IFT-6330-12

12-Bay SCSI-to-ATA and Fibre-to-ATA

Rackmount Disk Array Subsystems

User's Manual

Revision: 1.1

Infortrend ®

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Warnings and Certifications

FCC (applies in the U.S. and Canada)

FCC Class A Note

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

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

The changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Warning:

Use only shielded cables to connect I/O devices to this equipment.

You are cautioned that changes or modifications not expressly approved by the party responsible for compliance could void you authority to operate the equipment.

CE This device is in conformity with the EMC

Table of Contents

About This Manual

This manual provides the necessary information for an experienced computer user, with little or no RAID knowledge to install, use, and maintain an IFT-6330-12 SCSI-to-ATA/Fibre-to-ATA disk array subsystem.

The manual will be updated so as to be compatible with the latest product versions.

Date: 17 June 2003

Firmware Version: 2.11

Chapter 1   provides a brief introduction to the product, its features, options, and describes the hardware installation procedure.

Chapter 2   explains how to use, maintain and monitor the subsystem.

Chapter 3   gives some guidance regarding what steps to take in the event that problems are encountered.

Chapter 4   describes how the Fibre-to-ATA models differ in hardware from SCSI models.

Appendix A   explains different RAID Levels.

Appendix B   provides hardware specifications.

Appendix C   is a glossary of technology terms used in this document and more generally in discussions of RAID.

Appendix D   explains how to receive firmware and software upgrades, and other kinds of support.

Revision History

17 June 2003   version 1.1   initial release

Product Overview

Thank you for purchasing the IFT-6330-12.

The IFT-6330-12 RAID subsystem is a SCSI-to-ATA or Fibre-to-ATA RAID controller in a customized rackmount enclosure with drive bay space for twelve (12) ATA hard drives. The subsystem comes without hard drives so that users can select the drive size, speed, and other considerations that they prefer. The controller itself is completely independent of the host.

IMPORTANT:
The IFT-6330-12 is only designed to use ATA hard drives. It is not compatible with SCSI or other types of hard drives for installation and storage purposes.

RAID provides both increased drive access speed and fault tolerance (i.e., one drive in an array can fail but data integrity and operations are maintained). The IFT-6330-12 provides additional fault tolerance with dual, redundant, hot-swappable fans and power supplies. All RAID functions are performed by a PowerPC® RISC CPU with high-speed SDRAM and firmware in flash memory.

The controller has sophisticated drive failure management capabilities that allow automatic reassignment of reserved blocks when a bad sector is encountered during a write. In addition, the Bad Block Scrub function can be manually performed at regular intervals to ensure data integrity.

Hot swapping is supported through automatic disconnection of a failed drive and detection of a reserved drive, followed by background rebuilding of data. The controller also supports spare drive operation. What is particularly remarkable is all these failure recovery procedures are transparent to the host system.

Another particularly remarkable feature of the product is that it can be installed, configured, and used by users who know very little about RAID. Infortrend's Auto RAID Setup allows users to install what

drives they have and then the controller handles all setup, ID assignment, and configuration.

Standard Package Contents (12 bay models)

- IFT-6330-12 RAID Subsystem
- Twelve (12) drive trays
- RAID Management Software CD (RAIDWatch)
- User's Manual
- One (1) null modem port adapter
- Two (2) Power Cords
- 48 screws for HDD

SCSI Models Only:
- One SCSI Cable – external round cable x 1
- One SCSI Bus Terminator (installed) x 1

Products Covered

Model Number	Description
12 drives	
IFT-6330-12U3D	12-bay for ATA drives, dual Ultra160 SCSI host channels
IFT-6330-12F2D	12-bay for ATA drives, dual 2Gbps Fibre host channels

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Chapter 1

Hardware Components

and Installation

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1.1   Product Elements

The IFT-6330-12 consists of a RAID controller; twelve ATA drive bays and trays; redundant, hot-swappable power supplies; redundant, hot-swappable fans; and a rackmount enclosure to integrate all of these separate pieces.

1.1.1 RAID Controller

The controller, whether SCSI-to-ATA or Fibre-to-ATA, used in the IFT-6330-12 is the central element of the product. A RAID controller is, essentially, a sophisticated computer that manages data flow to and from array hard drives in the most fault-tolerant manner available. The RAID controller used in the IFT-6330-12 supports RAID levels 0, 1(0+1), 3, 5, 30, 50, JBOD and NRAID; and provides various user interfaces for system management and monitoring.

1.1.2 ATA Drive Bays and Trays

Drive bays are the spaces provided in the IFT-6330-12 enclosure for hard drives. Trays are containers where drives are mounted and which permit hot-swapping. The bays and trays in the product are designed for industry-standard 3.5" x 1" high ATA hard drives.

1.1.3 Power Supplies

The product comes standard with two redundant, hot-swappable power supplies. Both power supplies provide power to the product simultaneously and each is capable of supplying power to the product alone if necessary. Note that extended single-power supply operation is not recommended and should only take place in the event of a power supply failure.

1.1.4 Enclosure Fans

The product comes standard with two redundant, hot-swappable enclosure fans. Both fans provide airflow to the product simultaneously and each can operate independently if necessary. Note that extended single-fan operation is not recommended and should only be used in the event of a fan failure.

1.1.5 LAN Port

The IFT-6330-12 comes with a standard RJ-45 connector can be used for 10/100 Ethernet connection. The LAN port is used to connect to the GUI and enables users to manage the RAID subsystem using their web browser. The LAN port can also be used for telnet access.

1.1.6 Enclosure

The "box" which contains the controller, drives/drive trays and bays, power supplies, and fans is called an "enclosure." The enclosure includes various controls, ports, and other features used to connect the IFT-6330-12 to a host for example. The enclosure controls and ports will be described in detail later in this document.

1.2   Product Features

- Dual Ultra160 SCSI host interface, up to 160Mbyte/sec transfer rate for each
  OR
  Dual 2Gbps Fibre Channel host interface, up to 200Mbytes/sec transfer rate for each
- PowerPC 750CXe CPU with 256KB embedded L2 cache
- Standard 128MB SDRAM SODIMM cache memory, addressable to 1GB
- Easily upgraded Flash ROM for firmware
- Space for up to twelve (12) ATA-133 hard disk drives
- Supports 3.5" x 1" high ATA drives
- Smooth hot-swappable drive tray mechanism
- RAID levels: 0, 1(0+1), 3, 5, 30, 50, JBOD, NRAID
- Quick RAID Setup provides easy installation
- Multiple RAID Arrays are supported
- User-friendly RAIDWatch GUI RAID manager
- NPC (Notification Processing Center) as a sub-module to RAIDWatch for remote notification of system events
- Convenient front LCD control/status panel

- Two redundant, hot-swappable power supplies
- Two independent, hot-swappable cooling fans
- One RJ-45 LAN connector for managing the array with a GUI
- Compact enclosure
- Intelligent Drive Handling
- Up to 64TB per logical drive (LD) or array.
- Up to 1024 LUNs available for host side mapping
- Variable rebuild priority for various applications.
- Support SNMP v2.0 Management Information Base (MIB) with get and set function.

1.3 Physical

As described briefly in this chapter, the IFT-6330-12 consists of a RAID controller, drive bays and trays, power supplies, fans, and an enclosure.

1.3.1 Packing List

The box that the IFT-6330-12 came in should have included the following:
- IFT-6330-12 ATA RAID Subsystem
- Twelve (12) Drive Trays
- RAID Management Software CD
- One (1) Null Modem Port Adapter
- Two Power Cords
- 48 screws for securing hard disks

SCSI Models Only:
- One (1) SCSI Cable
- One (1) SCSI Bus Terminator

1.3.2 Location Diagram

The diagram below indicates the position of controls, switches, ports, indicators, and other physical aspects of the subsystem.
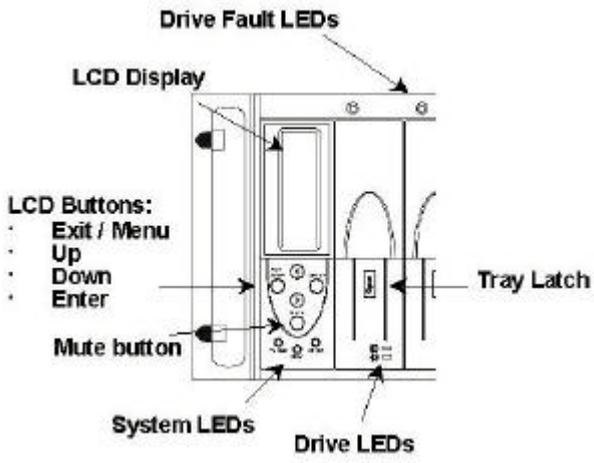
Figure 1- 1: Front Panel (12-bay module)
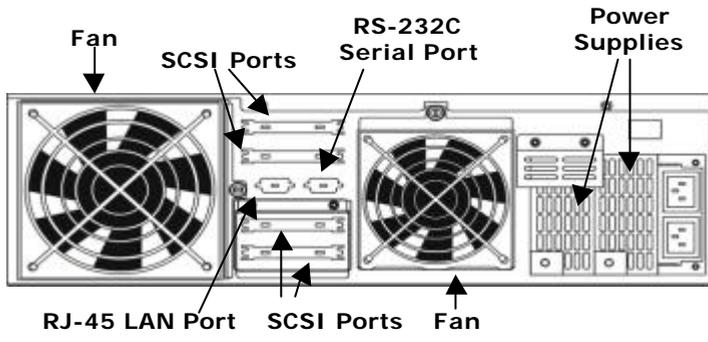
Figure 1-2: Rear Panel, SCSI Model
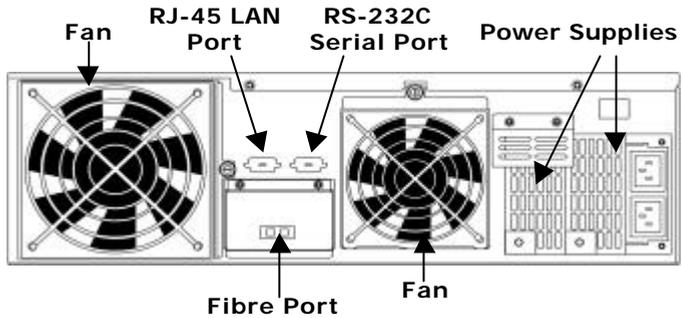
Figure 1-3: Rear Panel, Fibre Model (Dual port; two SFP connectors)

Note that the rear panel contains two LC ports (2 Gbps fiber optic). Also, if two Fibre loops are used as redundant paths to connect to a single host computer, the data flow should be managed by a third-party software.

1.3.3 Enclosure Features

The enclosure includes features designed to make installation and daily operation both easier and more secure.

- **On/Off Switch** – because data may be in the cache at the moment power is turned off (and would be lost if power was cut at that moment), the controller protects data integrity by not allowing power off until the cache has been completely flushed.
- **Alarm** – whenever a controller, drive, array, or enclosure event occurs, an audible alarm sounds to alert the system user or manager.
- **Mute Button** – when the alarm sounds, the mute button allows you to stop the alarm until the next event.
- **LEDs** – both the controller and each drive have multiple LEDs which provide basic operating status readout. The power supplies each has a single LED which indicates whether or not the power supply is good.
- **Drive Hot-Swap** – in the event of a failure or a need to add a drive (assuming there is an open drive bay), single drive can be removed or added at a time (as a member of a logical drive) without powering down the entire array.

- **Power Hot-Swap** – the power supplies are redundant and can be swapped without powering down the entire array in the event of a failure.
- **Fan Hot-Swap** – the fans are hot swappable so that in the event of a failure, a bad fan can be removed and replaced without needing to power down the array.
- **LCD Status Indications** – the LCD displays the current operating status of all drive bays during normal operations. Error conditions and failures in enclosure devices are also indicated on the LCD as they occur.
- **Tray Latches** – to prevent drives from being accidentally removed, each drive tray has a latch to secure it in place.

1.3.4 Termination (SCSI)

When using SCSI devices, it is always necessary to pay careful attention to termination. A SCSI bus must be properly terminated at both ends. The IFT-6330-12U3D SCSI model comes with one physical terminators attached to SCSI ports. If the RAID array is the last SCSI device on the bus, simply attach it to the host using the unterminated SCSI port and the enclosed external SCSI cable. *(For information about Fibre connections, see Chapter 4).*

If you want to daisychain other SCSI IFT-6330-12 arrays or other SCSI devices to your current SCSI IFT-6330-12, shut down all SCSI devices on the bus first. Once no devices on the bus are transmitting data, disconnect the terminator, connect the new SCSI device, terminate the bus (if it isn't already), and restart all devices. Note that termination must be on both ends of the SCSI bus, and only on both ends. Most SCSI HBAs have built-in auto-sense termination.

1.3.5 Notice for Fibre Channel Connection

The system Fibre port is not equipped with by-pass circuits. By-pass services should be provided outside the system. Connection to the host should be made using a 3rd party hub or switch, unless the system is connected point-to-point to a single host computer.

1.3.6 Host Requirements

In order for the IFT-6330-12U3D (SCSI models) to be connected to the host computer, the host must have a SCSI host bus adapter (wide or single-ended) installed. Most commonly, a host bus adapter (HBA) is an add-on card that includes external SCSI ports used to connect with SCSI devices, including the IFT-6330-12 array.

Fibre IFT-6330-12 models need a fibre HBA installed in the host for the same reasons as given above for SCSI.

1.4 Hard Drives

Now that you are familiar with the subsystem, choosing and installing the correct hard drives in the IFT-6330-12 is the first step in the installation process.

1.4.1 Guidelines

When choosing which hard drives to install, we strongly suggest that you consider the following:

- **Capacity (MB / GB) –** while it is important that you use hard drives with sufficient capacity for your storage needs, it is equally important that you use drives with the same capacity. RAID arrays use a "least-common-denominator" approach, which is to say that the array can only use the capacity of each drive up to the maximum capacity of the smallest drive. So choose big drives and use the same size.
- **RPM –** Revolutions Per Minute is one measure of hard disk speed. The higher the RPM, the faster the drive because seek times are reduced.
- **MS –** Milliseconds is another common measure of disk speed. MS is the average seek time. Lower numbers indicate faster seek times.
- **ATA -133 –** The IFT-6330-12 is an ATA disk array subsystem designed to work with the latest generation of ATA hard drives. This standard is downward compatible but ATA-133 drives are recommended.
- **Profile –** The trays and bays of the IFT-6330-12 are designed for 3.5" wide x 1" high hard drives. It is highly recommended that users not try to use any other size drive.

1.4.2 Supported Hard Drives

The IFT-6330-12 supports all ATA-133 hard drives. Drives from the following companies are, however, recommended by the manufacturer:

- IBM
- Seagate
- Maxtor
- Western Digital

Note that the IFT-6330-12 supports the use of different ATA drives (by manufacturer, size, speed, and so on) in a single array. The only limitation is that RAID implementation limits the maximum available space on every drive according to the maximum size of the *smallest* drive. Any additional space on larger drives in a mixed-drive array will not be used or available.

1.4.3 Other Considerations

The number of ATA drives installed directly relates to the available RAID levels (essentially, more drives equates to more options and higher RAID level availability). Also, with three or more drives, one drive can be used as a spare.

Finally, since a RAID array created using the IFT-6330-12 can be expanded by adding drives, it is important to consider using fewer large drives initially so that some drive bays will be available for future expansion needs.

1.4.4 Installing In Trays

Each drive bay in the IFT-6330-12 has a matching drive tray. To install an ATA hard drive in the enclosure, take an empty drive tray, hold the drive upside down and connect the short data and power cables to the drive, then flip the drive over and attach it to the tray using the four screws (steps as shown below):
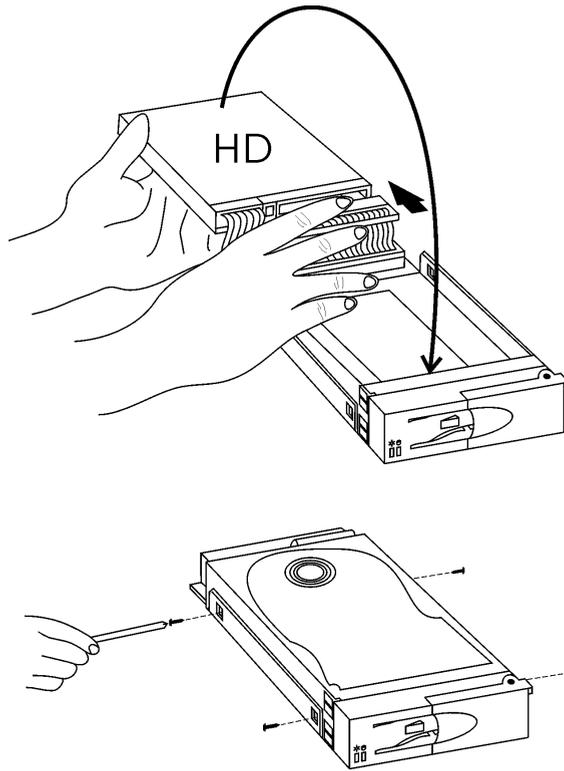
Figure 1-4: Drive-to-Tray Installation

Once the drive has been installed in a tray, insert the tray into an unoccupied drive bay and secure the tray lock:
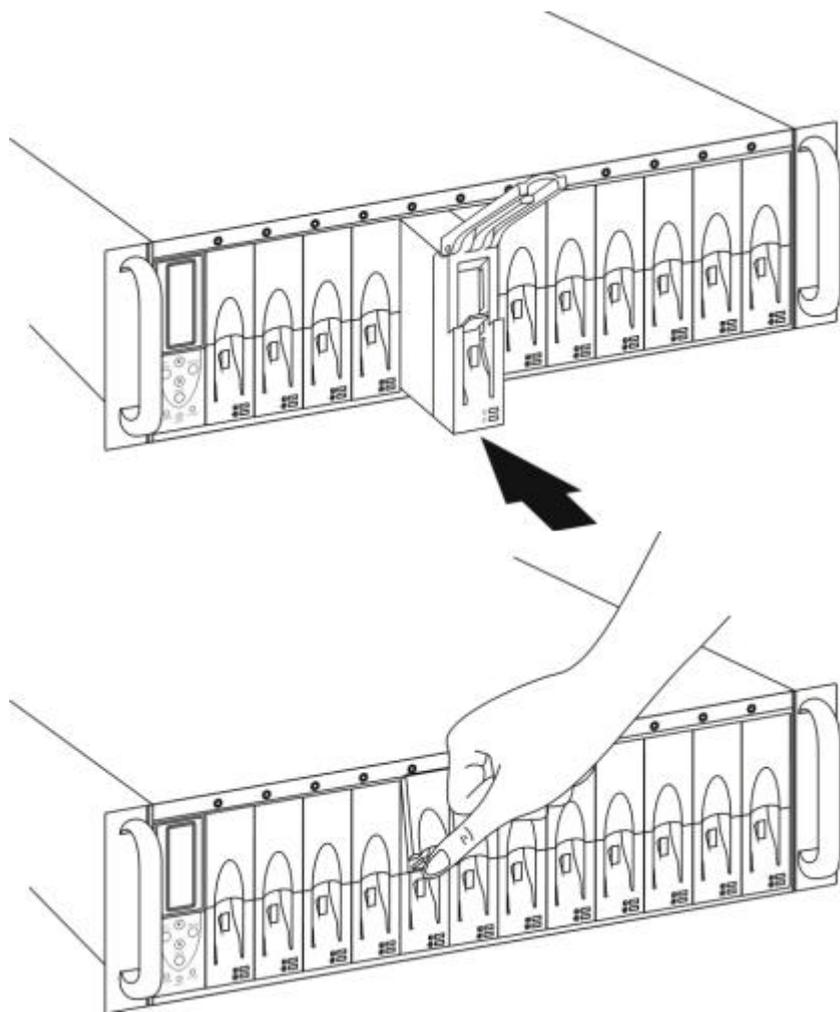
Figure 1-5: Tray-to-Bay Installation

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Program Updates

As Infortrend's valued customer, you are entitled to free RAIDWatch and system firmware updates. For more information about this service, call Infortrend sales or an Infortrend distributor in your area.

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<div align="right">Chapter 2</div>

System Monitoring,

Operation and

Use

2.1 Basics

The IFT-6330-12 is designed to be an easy-to-use RAID disk array, 2-requiring little maintenance or attention. This section describes the essential operating factors.

2.1.1 Indicators and Controls

The front panel of the IFT-6330-12 includes buttons for various functions and LEDs to provide information about the current operating status of the array and of each individual drive, 2-and drive bay.

Buttons include mute and LCD controls (Exit/Menu, 2-Up, 2-Down, 2-Enter).
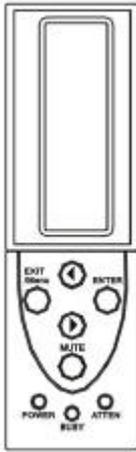
Figure 2-1: Front Panel Buttons and LEDs (12-bay)

2.1.2　Front Panel Buttons

- **Mute –** when the controller detects an error, 2-regardless of severity, 2-an alarm will sound. The mute button stops the alarm until the next error.
- **LCD Exit/Menu –** in most sub-menus, 2-this button works like "back" on a web browser or backspace on a keyboard; it takes you up one level. This key is also used to enter the Main Menu from the start-up display.
- **LCD Up and Down –** navigating buttons which correspond with the arrow icon on the right hand side of the LCD.
- **LCD Enter –** from each LCD menu, 2-pressing Enter either takes you one step deeper into the management controls or allows you to choose to confirm or deny an action.

2.1.3 Front Panel LEDs

The front panel of the IFT-6330-12 provides LEDs to indicate various information about the status of the array and each drive/drive bay. Array LEDs consist of Power, 2-Busy, 2-and Attention.

- **Power –** the power indicator is on whenever power is being supplied by either or both redundant power supplies.
- **Busy –** the busy LED lights when either the controller or a drive or drives are currently processing data and unable to respond to new requests (such as manual entries from the LCD panel).

- **Attention –** the attention LED comes on whenever the controller detects an error, 2-particularly involving hardware such as the power supplies, 2-fans, 2-or hard drives.

Each drive bay also has three LEDs: Power, 2-Activity, 2-and Drive Fault.
- **Power –** the lower LED on each drive tray indicates that power is being supplied to the drive in the tray.
- **Activity –** the upper LED on each drive tray indicates when data is being transferred to the drive in the tray.
- **Drive Fault –** on top of each drive bay is an indicator which should only come on when the drive in that bay fails.
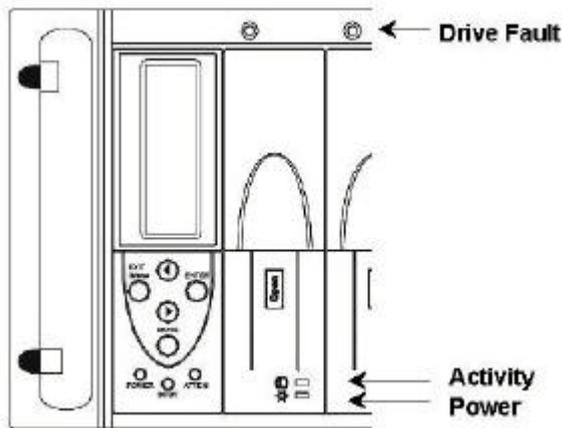
Figure 2-2: Front Panel LEDs

2.1.4 Rear Panel

The rear panel of the unit includes data ports, 2-a power connector, 2-fan and power supply access and the unit power switch.
- **Power Switch –** the power button is the on/off switch for the RAID enclosure. Note that if data is still being transmitted, 2-received, 2-or written to drives, 2-there may be a delay when you press the power button to turn the unit off while data transactions are completed.
- **Power Supply Status LED** – Each power supply also has a status LED. The LEDs are at the bottom of the exposed end of the power supplies. When a power supply is operating

normally, 2-the LED will be green. If the power supply has experienced a failure, 2-the LED will turn amber.

For 12-bay systems, 2-if power cords are properly attached, 2-AC power is maintained ON when the DC switch is in the "off" position. The status LED will blink steadily under this situation.

NOTE:
Please note that power cords should not be removed when the DC power switch is in the "On" position. So doing may cause the power switch to fail.

2.1.5 Alarm

The audible warning signal built into the IFT-6330-12 is a notification that there has been an error of some sort in the RAID array. Fatal errors are indicated by a single, 2-continuous signal. During non-fatal errors and array rebuilds, 2-the signal is a series of long tones interrupted by brief pauses.

Regardless of which type of tone, 2-it indicates that something has occurred which needs user attention. To mute the alarm, 2-in RAIDWatch, 2-go to the Status window and click the Mute button, 2-or press the Mute button on the front of the unit.

2.1.6 RAID Access

Once the RAID array has been setup, 2-it needs to be connected to a host computer. The host must have a SCSI or Fibre host bus adapter (HBA), 2-but otherwise the IFT-6330-12 can be used by a wide variety of hardware and OS configurations.

To connect the array (SCSI models) to a host HBA, 2-use a shielded, 2-round SCSI cable from either SCSI port at the back of the IFT-6330-12 enclosure to an external port of the SCSI HBA. (See *Section 2.1 Physical / Termination* for important SCSI-related information.) Connect the second host port to another host computer in the likewise manner. Please note that each host channel has two host ports; one for connecting to host and the other for cascading.

To connect a Fibre port to host computer or Fibre hub/switch, 2-use an SFP module and optical short wavelength cable recommended by the documents that came with your HBA card.

Once the array has been connected, 2-you must reboot the host and then assign the RAID array a drive letter designation. Each OS has a different procedure for assigning drive letters to storage devices. Consult your particular OS's documentation and the documentation for your HBA for more information.

2.1.7 RAID Sharing (Network)

RAID sharing with IFT-6330-12 subsystems involves allowing more than just the host computer to store and retrieve data from the unit.

Once a RAID array has been created and assigned a drive designation, 2-it can be shared to a LAN or WAN using the same OS-dependent method as other host storage devices (e.g., 2-"local" hard drives) are shared. Consult your OS documentation for information as to how to share storage devices.

In order to connect the array to different host computers, 2-host channel IDs or LUN numbers should be mapped with different logical configurations (logical drives). If there is only one logical configuration, 2-different ID/LUNs can be mapped with the same array capacity. However, 2-file-locking mechanism must be implemented with management software running to handle the sharing.

2.1.8 Subsystem Cascading (SCSI)

The IFT-6330-12 (6330-12U3D) includes two SCSI channels with four SCSI port connectors. The second SCSI port for a SCSI channel is for cascading to other SCSI devices (or must be terminated if there are no additional SCSI devices). The purpose of this is to allow multiple SCSI devices to share the same bus and thus the same host. To cascade another SCSI device, 2-connect its SCSI cable to the available (currently terminated) SCSI port.

2.1.9 Operating Guidelines

Once the array is installed, 2-running, 2-and connected to a host computer, 2-from a user point of view it generally functions as one or

several large hard drives. There are only two operating factors to consider: drive failures and powering down.

Regardless of whether or not you have included a spare drive in your array, 2-if a drive fails it should be replaced as soon as possible. Note that all drives in the array are hot-swappable, 2-so as long as only one drive of a logical array has a problem, 2-it can be exchanged without powering down and without data loss (for RAID 3 and 5 configurations).

In general, 2-RAID arrays are not intended to be regularly powered down. The best rule-of-thumb for powering down a RAID array is to always power the host computer down *first*. By the time the host is completely powered down, 2-the RAID controller will have had time to finish writing and checking data and can be powered down.

2.2   Other Management Tools

2.2.1 RS-232C

If your data volume is large, 2-it may improve your throughput performance to use a null modem cable for array management. The IFT-6330-12 comes with a standard, 2-9-pin RS-232C serial port, 2-which, 2-using a null modem cable, 2-can be connected to any COM port on a host computer for management purposes. The firmware-based terminal array management interface can manage the array through the RS-232C port.

The port's transmission settings have the following preset values and cannot be modified:

- Baud Rate: **38400**
- Parity: **No**
- Bits: **8**
- Stop Bits: **1**

In order to manage the array using the RS-232C port, 2-use the included null modem port adapter and a serial cable (not included), 2-connect the cable to the array RS-232C port and to the appropriate COM port on the management host, 2-set the above values in your

terminal software, 2-and activate the software. This will give you access to the firmware-based management program.

The firmware-based management program is a standard VT-100 terminal accessible program which will automatically start if you connect your host computer to the array via the RS-232C port and start any VT-100 terminal program using the communications protocol settings listed above.

2.2.2 LCD Panel

The LCD panel provides both a current status readout and full access to all controller functions and settings. The entire array can be installed, 2-monitored and maintained using only the LCD panel. For information on available options and using the LCD panel to manage the array, 2-see the Generic Operations Manual that came with the subsystem.

2.2.3 Out-of-Band via Ethernet

The RAIDWatch management software provides a GUI interface to the controller, 2-and the IFT-6330-12 allows you to access the array configuration via an Ethernet port. To simplify the installation process, 2-necessary software agents have already been implemented in controller firmware (release 2.31 and above).

To prepare the controller for using the RAIDWatch manager:

1. **Use the terminal utility to assign an IP address to the subsystem LAN port (procedure will be discussed later).**

    Reset the controller and PING the IP address to make sure the link is up and running.

2. **Make sure a small section of disk-reserved space (256MB) is created on every logical drive.**

    RAIDWatch's program and definition files must be put into the reserved space on logical drive(s). A meta-filesystem is created using a small section on logical drives once you choose to segregate a 256MB "Reserved Space."

3. **FTP the software programs to the reserved section.**

The main RAIDWatch programs should be FTP'ed to the reserved section of logical drives. Open your browser, 2-and type ftp://xxx.xxx.xxx.xxx (IP address). Login as root and there is no password. Ftp these files as follows:

- Company, 2-enclosure.txt, 2-grm.htm, 2-grm.jar, 2-ipaddr.txt, 2-multiraid.txt, 2-version.txt

These files are located in X:\RsvSpace where X is the CD-ROM letter.

Proceed to ftp the \data directory, 2-located on X:\RsvSpace\usr\hybrid to \usr\hybrid in the reserved space of your logical drives.

4. Java Runtime:

Install Java Runtime from the CD. If the computer is powered by Pentium 4, 2-it is required to install Java JRE version 1.3.1.

5. Sub-Modules

The NPC (Event Notification Utility) sub-module is also embedded since firmware version 2.31. There is no need to install NPC on the host.

Requirements
1. Subsystem with Ethernet connectivity: i.e., 2-IFT-6330-12
2. **Firmware revision 2.31** and above
3. **Management Station:**
   Pentium or above compatible (or equivalent PC) running Windows NT 4/Windows 2000; Solaris 7 & 8 (SPARC, 2-x86); AIX 4.3; or Red   Hat Linux 6.1 (kernel v2.2.xx); Red Hat 7, 2-SUSE 7, 2-WIN95/98, 2-Windows Me
4. Standard web browser. A computer running RAIDWatch manager must support:
   - TCP/IP
   - Java Runtime: a package is bundled with RAIDWatch installer or can be downloaded from SUN Micro's web site.

Configuration Procedure

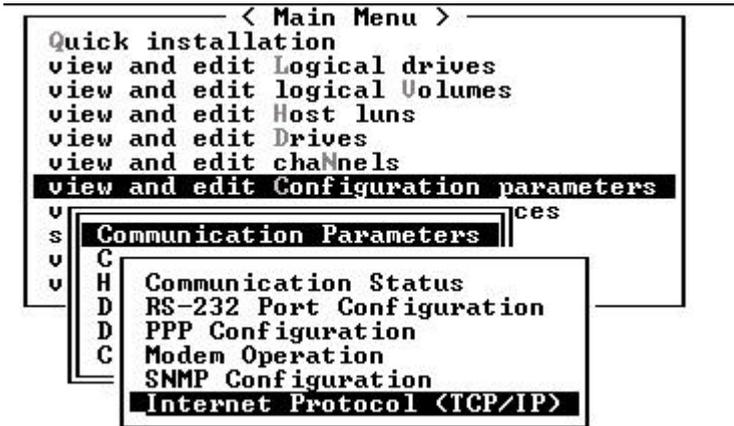Listed below are steps necessary for preparing RAIDWatch programs:

1. Follow the instructions in documentation that came with your controller for details on how to connect the Ethernet port. Java plug-in is also necessary for a host/management station.

2. Firmware 2.31 and above allows you to create a reserved space from logical arrays. The reserved space option will prompt during the array configuration process. If a logical configuration has been created and then deleted, 2-each of the reserved space on physical drives should be manually removed before configuring a new array.

    To delete the previous reserved space, 2-from the main menu select the "View and Edit Drives" menu item, 2-select the appropriate slot and then select "Rev Space" and press delete. See the diagram below.

3. Assign an IP address to the controller Ethernet port and specify the Net Mask and gateway values. Reset the controller for the configuration to take effect.

    To set the IP address select "View and Edit Configuration Parameters" from the main menu. Next select "Communication Parameters" and then select "Internet Protocol (TCP/IP)".

```
                    ─── < Main Menu > ───
  Quick installation
  view and edit Logical drives
  view and edit logical Volumes
  view and edit Host luns
  view and edit Drives
  view and edit chaNnels
  view and edit Configuration parameters
  v ┌────────────────────────────────┐ ces
  s │  Communication Parameters      │
  v │ C ┌──────────────────────────────
  v │ H │  Communication Status
    │ D │  RS-232 Port Configuration
    │ D │  PPP Configuration
    │ C │  Modem Operation
    └───│  SNMP Configuration
        │  Internet Protocol (TCP/IP)
        └──────────────────────────────
```

Once the "Internet Protocol (TCP/IP)" menu item is selected, 2-press "enter" and you will be able to see the screen that shows the DHCP Client, 2-the Netmask, 2-and the Gateway values.

To enter an IP address select "Address: DHCP Client" in the above menu and a new screen that allows you to enter the IP address will appear. Enter the IP address. After the IP address has been entered, 2-the NetMask and Gateway values must also be entered. To do this, 2-click on the appropriate menu item and enter the corresponding value.

4. The controller will take a while formatting a small storage section on physical drives before logical drives can be successfully initialized.

5. When the initialization process is complete, 2-FTP RAIDWatch programs (as listed previously) to the designated controller IP address.
   - The controller default for the reserved space cannot be changed.
   - One logical drive with the reserved space configuration is sufficient for running the management software.

---

6. For configuring event notification, 2-create a text file and name it "agent.ini". FTP this file to under the root directory of the reserved space for the configuration to work.

7. Start your web browser and enter the IP address assigned to the controller followed by "grm.htm" as your URL (e.g., 2-http://222.212.121.123/grm.htm).

8. A RAID system thus connected can also be accessed by another RAIDWatch host in a greater topological scheme in which multiple RAID systems are managed by a RAIDWatch station.

```
[SNMP_TRAP]
ENABLED=0         (1=on; 0=off)
SEVERITY=1        (level of messages to be received: 1. notification, 2-2.
                   warning, 2-3. alert. "3" covers events of all levels)
COMMUNITY=public
RECEIVER1=10.20.10.30,2
[EMAIL]
ENABLED=0
SEVERITY=1
SUBJECT=Event Message
SENDER_MAIL_BOX=XXX@XXXX
SMTP_SERVER=127.0.0.1
RECEIVER1=XXX@XXXX,3
        ("3" specifies the level of events to be received by this receiver)
RECEIVER2=XXX@XXXX,1
RECEIVER3=XXX@XXXX, 2-2
RECEIVER4=XXX@XXXX,1
[BROADCAST]
ENABLED=0
SEVERITY=1
```

2.3 Redundancy and Hot Swap

One of the hallmarks of a reliable RAID system is a high degree of built-in redundancy and the ability to swap failed elements out without powering down. The intended purpose is to create highly reliable, 2-always-on data storage.

The IFT-6330-12 provides redundancy and hot-swap capabilities to all major components, 2-including hard drives, 2-fans, 2-and power supplies.

2.3.1 Hard Drive Hot Swap

All hard drives are hot swappable. However, 2-this capability is designed to serve the purpose of maintaining data integrity in the event of single drive failure in a logical group of hard drives. With the exceptions of a single drive, 2-or RAID 0 configuration, 2-single drive hot swapping is a data-safe operation (i.e., 2-no data will be lost if a drive is hot swapped).

Drives included in a logical configuration (drives that have been initialized by the system) should never be removed from drive bays unless:

- A member drive has failed in a logical drive configuration and needs to be replaced.

Before removing a faulty drive, 2-make sure you see the lit red LED on top of its drive bay. You may also verify a faulty drive's location from RAIDWatch's status window. If you mistakenly remove a healthy drive from a logical array which already has a failed drive, 2-unrecoverable data loss will occur.

Step 1: To remove a drive, 2-press the tray latch button to release the catch, 2-and pull the latch until the drive is fully released then gently slide the drive out.
Step 2: Next, 2-remove all four mounting screws.
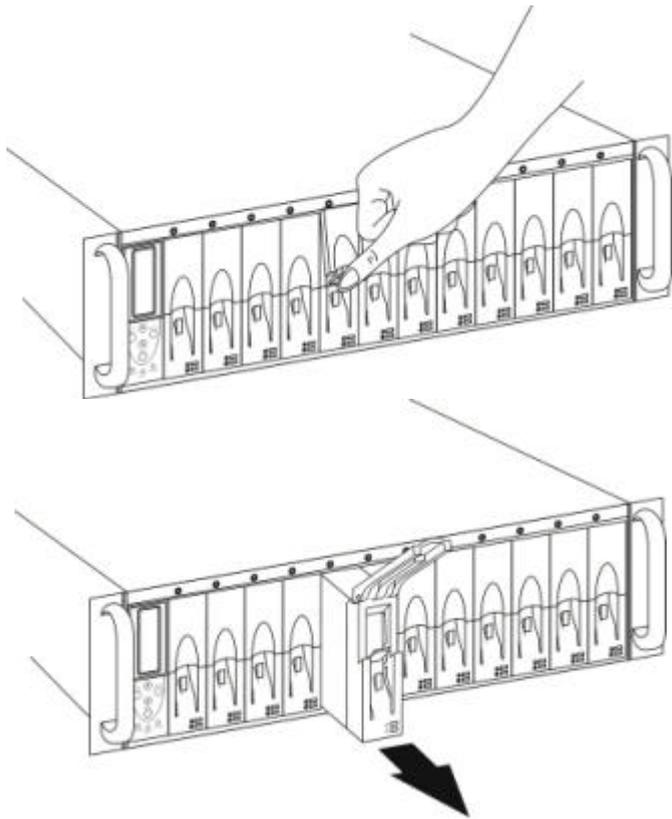**Step 3:** Then flip the drive over and disconnect the power and data cables (as shown below).
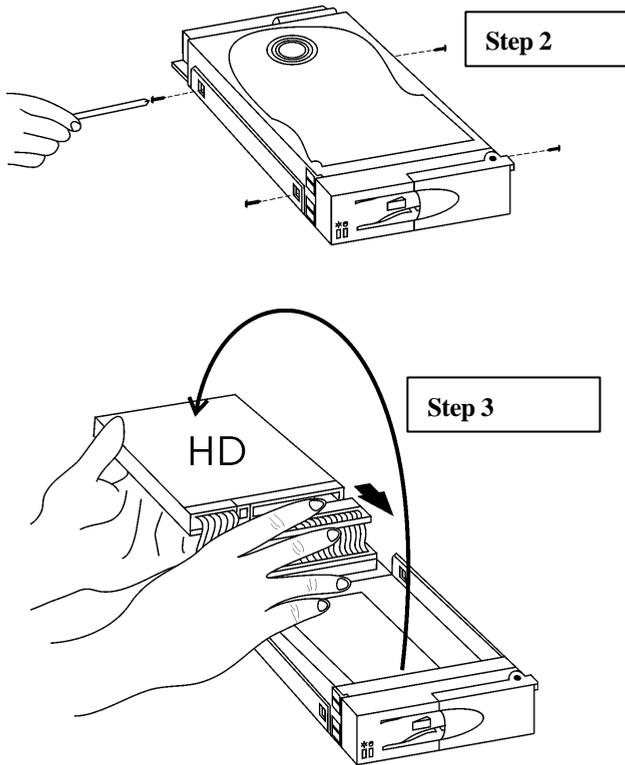
Figure 2- 3: Drive Removal – Step 1

Step 2

Step 3

HD

Figure 2- 4: Drive Removal – Steps 2 and 3

WARNING!

A failed drive will be indicated by a "**X**" mark on the LCD and by a lit red LED just on top of the drive bay. **DO NOT** remove the wrong drive! *Removing the wrong drive may result in complete data loss!*

In the event of a hard drive failure in a RAID 1, 2-3, 2-or 5 configuration, 2-remove the failed drive (as shown above) and replace it with a new, 2-similar capacity drive. After a delay, 2-the array will automatically rebuild the configuration.   A spare automatically engages in array rebuild, 2-and a new drive inserted

afterward (failed drive being removed) should be configured as a spare.

2.3.2 Redundant Fans

The IFT-6330-12 has two main enclosure cooling fans accessible from the rear panel. Both fans are necessary to maintain adequate airflow for enclosure cooling. Each fan is independently hot-swappable.

To maintain sufficient airflow through the enclosure, 2-it is not recommended to operate the IFT-6330-12 for long periods of time with only one fan. A fan failure will be detected by the RAID controller, 2-the failure will be recorded in the Event Log, 2-the Attention LED will light, 2-and the alarm buzzer will sound.

To remove a faulty fan and replace it, 2-follow the procedure below (note that the entire process can be accomplished while power is still on):

The fan modules on a 12-bay system should be secured with four mounting screws.

Step 1: Loosen the screw fasteners on the correct fan housing. They are four on each fan. Then the fan shield can be removed.

Step 2: Loosen the hand screw. Open the housing by rotating it from right to left so that the power connector is exposed.

Step 3: Disconnect power from the faulty fan by unplugging the small power connector located rear-center of each fan.

Step 4: Now slide the fan out of the housing.

Step 5: Put a new fan in the housing, 2-being careful that the front (the side with a sticker) of the fan faces out and that the fan wire runs from the top of the right side.

Step 6: swing the fan housing back into place, 2-tighten down the hand screw, 2-reconnect power (be careful that the fan will rotate instantly), 2-and secure the fasteners (one piece at a time) with fan shield.
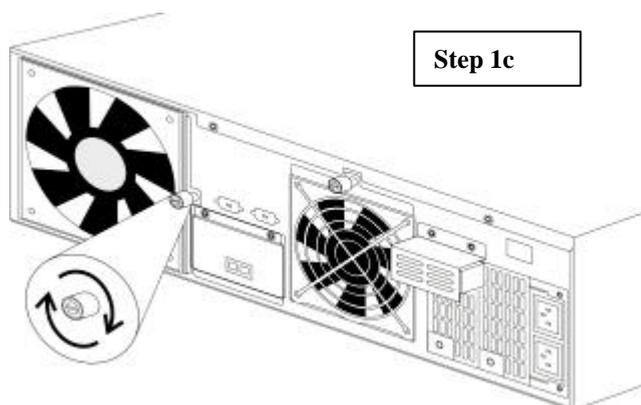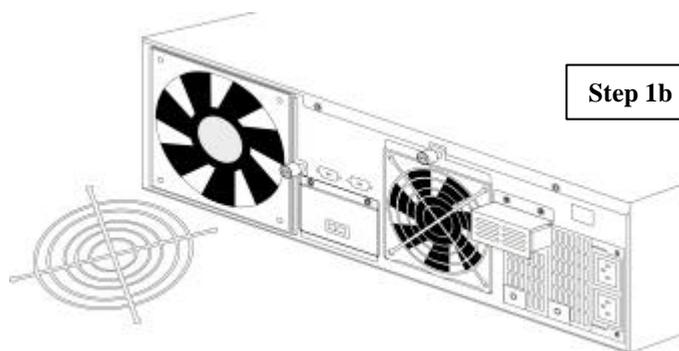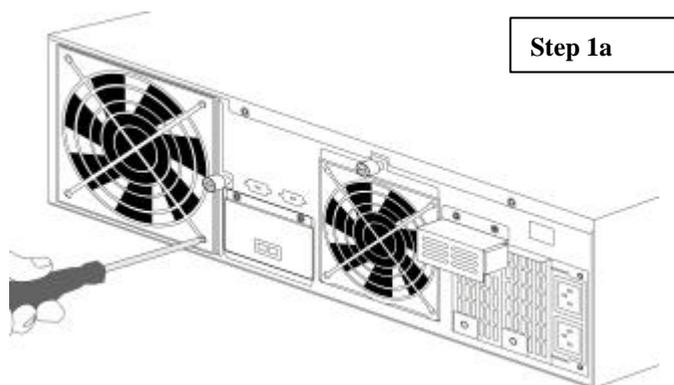
Step 1a

Step 1b

Step 1c
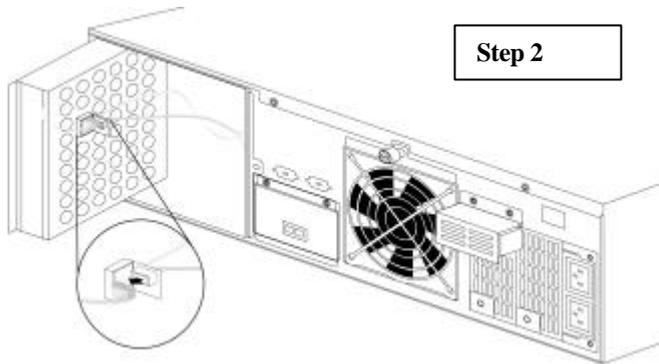
Figure 2-5: Fan Swap – Step 1

Figure 2-6: Fan Swap – Step2

If you have a fan failure, 2-we highly recommend that you contact your supplier. They should have a replacement ready for you.

2.3.3 Redundant Power Supplies

The IFT-6330-12 has two independent, 2-redundant power supplies. Each supply is capable of providing all necessary power to the array and enclosure. Both power supplies provide power to the system when both are functioning.

If a power supply fails, 2-the failure will be detected by the RAID controller, 2-the failure will be recorded in the Event Log, 2-the Attention LED will light, 2-and the alarm will sound. Each power supply also has a status LED. The LED is green when the power supply is operating properly and turns amber if the power supply fails.
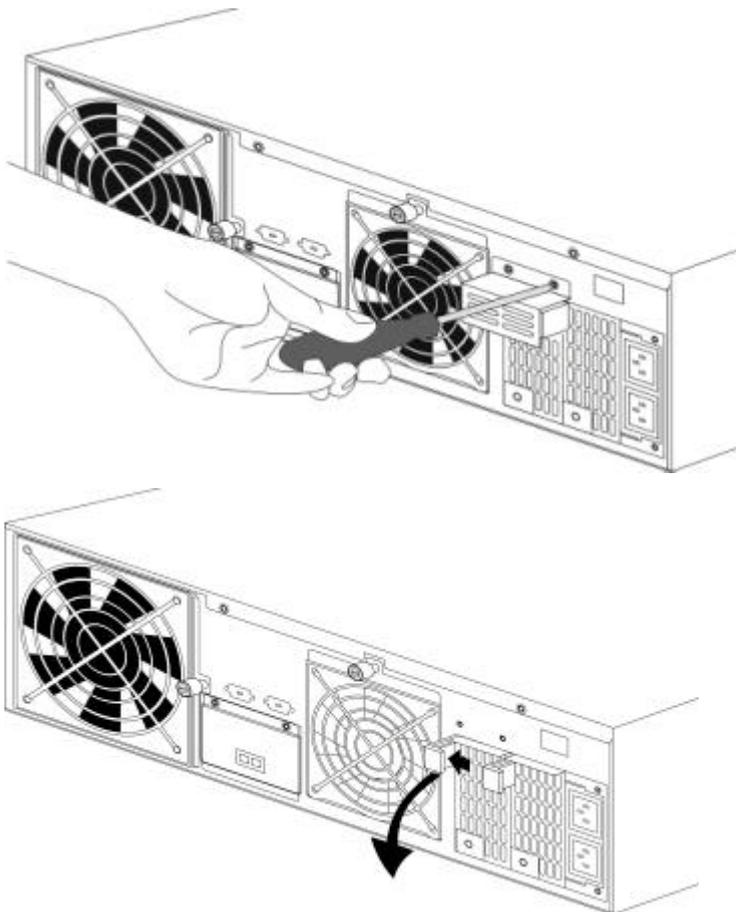
Figure 2-7: Removing a Power Supply (12 bay system)

Remove the two screws that secure the guard cover on enclosure bulkhead right over the back of the power supply modules.

Snatch the ends of retention latch together to release the module from canister. While pulling the module out of the enclosure, 2-exert a downward force on the retention latch until it is tilted forward at a thirty degree angle.

Note that a new module can only be installed into the enclosure when the latch is pulled outward to a thirty degree angle.

Before sliding a new power supply into the unoccupied bay, 2-you must suspend data transmissions from the array host. In general, 2-to do this requires pausing all services and software that may access the data on the array.

WARNING!

If data is still being sent and received when a new power supply is installed in the unit, 2-it is possible you will encounter data errors.

Once data I/O has been suspended by the host, 2-a new power supply can then be gently slid into the unoccupied space. We recommend that you contact your supplier to acquire a replacement power supply to maintain the security provided by power supply redundancy.

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Chapter 3

Troubleshooting

3.1 Controller

Problems with the controller fall into two categories, serious and disastrous. The controller is the only major component in the IFT-6330-12 that can cause a fatal failure on its own.

After the system POST is complete, the controller will begin initializing the RAID. The following message will be displayed by the LCD panel:

```
Initializing...
  Please Wait...
```

If everything is working normally, shortly after this message, the system should be up and running. The LCD panel will display the Ready screen and the status in RAIDWatch will indicate Ready.

3.1.1 Problems at Startup

Controller failure at startup will most likely result in a failure to initialize the RAID. If your system hangs at this point of the power-up (wait at least 5 minutes before deciding that the system is stuck), power off, wait 10 seconds, and try again.

Attempt this remedy three times, if the system still does not initialize, check all other components for good connections and status as indicated by LEDs.

3.1.2 Other Problems

The controller is the heart and brain of a RAID array. If, during normal operations, the controller fails the most obvious symptoms will be that the LCD does not light and the array is inaccessible.

NOTE:

Once the POST and RAID initialization are completed (meaning that the controller is functioning properly), any subsequent failures or problems will most likely generate an event message in the array event log.

3.2 Enclosure

The enclosure elements (power supplies, fans, drive trays, LED indicators, ports) are, in most cases, monitored by the RAIDWatch GUI software through the controller (which also monitors and records problems), so problems with them will be displayed in the status window of RAIDWatch.

NOTE:

Detailed information about how to remove and replace power supplies and fans is included in *Section 2.3 Redundancy and Hot Swap*.

3.2.1 Power Supplies

The system comes with two, hot-swappable, redundant power supplies, each of which can supply sufficient power for the entire array indefinitely.

If a power supply fails, a variety of things will happen. The event will be recorded in the array event log by the controller. At the same time, the system alarm will sound and the Attention LED will light. If you are using RAIDWatch to monitor the array, you will see the Status change from Ready to Error, and the array symbol will display the back of the unit with the power supplies highlighted red. On the power supply itself, the status LED will change from Green to Amber, indicating which power supply has failed.

The status LED of a power supply will change from green to amber on the back of system.

Because the unit comes with redundant power supplies, it is possible to replace a failed power supply without powering down the system.

To determine which power supply has failed, carefully examine the LED of both supplies. The LED of a failed power supply should be amber or red. If you are uncertain which power supply has failed, power down the host and make certain that the array cache is empty BEFORE removing a power supply.

To check the cache, press the down arrow button once from the LCD Ready display. If it reads "Empty," there is no data in the cache and you may safely power down or remove a suspect power supply.

NOTE:
The RAIDWatch error readout for the power supplies is unable to display *which* power supply has failed. The display highlights both power supplies, but that does not mean both have failed.

To remove a power supply, Face the back of the system and determine which power supply has failed. The power cord on the upper position connects to the power supply unit on the left, while power cord on the bottom connects to the unit on the right.

To replace the unit, remove the guard cover and snatch the ends of the retention latch on the back of the unit together to release it from chassis. The guard cover prevents unauthorized access to the power supply units. Pull the unit with sufficient and slightly downward force to disengage the power supply module from the chassis.

Before sliding a new power supply into the unoccupied bay, it's better to suspend data transmissions from the array host. In general, to do this requires pausing all services and software that may access the data on the array.

WARNING!

If data is still being sent and received when a new power supply is installed in the unit, it is possible you will encounter data errors.

Once data I/O has been suspended by the host, a new power supply can then be gently slid into the unoccupied space.

3.2.2 Fans

The system also comes with two hot-swappable cooling fans. Both fans are necessary to maintain adequate airflow throughout the enclosure, particularly over extended periods of time.

If a fan fails, it will register as an error event and be logged and available both via the LCD panel and in RAIDWatch.

Removing a failed fan and installing a replacement is a fairly complex process:

12-bay System –

Step 1: Use a Phillips #1 screwdriver to remove the four fasteners that secure the fan and the fan shield.

Step 2: Each fan housing is mounted on a swivel. To open the housing, loosen the hand screw to the right of the fan.

Step 3: Disconnect the power cable for the failed fan. It is located in the middle of the fan and can be disconnected by squeezing the connector to release it and then pulling gently.

Step 4: Gently slide the fan out of the housing.

Step 5: Put a new fan in the unoccupied space, being careful that the front of the fan (the side with a sticker) faces out and that the fan wire runs from the top right corner of the fan.

Step 6: To install the replacement, slide it into the housing, noting the top-bottom and front-back orientation of the fan. The back of the fan should be towards the power connector and the cable at the top right of the fan should be oriented for ease of installation.

Step 7: Secure the mounting screws from the front of the fan housing with the fan shield, and reconnect power. Please be careful when connecting power cable, assuming that the system is still running, the fan will start up immediately.

Swivel the housing back in place, and tighten down the hand screw.

All displays and readouts should reflect that the fan error has been repaired.

3.2.3 Drive Trays

Drive trays as a component separate from drives are unlikely to encounter problems unrelated to a drive failure. In the event that you suspect a drive failure may in fact be a problem with a drive tray, shut down the host, remove the questionable drive and tray, and examine the power and data cables to see if they have come loose or are damaged. Please note that only one drive can be removed (among those configured into a logical drive) at any time when the system is powered on. Having two drives (trays) removed at a time will fail the array. Although in most cases, provided there is no host access, reinstall drives into the original position will make the controller to recognize the original RAID.

If, after checking the cables and returning the drive to its bay in the enclosure, the drive is still showing a failure, the drive itself has probably failed.

3.2.4 LEDs

LEDs, both on the enclosure and on each drive tray, are primarily used to indicate the status of the drives, power supplies, and array. Each of the LEDs listed below has a warning function:

- **Attention LED –** front panel, left side – when lit, indicates that some error has occurred.
- **Drive Fault LEDs –** at the top of the front panel, one for each drive bay – when lit, indicates that the drive in the corresponding bay has failed.
- **Power Supply LEDs –** On the bottom left of each power supply module – when lit green, the power supply is working; when lit amber, the power supply has failed. (Note that these are distinct from the power LEDs on each drive tray and on the main front panel.)

3.2.5 Ports

The ports on the IFT-6330-12 are not likely to fail even under the most strenuous circumstances. It is much more likely that a cable has failed, so the first thing to do if you suspect a port or cable failure is to replace the cable with one that is known to be good. If replacing the cable repairs the problem, the failure is with the old cable not the port. Note that a SCSI bus must be terminated at both ends.

3.2.6 Termination (SCSI)

When using SCSI devices, it is always necessary to pay careful attention to termination. A SCSI bus must be properly terminated at both ends. The IFT-6330-12 SCSI models come with a physical terminator attached to the port or to the SCSI port on the bottom. If the RAID array is the last SCSI device on the bus, simply attach it to the host using the unterminated SCSI port and an external SCSI cable.

If you want to daisychain other SCSI IFT-6330-12 arrays or other SCSI devices to your current SCSI IFT-6330-12, shut down all SCSI devices on the bus first. Once no devices on the bus are transmitting data, disconnect the terminator, connect the new SCSI device, terminate the bus (if it isn't already), and restart all devices. Note that termination must be on both ends of the SCSI bus, and only on both ends. (For information about Fibre connections, see Chapter 4.)

3.2.7 Replacement Parts

New fans, power supplies, trays, and other similar enclosure parts may be available from your supplier. Please note that replacement parts are *not* available directly from the manufacturer. We suggest that you contact your supplier in the event of a failure or damage to inquire about replacement part availability.

3.2.8 SODIMM

Instructions on SODIMM removal and replacement are available through your supplier should you wish to upgrade the memory yourself. Contact your supplier for information.

3.3 *Drives*

Drives sometimes fail. One purpose for a RAID array is to protect data integrity in the event of a drive failure. In a RAID1, RAID3, or RAID5 configuration, a single drive failure is not catastrophic. Data is not only protected, it remains available despite the drive failure.

If a drive fails, the Attention LED will light, the red Fault LED to the top of the bay will also light, the alarm will sound, the LCD will display an error icon, and the event log will record the drive failure.

3.3.1 Spare Installed

If the array has a spare drive already installed, the spare will automatically replace the failed drive.

NOTE:
It is highly recommended that you replace a failed drive even if you already have a spare. An installed spare provides an additional safeguard against future drive failures.

3.3.2 No Spare Installed

If there is no hot-ready spare drive installed, a single drive failure in a RAID1, RAID3, or RAID5 array will still not result in data loss or downtime. If a drive fails without a spare, remove the failed drive and replace it with a new one of equal or greater capacity.

The RAID controller will automatically rebuild the array once a new drive has been installed to replace the failed drive. The new drive can be installed in any unoccupied drive bay.

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Chapter 4:

Fibre Channel

Subsystems

At the current stage of development, Fibre-to-ATA model of the IFT-6330-12 comes in dual channel configuration. The dual channel model has two SFP connectors.

4.1 Physical

The primary physical difference between SCSI-to-ATA models and Fibre-to-ATA models are the host data ports. On Fibre-to-ATA models, the SCSI ports have been replaced by two port receptacles on the rear panel of the unit. Short wavelength optical connection is supported. See the figure below.
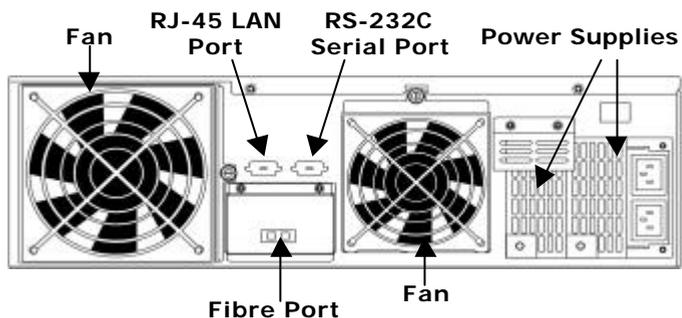
Figure 4-1 : Rear Panel, Single Channel Fibre-to-ATA Model

Note too that the SCSI ports are not present on Fibre-to-ATA models (for obvious reasons). All other physical aspects of Fibre-to-ATA models, front panel indicators and controls, hard disk compatibilities and tolerances, power supplies and fans, are identical to SCSI-to-ATA models as described throughout this User's Manual.

4.1.1 Host Requirements

In order for the IFT-6330-12F2D (Fibre models) to be connected to the host computer, the host must have a fibre host bus adapter installed and a SFP module. Most commonly, a host bus adapter (HBA) is an add-on card that includes external fibre ports used to connect with fibre devices, including the IFT-6330-12 array. It is necessary to use an SFP module to connect the HBA to the IFT-6330-12. If your HBA does not come with an SFP module, you will not be able to connect it to the IFT-6330-12. Please contact our technical support to obtain IFT's Quality Vendor List (QVL) to determine which SFP modules and HBAs are compatible with the IFT-6330-12.

Use Fiber optic cables to connect to host. If connection to host is made to a GBICs converter, an LC-SC cable may be used. You may use cables recommended by your HBA manufacturer. Do not bend or allow the cable to be damaged following the instructions by the manufacturer of the cable you select.

Please note that there is no by-pass circuits along the host port. By-pass circuitry must be provided with a Fibre hub or switch.

Once the array has been connected, you must reboot the host and then assign the RAID array a drive letter designation. Each OS has a different procedure for assigning drive letters to storage devices. Consult your particular OS's documentation and the documentation for your HBA for more information.

4.1.2 RAID Management

In addition to an HBA, host computers that want to use the RAIDWatch Java GUI management software must meet the following minimum configuration: Pentium or above compatible (or equivalent PC or workstation) running Windows NT or Windows 2000. A host computer running RAIDWatch must also either have a network (LAN) card installed and running or MS Loopback Adapter installed and running. (See the end of Section 2.4 for more information.)

If RS-232C terminal management is used, the IFT-6330-12 is compatible with Solaris (SPARC, x86) and Linux workstations and computers.

Appendices

These appendices provide basic information about the IFT-6330-12 ATA RAID subsystem, some vocabulary assistance to users who are new to RAID, and specifics about how to receive software support and product upgrades.

> **Appendix A :** RAID (RAID level descriptions)
> **Appendix B :** Specifications (primarily hardware)
> **Appendix C :** Glossary of Terms (primarily RAID-related)
> **Appendix D :** Upgrades and Software Support

A. RAID

Redundant Array of Inexpensive Disks (RAID) is a storage technology used to improve the processing capability of storage systems. This technology is designed to provide reliability in disk array systems and to take advantage of the performance gains offered by an array of multiple disks over single-disk storage.

RAID's two primary underlying concepts are (1) that distributing data over multiple hard drives improves performance and (2) that using multiple drives properly allows for any one drive to fail without loss of data and without system downtime. In the event of a disk failure, disk access will continue normally and the failure will be transparent to the host system.

Originally designed and implemented for SCSI drives, RAID principles have been applied to IDE drives in the IFT-6330-12.

NOTE:
The IFT-6330-12 has been designed to tolerate a single fault in any major component except the controller itself. Drives, fans, power supplies, one of any (or even "each" under worst case) can fail and data will still be maintained and available.

RAID has six levels : RAID 0 ~ 5. RAID levels 1, 3 and 5 are the most commonly used, while RAID levels 2 and 4 are rarely implemented.

The IFT-6330-12 does not support a non-RAID storage configuration, thus a minimum of two hard drives must be installed.

The following sections describe in detail each of the commonly used RAID levels.

IMPORTANT!
The IFT-6330-12 only supports RAID 0, RAID 1, RAID 3, RAID 5, 30, 50, NRAID, JBOD, RAID 1+Spare, RAID 3+Spare, and RAID 5 +Spare.


A.1 Non-RAID Storage

One common option for expanding disk storage capacity is simply to install multiple disk drives into the system and then combine them end to end. This method is called *disk spanning*.

(Note that the IFT-6330-12 does not support non-RAID storage.)

In disk spanning, the total disk capacity is equivalent to the sum of the capacities of all IDE drives in the combination. This combination appears to the system as a single logical drive. Thus, combining four 1GB IDE drives in this way, for example, would create a single logical drive with a total disk capacity of 4GB.

Disk spanning is considered non-RAID due to the fact that it provides neither redundancy nor improved performance. Disk spanning is inexpensive, flexible, and easy to implement; however, it does not improve the performance of the drives and any single disk failure will result in total data loss.

Non-RAID

2 + 3 + 1 + 2 = 8 GB Logical Drive
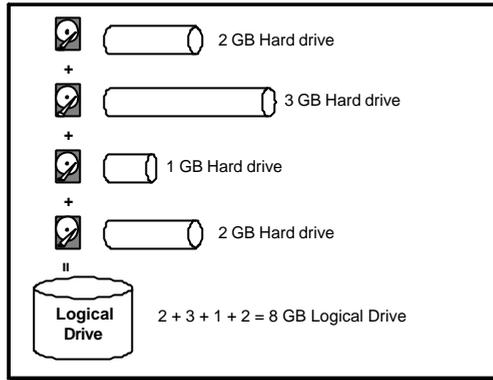
A.2 RAID 0

RAID 0 implements *block striping* where data is broken into logical blocks and striped across several drives. Although called "RAID 0," this is not a true implementation of RAID because there is no facility for redundancy. In the event of a disk failure, data is lost.

In block striping, the total disk capacity is equivalent to the sum of the capacities of all IDE drives in the array. This combination of drives appears to the system as a single logical drive.

RAID 0 provides the highest performance without redundancy. It is fast because data can be simultaneously transferred to/from multiple disks. Furthermore, read/writes to different drives can be processed concurrently.

RAID 0

Logical Drive — Physical Disks — Striping
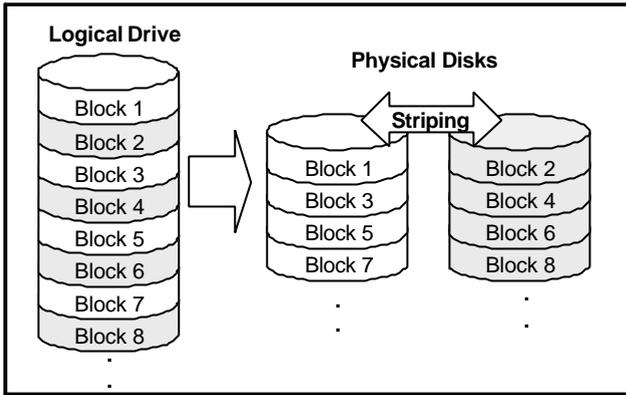
A.3 RAID 1

RAID 1 implements *disk mirroring* where a copy of the same data is recorded onto two sets of striped drives. By keeping two copies of data on separate disks or arrays, data is protected against a disk failure. If, at any time, a disk on either side fails, the remaining good disk (copy) can provide all of the data needed, thus preventing downtime.

In disk mirroring, the total disk capacity is equivalent to half the sum of the capacities of all IDE drives in the combination. Thus, combining four 1GB IDE drives, for example, would create a single logical drive with a total disk capacity of 2GB. This combination of drives appears to the system as a single logical drive.

NOTE:
One drawback to RAID 1 is that it does not allow running expansion. Once a RAID 1 array has been created, to expand it, the data must be backed up elsewhere before a new drive can be added. RAID levels 3 and 5 permit running expansion.

RAID 1 is simple and easy to implement; however, it is more expensive as it doubles the investment required for a non-redundant disk array implementation.

RAID 1

Logical Drive

Physical Disks

Mirroring
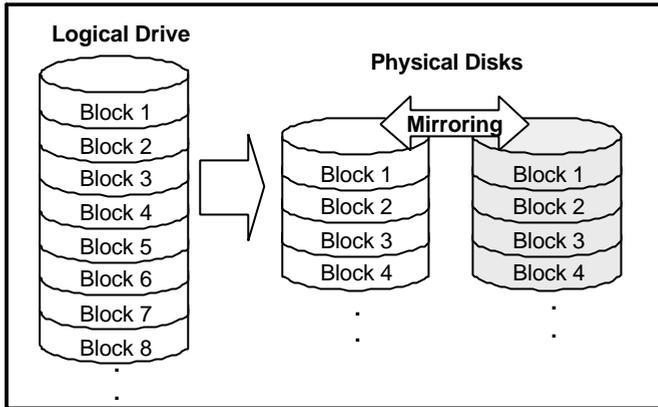
In addition to the data protection RAID 1 provides, this RAID level also improves performance. In cases where multiple concurrent I/Os are occurring, these I/Os can be distributed between disk copies, thus reducing total effective data access time.

A.4 RAID 1(0+1)

RAID 1(0+1) combines RAID 0 and RAID 1 – *mirroring and disk striping*. RAID (0+1) allows multiple drive failure because of the full redundancy of the hard disk drives. If more than two hard disk drives are chosen for RAID 1, RAID (0+1) will be performed automatically.

RAID 1 (0+1)

Physical Disks

Logical Drive

Striping

Block 1	Block 2
Block 3	Block 4
Block 5	Block 6
Block 7	Block 8

Mirror

Mirror 1	Mirror 2
Mirror 3	Mirror 4
Mirror 5	Mirror 6
Mirror 7	Mirror 8

Striping
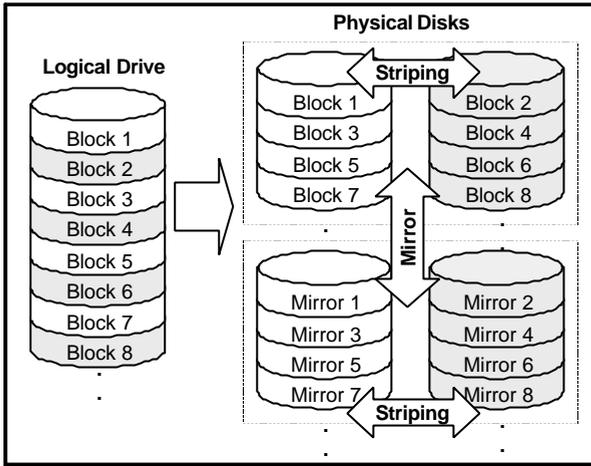
IMPORTANT:

RAID (0+1) will not appear in the list of RAID levels supported by the controller. If you wish to perform RAID 1, the controller will determine whether to perform RAID 1 or RAID (0+1). This will depend on the number of drives selected for the logical drive.

A.5 RAID 3

RAID 3 implements *block striping with dedicated parity*. This RAID level breaks data into logical blocks, the size of a IDE disk block, and then stripes these blocks across several drives. One drive is dedicated to parity. In the event a disk fails, the original data can be reconstructed from the parity information.

In RAID 3, the total disk capacity is equivalent to the sum of the capacities of all IDE drives in the combination, excluding the parity drive. Thus, combining four 1GB IDE drives, for example, would create a single logical drive with a total disk capacity of 3GB. This combination appears to the system as a single logical drive.

RAID 3 provides increased data transfer rates when data is being accessed in large chunks or sequentially. However, in write operations that do not span multiple drives, performance is reduced since the information stored in the parity drive needs to be re-

calculated and re-written every time new data is written to any of the data disks.

RAID 3

```
Logical Drive                    Physical Disks
                                              Dedicated
                                               Parity
  Block 1
  Block 2          ⟵  Striping  ⟶
  Block 3        Block 1    Block 2    Parity (1,2)
  Block 4        Block 3    Block 4    Parity (3,4)
  Block 5        Block 5    Block 6    Parity (5,6)
  Block 6        Block 7    Block 8    Parity (7,8)
  Block 7          .          .          .
  Block 8          .          .          .
    .
    .
```
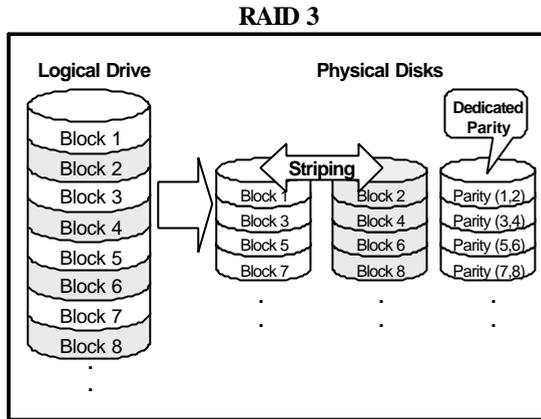
A.6 RAID 5

RAID 5 implements *multiple-block striping with distributed parity*. This RAID level offers the same redundancy available in RAID 3; though the parity information this time is distributed across all disks in the array. Data and relative parity are never stored on the same disk. In the event a disk fails, original data can be reconstructed using the available parity information.

RAID 5
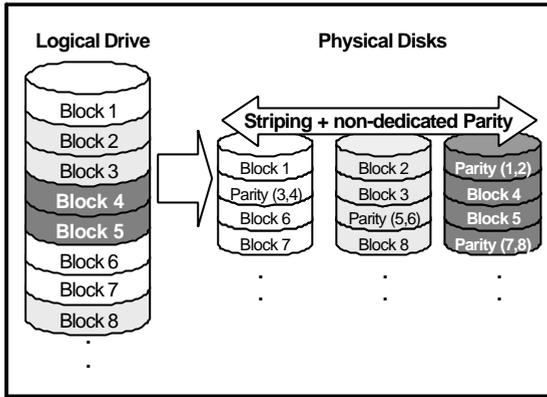
RAID 5 offers increased data transfer rates when data is accessed in large chunks (i.e., sequentially) and reduced data access time for many simultaneous I/O' s when they do not span more than one drive.

A.7 Spares

RAID implementations include one other basic concept that needs to be introduced at this point: spare drives. RAID levels that have redundancy, levels 1, 3, and 5 all allow users to include a drive as a "spare"(using QuickRAID Setup). Spare drives are installed, fully functioning, "hot-ready" hard drives which a RAID controller will use to replace a failed drive as soon as the failure is detected. The purpose of this, obviously, is to enhance the existing fault-tolerant capabilities of a RAID array. Spare drive implementations has been discussed in greater detail in earlier chapters.

If the multiple-array configuration is preferred in a subsystem, drives not selected as member drives automatically become global spares. A global spare automatically participates in the rebuild of any logical drive which has a failed member.

B. Specifications

Controller
• 64-bit PowerPC RISC processor with 256KB embedded L2 cache
• 128MB cache memory on SDRAM SODIMM
• 2 independent 66MHz/64-bit PCI buses
• Firmware in Flash ROM for easy upgrades

RAID Operation
• RAID level 0, 1(0+1), 3, 5, 30, 50, JBOD, and NRAID
• Hot-spare drive operation
• Drive hot-swapping
• Automatic background rebuild
• On-line drive expansion

Drive Interface
• ATA-133
• Twelve (12) hot-swap drive bays and trays
• Support for one inch height form factor disk drive

Host Interface
• Dual SCSI-160, transfer rate up to 160Mbytes/sec for each, or Dual 2Gb Fibre, transfer rate up to 200Mbytes/sec for each
• Concurrent I/O commands
• Tagged Command Queuing
• Automatic bad-sector reassignment
• Up to 14m cable length *(SCSI models); Up to 30m (copper) and up to 10km (optical Fiber)*
• One RJ-45 LAN Port

Controls / Indicators
• Front LCD control panel for setup and configuration
• 3 drive LED indicators: power, activity, drive fault
• Device failure indication through LCD
• Built-in alarm / Alarm Mute button

Accessories
• External SCSI cable *(SCSI models only)*
• Installed SCSI terminator *(SCSI models only)*
• RS-232C Null Modem port adapter

Management Software
• **RAIDWatch** management software for Windows 2000/NT via In-band Management (SCSI or Fibre)
• Firmware-embedded manager via RS-232C (platform independent)

Physical / Electrical		
• **Interfaces**	**SCSI Only** : 68-pin, LVD SCSI host channel	
	All Models : One DB-9 RS-232C serial port (38400, n, 8, 1) for terminal connection; one RJ-45 Ethernet connector for web-based management.	
• **Power Supply**	Two redundant hot-swappable power supplies with PFC	
• **Input**	90~260VAC, 47 to 63 Hz	
• **Output**	@12V (25A max.), 5V (20A max.), 350Watts in max for combined output power	
• **Cooling Fan**	Two cooling fans in two separate modules, one is 12cm, the other is 9.2cm, ball bearing for both, 12V DC in, thermal variable speed	
		9.2cm	12cm
	Rated current	0.23A	0.41A
	Max. airflow	72.2CFM	44CFM
	Rated speed	2600RPM	2250RPM
	Acoustic noise	35dBA	36.8dBA
	Measured when operating at 30°C		
• **Operating Temp.**	5 to 40°C	
• **Relative Humidity**	10-95%, non-condensing	
• **Altitude**	Sea level to 10,000 ft	
• **Body Dimensions**	134H x 482W x 510D millimeters	

C. *Glossary*

ATA   **AT A**ttachment – ATA is a disk drive implementation that integrates the controller on the disk drive itself. Also known as ATA, straight ATA supports one or two hard drives and a 16-bit interface.

ATA-133 Also known as UDMA-133, this is a new version of ATA that increases ATA's throughput to 133 MBps.

FC-AL   **F**ibre **C**hannel-**A**rbitrated **L**oop – a high bandwidth, full duplex mass storage data transfer standard for use over optical cable.

HBA   **H**ost-**B**us **A**dapter – an HBA is a device that permits a PC bus to pass data to and receive data from a storage bus (such as SCSI or fibre channel).

Host   A computer, typically a server, which uses a RAID system (internal or external) for data storage.

IDE   Abbreviation of either **I**ntelligent **D**rive **E**lectronics or **I**ntegrated **D**rive **E**lectronics. An IDE interface is an interface for mass storage devices, in which the controller is integrated into the disk drive. Although the term actually refers to a general technology, most people use it to refer the ATA specification. Refer to ATA for more information.

In-Band SCSI or **Fibre**   (sometimes "in-band" or "In-band" and also known as "In-band Management") A means whereby RAID management software can use SCSI or Fibre Channel cabling and protocols to manage a controller. (Note: in-band management is typically used in place of RS-232C for controller management.)

JBOD   **J**ust a **B**unch **o**f **D**rives – non-RAID use of multiple hard disks for data storage.

JRE   **J**ava **R**untime **E**nvironment – the Solaris Java program used to run .JAR applications locally or over a network or the internet.

LUN   **L**ogical **U**nit **N**umber **–** A 3-bit identifier used on a SCSI bus to distinguish between up to eight devices (logical units) with the same SCSI ID.

Mapping   The assignment of a protocol or logical ID to a device for purposes of data storage, data transfer, or device management.

MIA   **M**edia **I**nterface **A**dapter – a signal converter designed to convert standard DB-9 Fibre Channel signal interfaces to single- or multi-mode SC optics.

Mirroring   A form of RAID where two or more identical copies of data are kept on separate disks. Used in RAID 1.

NRAID   Non **RAID**

Parity   Parity checking is used to detect errors in binary-coded data. The fact that all numbers have parity is commonly used in data communications to ensure the validity of data. This is called parity checking.

RAID   Redundant Arrays of Independent Disks (Originally "Redundant Arrays of Inexpensive Disks"). The use of two or more disk drives instead of one disk, which provides better disk performance, error recovery, and fault tolerance, and includes interleaved storage techniques and mirroring of important data.

SCSI   **S**mall **C**omputer **S**ystems **I**nterface (pronounced "scuzzy") – a high-speed interface for mass storage that can connect computer devices such as hard drives, CD-ROM drives, floppy drives, and tape drives. SCSI can connect up to sixteen devices.

Spare   (Local / Global) A drive designation used in RAID systems for drives that are not used but are instead "hot-ready"

and used to automatically replace a failed drive. RAIDs generally support two types of spare, Local and Global. Local spares only replace drives that fail in the same logical drive. Global spares replace any drive in the RAID that fails.

Stripe   A contiguous region of disk space. Stripes may be as small as one sector or may be composed of many contiguous sectors.

Striping   Also called RAID-0. A method of distributing data evenly across all drives in an array by concatenating interleaved stripes from each drive.

WWNN   **W**orld **W**ide **N**ode **N**ame – a unique 64-bit identifier assigned to fibre devices to distinguish them from all other fibre devices.

WWPN   **W**orld **W**ide **P**ort **N**ame – a unique identifier assigned to fibre devices to help distinguish them from all other fibre devices.

D. Updates and Upgrades

Java Runtime Environment

JRE (Java Runtime Environment) is a shareware product from Sun/Solaris.
Two websites that may be of use relative to JRE are:
The main Java website URL:

java.sun.com

The JRE download website URL:

www.sun.com/software/solaris/jre/download.html

Software and Firmware Updates

Infortrend will provide RAIDWatch and controller firmware updates
periodically via our distributors and sales offices.

Uninstalling RAIDWatch

RAIDWatch agents and RAIDWatch Manager can be uninstalled. Choose
the Uninstall icon in the RAIDWatch group.

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