM)	**CRU**	**AA-D58100**
FC Advance Cooling Module (ACM)	**CRU**	**MF-000041**
FC Rackmount Rail Kit	**CRU**	**AK-000385**
FC Disk Slot Filler	**CRU**	**AA-000382**
FC 3.0 meter DB9-HSSDC Cable	**CRU**	**AW-B50700**
FC 0.5 meter HSSDC-HSSDC Cable	**CRU**	**AW-B50800**
FC 10 meter DB9-HSSDC Cable	**CRU**	**AW-B50900**
FC 36G 10K Disk Drive	**CRU**	**AA-D57400**
FC 73G 10K Disk Drive	**CRU**	**AA-D57500**

7.4 Tape Subsystem

Description	CRU/FRU/DRU	Part Number
DDS-4 DAT Tape Drive	CRU	AA-T51100
DDS-4 DAT Tape Drive with Autoloader	CRU	AA-T51200
DLT 8000 Tape Drive	CRU	AW-T51300
SCSI Cable (to first tape drive - 10 ft/30 ft)	CRU	AW-001046-01/02
SCSI Cable (daisy chain to 2nd tape drive-3 ft)	CRU	AW-001072
SCSI Terminator LVD/SE Multi Mode	CRU	AW-T50004

7.5 Power Cords

Description	CRU/FRU/DRU	Part Number
United States (Chicago 6' only) NEMA 6-20P Plug	CRU	AW-B38006
United States (Chicago 10' only) NEMA 6-20P Plug	CRU	AW-B38007
United States 3.5m NEMA 6-20P Plug	CRU	AW-B38008
United States 4.5m NEMA 6-20P Plug	CRU	AW-B38009
United States 3.5m L6-30P Twist Lock Plug	CRU	AW-B38026
United States 4.5m L6-30P Twist Lock Plug	CRU	AW-B38027
Cont'l Europe 3.5m	CRU	AW-B38010
Cont'l Europe 4.5m	CRU	AW-B38011
UK 3.5m	CRU	AW-B38012
UK 4.5m	CRU	AW-B38013
INDIA/S.Africa 3.5m	CRU	AW-B38014
INDIA/S.Africa 4.5m	CRU	AW-B38015
no plug 3.5m	CRU	AW-B38016
no plug 4.5m	CRU	AW-B38017
Austrailia/New Zealand 3.5m	CRU	AW-B38018
Austrailia/New Zealand 4.5m	CRU	AW-B38019
Italy 3.5m	CRU	AW-B38020
Italy 4.5m	CRU	AW-B38021
Isreal 3.5m	CRU	AW-B38022

Isreal 4.5m	**CRU**	**AW-B38023**
Japan 3.5m	**CRU**	**AW-B38024**
Japan 4.5m	**CRU**	**AW-B38025**
Power Strip Cables	**CRU**	
Internal Power Jumper to cabinet Power Strip	**CRU**	**AW-B38000**
Cabinet Ground Cables	**CRU**	
CBL, Cabinet Ground Cable (included)	**CRU**	**AW-001075**