

FibreArray-12 Disk Enclosure

User's Guide

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Disclaimer

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The product description in this document is intended solely for use in operation, installation and maintenance of the Raidtec *FibreArray-12* Disk Enclosure. Use of this document for all other purposes, without prior written approval from Raidtec Corporation is prohibited.

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Trademarks

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Modifications

Changes or modifications not expressly approved by Raidtec Corporation could void the user's authorization to operate the equipment.

FCC Radio Frequency Interference Statement

This equipment generates, uses, and can radiate radio frequency energy. If not installed and used in strict accordance with the manufacturer's instructions, it may cause interference to radio and television reception. The limits are designed to provide reasonable protection against interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation.

NOTE: *This equipment has been tested and found to comply with the limits for a Class A computing device in accordance with the specifications in Subpart B of Part 15 of FCC rules.*

If this equipment does cause interference to radio or television reception, users are encouraged to try one or more of the following corrective measures:

- Reorient the receiving antenna.
- Relocate the computer with respect to the receiver.
- Move the computer away from the receiver.
- Plug the computer into a different outlet so that computer and receiver are on different branch circuits.
- Consult the dealer or an experienced radio/television technician for additional suggestions.

FCC Booklet Information

The following booklet, prepared by the Federal Communications Commission, may also be helpful in resolving interference issues: *How to Identify and Resolve Radio/TV Interference Problems*. This booklet is available from the U.S. Government Printing Office, Washington, DC 20401, Stock No. 004-000-00345-4.

Shielded Cables

SHEILDDED INTERFERENCE CABLE (S) MUST BE USED ACCORDING TO FCC 15.838D

Compliance

CANADA:

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

Le present appareil numerique n'emet pas de bruits radioelectriques depassant les limites applicables aux appareil numerique de la class A enoncees par les Reglements sur les brouillages radioelectriques emis par le Ministere des Communications du Canada.

EUROPE:



This device complies with EU EMC Directive 89/336/EEC and was assessed to the requirements of the following:
EN 55022-1994+A1, A2 CISPR 22 Class A.
EN 50082-1-1997 (EN 61000-4-2,3,4,5,6,11).

This product has been investigated in accordance to UL 1950.



This product was designed, developed, and manufactured under an NSAI registered I.S. EN ISO 9001 quality system.

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IMPORTANT SAFETY INSTRUCTIONS

General Precautions and Electrical Considerations

- **Read** all these instructions before setting up and using your system!
- **Follow** all warnings and instructions noted on the computer and in the operating instructions.
- **Save** these instructions for future reference.
- **Use** of a non-interruptible power supply is strongly recommended.
- **Do not** set up or use this device near water. Electrical shock and damage may occur if water shorts out high voltage parts.
- **Do not** block the cabinet vents or place this device in a built-in installation unless proper ventilation is provided. Blocking cabinet vent could cause installed components to overheat and operate unreliably. Avoid setting the device on a bed, sofa, carpet, pillow or other soft surfaces that can cover the cabinet vents.
- **Never** set the device on a radiator, heat register, or other heat source.
- **Never** insert foreign objects into the cabinet slots. Fire, electrical shock, and/or damage may occur if such objects short out high voltage parts.
- **Operate** the device using the correct type of AC power source, as specified on the label (typically, 115V/50Hz in the US and Canada; 230V/60Hz in the UK and Europe).
- **Plug** the power cord into a properly grounded electrical outlet to prevent electrical shock.
- **Do not** use adapter plugs or remove the grounding prong.

- **Replace** any obsolete outlet. If you use an extension cord with the system, use a 3-wire extension cord and make sure that the extension cord's ampere rating is sufficient to handle the load of all the equipment plugged into it.
- **Use** an approved surge suppresser to protect the equipment from erratic electricity.
- **Install** new or replace failed disk drives with UL listed or UL recognized disk drives ONLY.
- **Make sure** the total load of all devices attached to one cord or one outlet never exceeds 15 amperes. The wattage rating for most devices is listed on the label for the product.
- **Do not** set any object on the power cord. Situate the power cord away from traffic areas so it will not be stepped on or tripped over.
- **Prevent** static electricity from permanently damaging your electronic components. Handle components and cards with care. Avoid touching components and contacts on cards. If possible, hold the card by its edges or by its metal mounting bracket.
- **Do not** attempt to service this device yourself except as explained in the manual.

Please ensure the following precautions are observed when rack mounting the equipment:

- The maximum operating ambient temperature is 40° Celsius.
- The rear of the unit should have at least one foot of clearance to any other objects for ventilation.
- The unit should be powered from a dedicated branch circuit to prevent circuit overloading.

- The safety earth connection is provided by power supply cord. The power supply cord should be connected to an outlet that is grounded in accordance with the National Electric Code (NEC).

Contact service personnel for assistance if:

- A power cable or plug is frayed or damaged.
- The device is exposed to rain or water, or liquid has been spilled into it.
- The device is dropped or the cabinet is damaged.
- The device does not operate normally when the operating instructions are followed.

Cleaning Instructions

- Turn off the equipment and unplug it from the electrical outlet before cleaning.
- Use a slightly damp cloth for cleaning. Never apply liquid or aerosol cleaners directly to computing devices.
- If the device gets wet, unplug all system power cables and contact Raidtec Technical Support for assistance.

2. QUICK INSTALL CHECKLIST

The following checklist outlines the basic steps involved in getting your *FibreArray-12* enclosure(s) installed, configured, and running live. Consult the specific installation and configuration sections of this manual for detailed instructions on how to perform each step.

Step	Chapter
✓ Unpack and inspect enclosure components.	<i>Chapter 4. Hardware Installation; Safety Precautions & Unpacking Procedures</i>
✓ Install disk drives and additional <i>FibreArray</i> Port Bypass Module(s) (PBMs), if necessary in the <i>FibreArray-12</i> enclosure(s).	<i>Chapter 4. Hardware Installation; To Install or replace a Disk Drive and To Install Port Bypass Module</i>
✓ Connect <i>FibreArray-12</i> enclosure components together via serial and Fibre Channel cables. Attach an RS 485 serial loopback to the SER 4 serial port on the last enclosure in your enclosure configuration.	<i>Chapter 4. Hardware Installation; Cable Connections for Single and Multiple Enclosure Configurations.</i>
✓ Install software on the host system.	<i>Chapter 7. FCRAIDmanLITE-12 User's Guide; and Chapter 6. EAM Configuration using Serial Tool.</i>
✓ Configure <i>FibreArray-12</i> enclosure(s).	<i>Chapter 5. Enclosure Configuration; Quick Configuration Checklist.</i>

NOTE: To power up a *FibreArray-12* enclosure, turn on the power switches at the rear of the enclosure one immediately after the other to avoid setting off the power supply alarm.

3. FEATURES

This chapter provides general information on the following:

- General *FibreArray-12* features.
- Environment Array Manager.
- LCD Control Panel Diagram.
- LCD control panel and icons.
- Service channel.
- Drive status LEDs.
- Fan Monitoring.
- Temperature Monitoring.
- Power Supply Monitoring.
- Communication Ports.
- Event notification.

FibreArray-12

The *FibreArray-12* is a Fibre Channel JBOD enclosure. A single *FibreArray-12* takes up to twelve (12) standard, 3½" Fibre Channel drives. As a Fibre Channel Arbitrated Loop (FC-AL) enclosure, the *FibreArray-12* provides 100% uptime, fault tolerance and data loop continuity for all drives. Up to ten (10) *FibreArray-12* enclosures can be cascaded together, supporting up to 120 drives in a single loop.

The enclosure comes standard with a single Port Bypass Module (PBM) enabling 100MB/second data transfer in a single loop, you can add another optional PBM for up to 200MB/second. The Environment Array Manager (EAM) monitors drive presence, power, fan and ambient temperature (optional) with local and remote alerts.

The *FibreArray-12* comes with *FCRAIDmanLITE-12* software for enclosure configuration and alert monitoring. The LCD control panel is a factory fitted option. *FibreArray-12* enclosures can be tower or rack mounted.

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Disk Enclosure



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FibreArray-12

- **Port Bypass Module (PBM) functions:**
 - Single loop at 100 MB per second with single PBM (standard).
 - Dual loop adding an optional second PBM at 200 MB/sec.
 - 30 meter (copper) between PBMs with full signal regeneration.
 - 10km (FibreOptic) between PBMs with full signal regeneration (via a Media Interface Adapter (MIA) for Fibre Optic connections).

- **Environment Array Manager (EAM) functions:**
 - Direct interface via LCD control panel (optional).
 - Temperature, power, and fan monitoring and alerts.
 - RS-232 serial external interface for remote software control.

- **Backplane:**
 - Accepts twelve (12), 3½" FC-AL disk drives.

- **FCRAIDmanLITE-12 Software**
 - *FCRAIDmanLITE-12* software provides a 32-bit, Windows compatible GUI for *FibreArray-12* enclosure configuration, administration, and alert notification. This utility is available for operation in both Windows 95/98 and Windows NT environments.
***FCRAIDmanLITE-12's* graphical interface includes:**
 - Environment Monitoring.
 - Temperature sensor configuration.
 - Local and remote alarm administration.
 - Diagnostic features and event notification
 - Complete password protection for key configuration and diagnostic functions.

- **EAM Configuration Serial Tool**
 - This tool allows users to configure *FibreArray-12* enclosures IDs, enable temperature sensors and set temperature thresholds in instances where *FibreArray-12* enclosures do not have LCD panels. This utility is available for operation in both Windows 95/98 and Windows NT environments and can also be used under any terminal emulation software.

Environment Array Manager (EAM)

The FibreArray-12 Environment Array Manager (EAM) monitors temperature, fans, power supplies, disk presence, and disk fault status. The primary interface to the EAM is via the LCD display panel on the front of the enclosure. The EAM outputs appropriate status information in the form of drive LED indicators, LCD panel, and/or communication messages via the serial port to local or remote systems and applications such as the Raidtec *FCRAIDmanLITE-12* software.

The front panel LCD screen displays the *FibreArray-12* model and EAM release version numbers, the enclosure ID, and status information during normal operation of the enclosure. On initial power up, the default LCD message display provides enclosure identification similar to the following example.

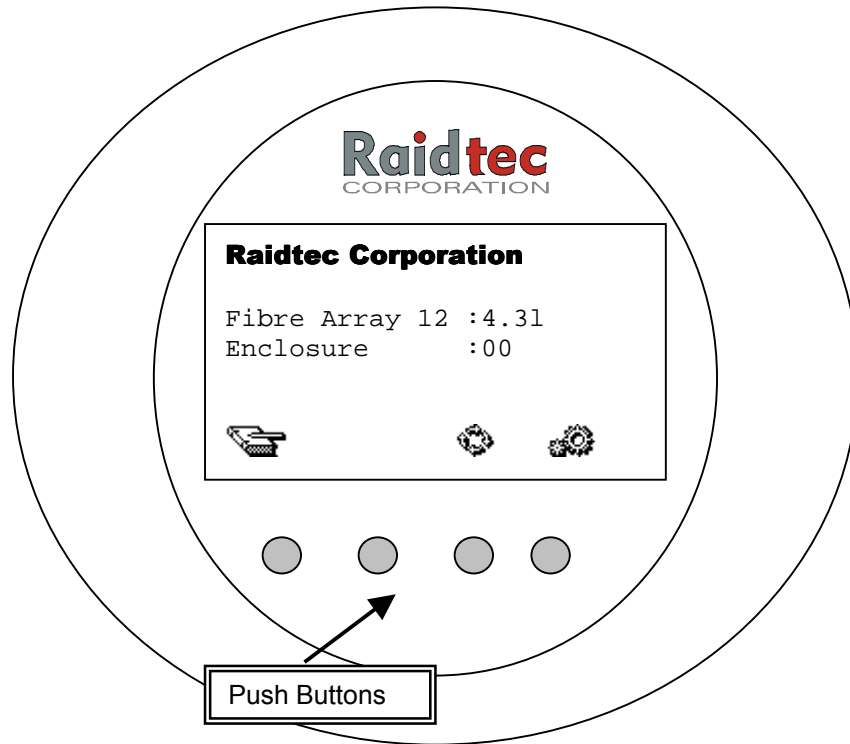
```
Raidtec Corporation  
  
Fibre Array 12 :4.31  
Enclosure      :00
```

The bottom line of the display is reserved for event notification.

LCD Control Panel Diagram

NOTE: *The LCD Control Panel is a factory fitted option.*

The following diagram illustrates the button locations and other visible features of a *FibreArray-12* Subsystem LCD control panel. Your LCD panel looks similar to the following example.



Use the tables on the following page to as a guide to using the buttons on the LCD panel.





LCD Panel Tables

Refer to these tables as a guide to the uses and functions of the *FibreArray-12* LCD Panel. The LCD panel has two sets of menu icons that represent the functions of the LCD buttons under the display.

- Main Menu Icons. Provide access to the various menus.
- Sub Menu Icons. Allow users to select options.




Main Menu Icon Table

The Main menu icons and their functions are as follows:

Button Label	Main Menu Icon	Function
ALARM RESET (ERROR LOG)	 	Displays only when the Error Log Alarm sounds. Press to halt the alarm and enter the Error Status Menu. Displays the Error Log.
RECREATE DRIVE (View/Rebuild RAIDset)		Not available in JBODS.
SELECT		This icon rotates when you perform an action on the RAIDmanLITE software and each time RAIDmanLITE sends a command to the EAM (every four or five seconds). The button clears the LCD display.
ENTER (CONFIGURATION)		Displays Configuration Menu.

Sub Menu Icon Table

The sub menu icons allow users to select and enter the options they want to use in the LCD panel sub menu.

Button	Sub Menu Icon	Function
UP		Scrolls up utility menu choices.
DOWN		Scrolls down utility menu choices.
ENTER		ENTER button, accepts choices.

Service Channel

The Raidtec Service Channel is the means by which the EAM monitors and configures *FibreArray-12* enclosure parameters. It is also how all PCBs in the enclosure communicate to the EAM.

Drive Status LEDs

Each *FibreArray-12* drive has three (3) associated LED indicators visible from the front of the enclosure. The following LED color indicators display each individual drive's status.

- Drive Error Red.
- Drive Activity Yellow.
- Drive Power Green.

A red LED also indicates the following:

- A red LED will remain flashing when a drive is initializing.
- A red LED will remain on when there is a fault with the drive.

Fan Monitoring

Six (6) rear mounted, fans provide cooling for the enclosure. These fans are attached to the fan backplane. The backplane monitors the fans for any abnormal current variations and flags a fan failure via the Service Channel to the EAM, the LEDs on the front of the enclosure and to *FCRAIDmanLITE-12*.

Temperature Monitoring

One (1) temperature monitor port is present by default, mounted on the EAM controller you can use the Configuration menu on the LCD panel to set appropriate thresholds. When the temperature exceeds the thresholds, any alerts generated are flagged through the EAM to the front panel LCD and the RS-232 port, if configured.

Power Supply Monitoring

The *FibreArray-12* power subsystem consists of two (2) hot replacement PSUs in an N+1 fault tolerant arrangement. Power distribution is via the power subsystem backplane. If there is a PSU failure, the appropriate front LED flashes on the front LCD panel and the EAM sends an alert to the Error Log alarm on the LCD control panel.

Communications Ports

You will find four (4) DB9 ports on the rear of the *FibreArray-12* enclosure labeled SER 1, SER 2, SER 3 and SER 4 respectively.

- SER 1 is not used on the *FibreArray-12* enclosure.
- SER 2 provides an RS 232 link for configuration and event notification via the *FCRAIDmanLITE-12* software (and the EAM configuration using Serial Tool software).
- SER 3 and SER 4 use RS485 multi-drop lines for multi-enclosure communication.

NOTE: *In instances where your FibreArray-12 enclosures do not have LCD panels you can use SER 2 to configure your enclosure IDs via EAM Configuration using Serial Tool. (See Chapter 6. EAM Configuration using Serial Tool.)*

Event Notification

The front LCD panel display and indicators are the primary interface for event notification and error reporting features. Depending on the event, the EAM will operate the following alerts:

- Sound an audible alarm.
- Flash the appropriate LED indicator.
- Display the Error Log Alarm icon on the LCD panel.
- Communicate an alert message to via SER 2 to the *FCRAIDmanLITE-12* administration software.

4. HARDWARE INSTALLATION

Use the information in this chapter to do the following:

- Check and unpack the *FibreArray-12*.
- View enclosure diagrams.
- Install or replace a disk drive.
- Install or replace a Port Bypass Module (PBM).
- Unlock/lock a Power Supply Unit (PSU).
- Connect cables for single and multiple enclosure configurations.

Safety Precautions & Unpacking Procedures

Place your *FibreArray-12* disk enclosure component box(es) near the location(s) where they will be permanently installed. During the unpacking and installation process, please observe the following precautions.

- **Open all boxes carefully** to prevent any damage to the contents.
- **Observe proper electrostatic protective measures** including use of a ground strap, when handling Electro Static Discharge (ESD) Sensitive Devices such as the *FibreArray-12* Port Bypass Module (PBM) and disk drives.
- **Check components & accessories shipped against packing lists.** If the contents do not match the packing lists, contact your Supplier or Raidtec sales representative immediately for assistance.
- **Perform a visual check** on your *FibreArray-12* enclosure(s), accessories and optional equipment for any physical damage that may have occurred during shipment.

NOTE: *Interstate commerce rules require immediate reporting of goods damaged in shipment (usually within 24 hours) in order to receive compensation for damage or losses from the shipper.*

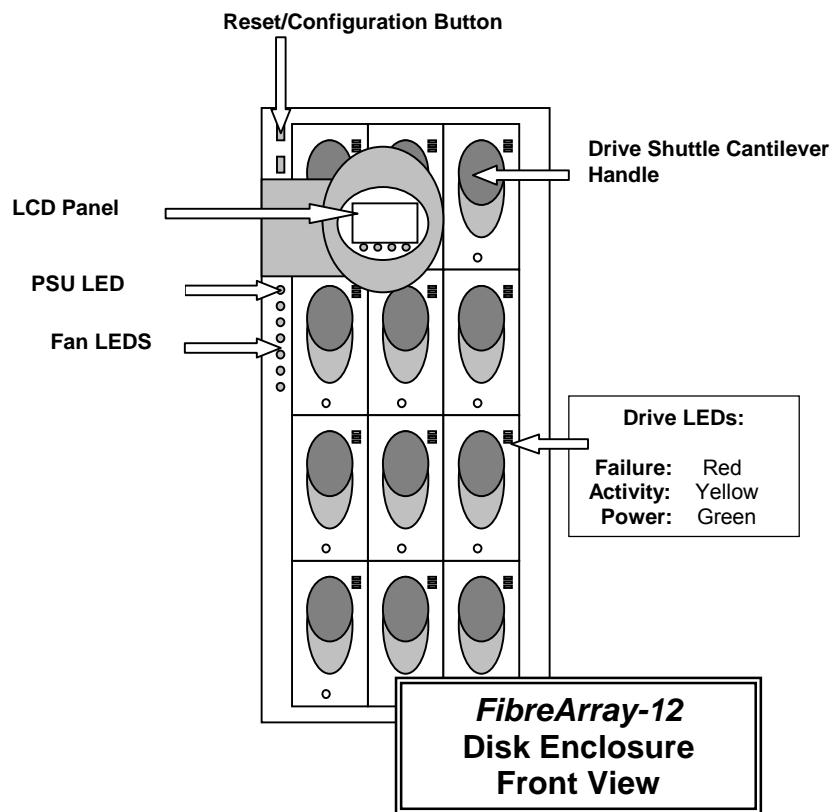
- **Save all boxes and packing materials** received in the original shipment of your *FibreArray-12* components and accessories in case you need to transport or ship your *FibreArray-12* enclosure.

NOTE: *To maintain adequate air flow and maximum cooling in the FibreArray-12 enclosure(s), remove all packing material.*

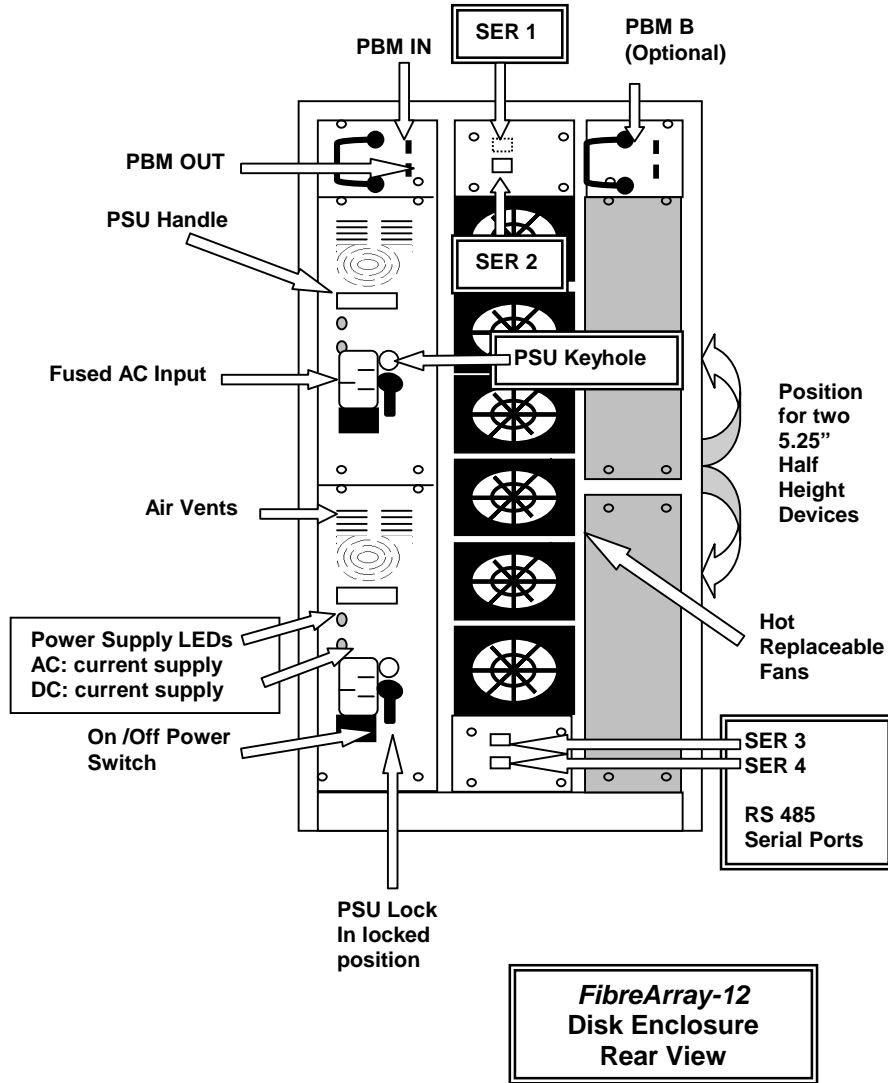
- **Complete** and return your warranty registration card.
- **Retain your invoice.** All warranty repairs require proof of purchase. The product must be returned in the original packaging.

FibreArray-12 Front View

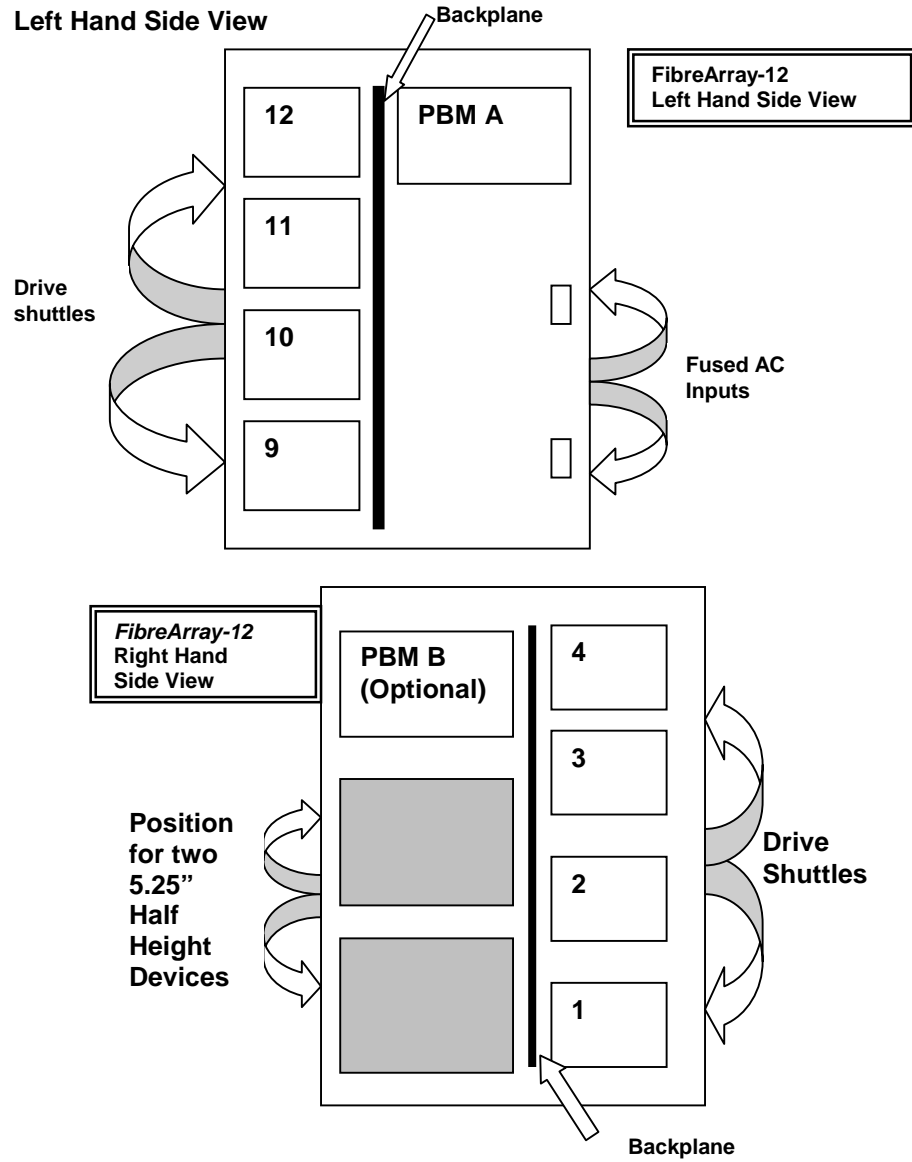
The following diagrams illustrate the general position of a *FibreArray-12* enclosure's internal and external connectors, components, and other visible features.



FibreArray-12 Rear View

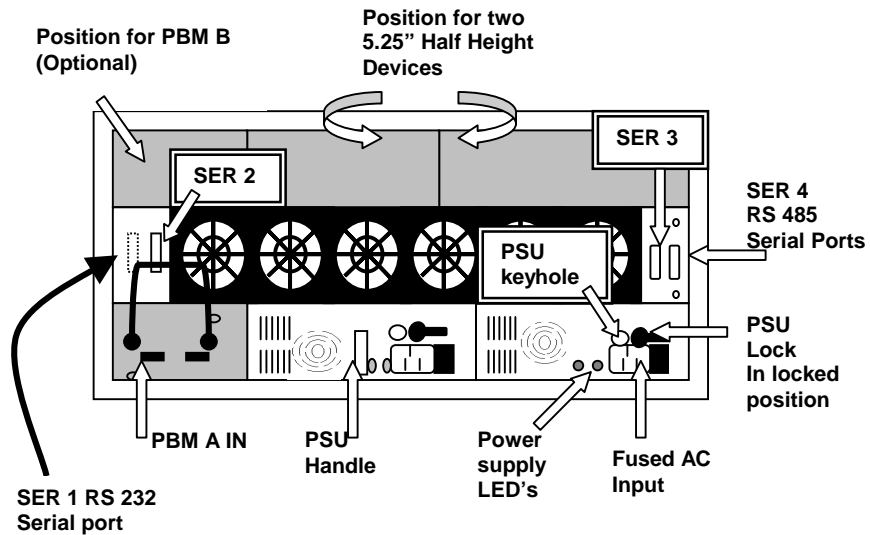
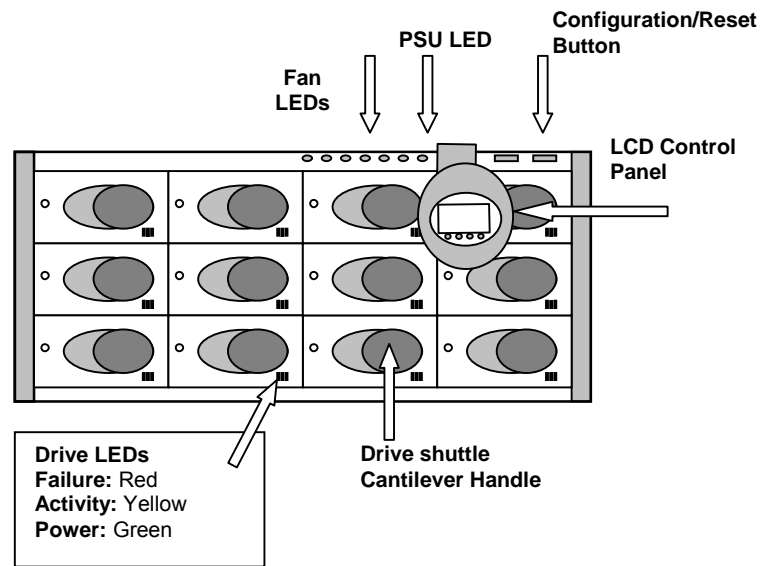


FibreArray-12 Side Views



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FibreArray-12 Rack Mount Version



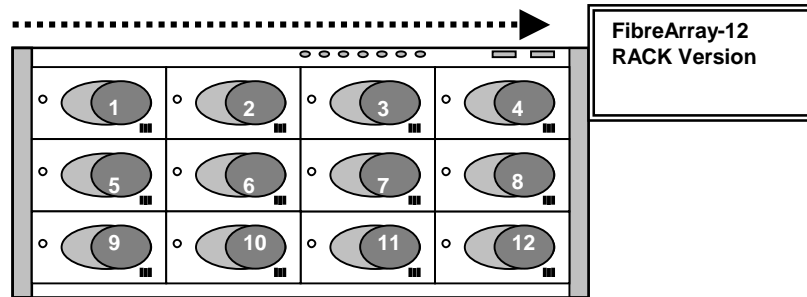
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Drive Order for FibreArray-12 Rack and Tower Versions

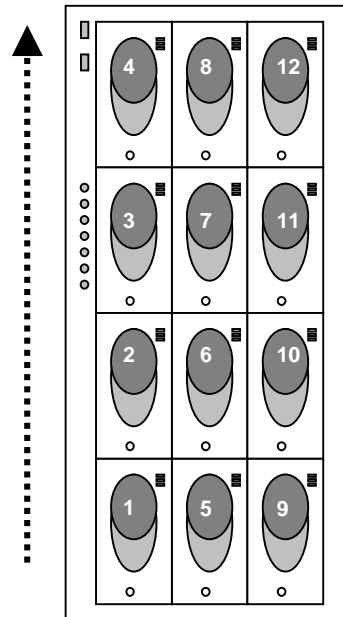
The drive IDs are in the following order for both rack and tower versions of the *FibreArray-12* disk enclosure.

NOTE 1: *On the Rack enclosure the order of the drive IDs runs from left to right, starting at the top left hand corner of the Rack Enclosure and ending at the bottom right hand corner of the enclosure.*



FibreArray-12
Tower Version

NOTE 2: *On the Tower enclosure the order of the drive IDs runs from the bottom to the top of the enclosure, starting at the bottom left hand corner, and ending at the top right hand corner of the enclosure.*



To Install or Replace a Disk Drive

The *FibreArray-12* disk drive shuttles are designed to take all 3.5" disk drives. The removable shuttle provides mounting holes for securely installing, 3.5" form factor, Fibre Channel-Arbitrated Loop (FC-AL) disk drives. Once installed in the shuttle, the disk drive's 40 pin, SCA connector mates correctly with the Fibre Channel (FC) backplane. (Raidtec-supplied FC-AL drives come pre-configured in shuttles ready for insertion into the *FibreArray-12* enclosure.)

Use the following instructions to:

- **Install a third-party drive.**
 - **Replace a drive.**
1. Insert the key in the lock, and turn the key to the right.
 2. While holding the key in this position, pull the shuttle handle forward. This action disconnects the drive's SCA interface and removes power from the disk drive.
 3. Release the key. If a drive is already installed in the shuttle, allow the drive to spin down completely before fully extracting the shuttle from the bay assembly.

NOTE: *Please observe proper electrostatic protective measures when handling disk drives.*

4. Place the shuttle on its side with the four sink hole slots facing upwards (see **Figure.1**) Insert the drive in the disk shuttle.

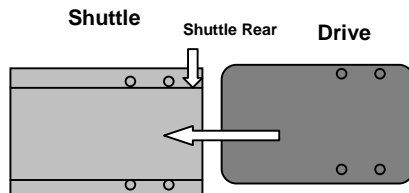


Figure 1. Drive Shuttle Side View.

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5. Position the disk drive so the rear 40 pin SCA drive connector is at the top side of the shuttle and that the rear of the drive is flush with the rear of the shuttle. (See **Figure 2.**)

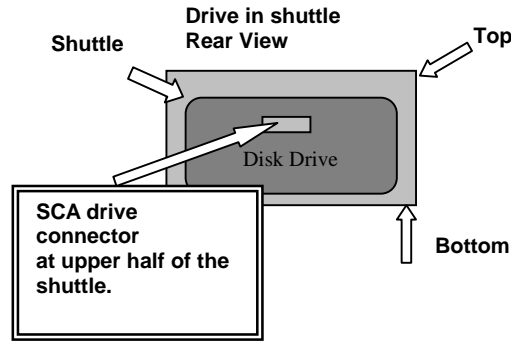


Figure 2. Drive Shuttle Rear Side View.

6. Secure the drive in the shuttle with the four screws provided. ***It is very important that the drive is securely fastened.*** The drive shuttle screws must be flush with the edge of the shuttle to ensure the shuttle fits smoothly into the enclosure. The proper fastening of the drive in the shuttle enables the shuttle to act as a highly effective heat sink. Return the shuttle to the upright position. The rear of the drive should now look like this.

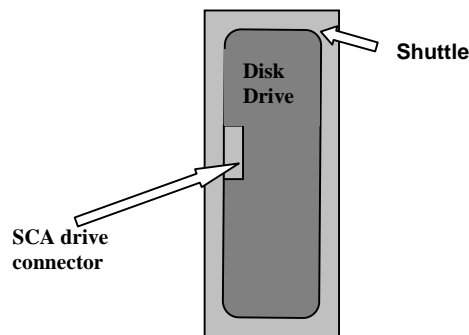


Figure 3. Drive Shuttle in Upright Rear View.

7. Insert the drive shuttle between the guide rails. Push the drive shuttle firmly to secure, the drive locks automatically upon insertion. Repeat steps 1 through 7 until you have installed all the drives.

8. To ensure optimum cooling in the enclosure, check that **all drive shuttles** are inserted in the enclosure irrespective of the number of disk drives you are using in the enclosure.

To Install a Port Bypass Module

You can install two (2) Port Bypass Modules (PBMs) in a *FibreArray-12* enclosure; one PBM for the “A” channel on the drives and one PBM for the “B” channel. *FibreArray-12* enclosures come standard with PBM-A installed in the left-hand PBM slot on the rear of the enclosure.

Use the following information to:

- **Install a second PBM.**
- **Replace an existing PBM.**

1. Remove the PBM from its protective wrapping and from the anti-static bag.

NOTE: *Please observe proper electrostatic protective measures when handling the FibreArray PBM and other Electro Static Discharge (ESD) Sensitive Devices.*

2. If you are adding a new PBM, unscrew and remove the blanking plate on the top left-hand side panel on the rear of the *FibreArray-12* enclosure.
3. If you are replacing an existing PBM, disconnect the DB9 connectors and remove the existing PBM from its slot.
4. Orient the PBM so the mounting **face plate handle** is on the **left**.

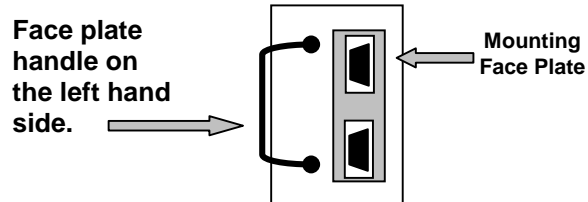


Figure 1. Mounting Face Plate Handle.

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5. Align the top and bottom metal mounting bracket edges with the guide rails on the **extreme right-hand side**, inside the open PBM slot.
6. Carefully slide the PBM along the guide rails **on the extreme right hand side** inside the open PBM slot until the backplane connector is firmly seated.

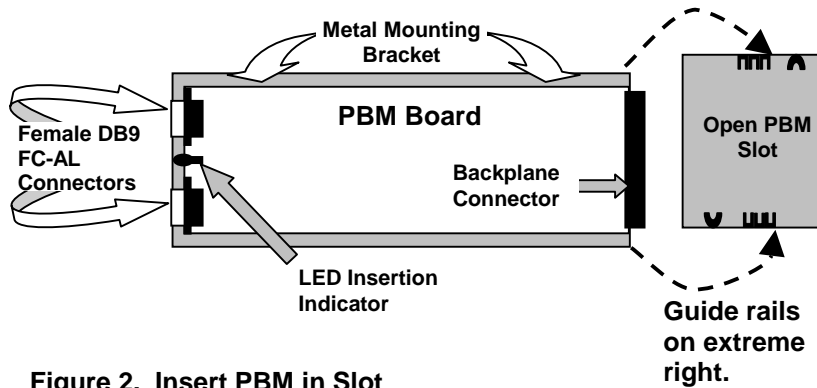
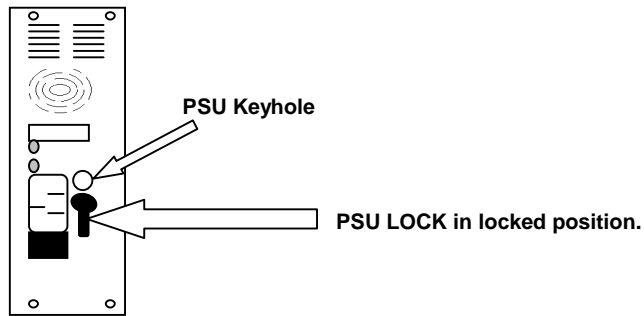


Figure 2. Insert PBM in Slot

7. When the PBM is fully inserted and power is on, the red LED insertion indicator illuminates.
8. Secure the mounting face plate to the enclosure with the screws provided.
9. If you are replacing an existing PBM, reconnect the DB9 connectors as they were originally.
10. If you are adding a PBM to an existing host system, or this is a new installation, refer to the Single and Multiple Enclosure Configuration diagrams on the following pages of this chapter for connection recommendations.

Power Supply Unit Lock

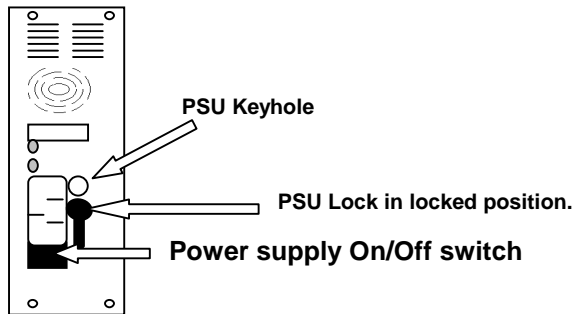
On each Power Supply Unit (PSU) on your *FibreArray-12* enclosure there is a Power Supply Unit (PSU) Lock. The PSU lock secures the PSU into place on the *FibreArray-12*.



Power Supply Unit in locked position.

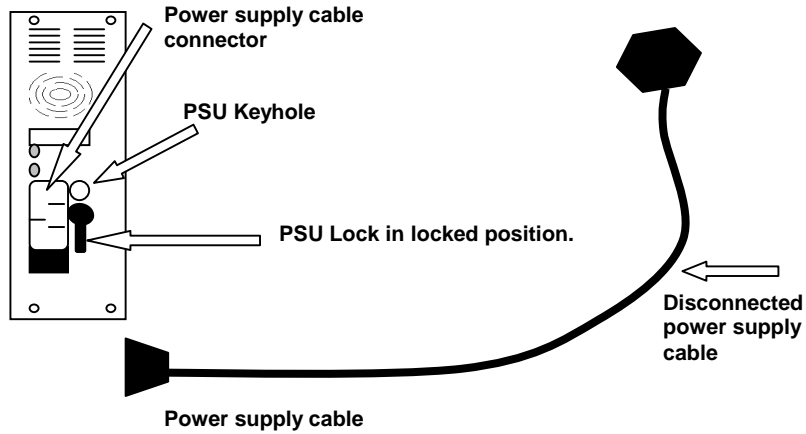
To Unlock a Power Supply Unit

1. Press the power supply switch on the rear of the power supply unit to the **OFF** position.

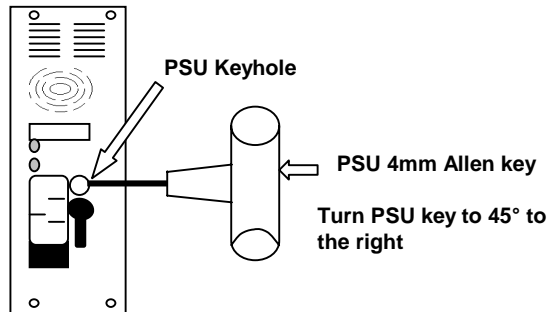


Power supply unit switched off.

2. Disconnect the power supply cable from its socket and remove the power supply cable from the rear of the power supply unit. You cannot unlock the power supply unit without first removing the power supply cable from the power supply unit.

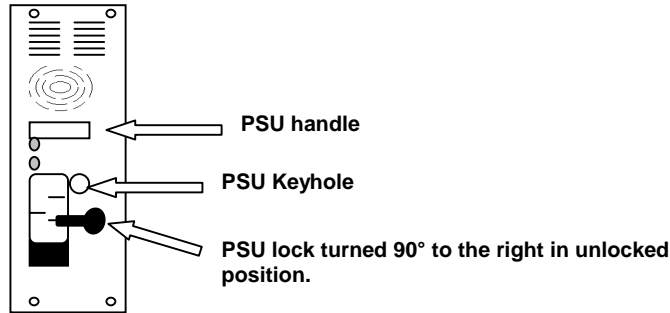


3. Insert the PSU Allen key into the PSU lock and gently **turn the Allen key** approximately **45° to the right**.



Insert PSU Allen key into PSU lock and turn key 45° to the right.

4. Turn the **PSU lock 90°** to the **right**. The PSU is now in the unlocked position. You cannot connect the PSU to a power supply cable while the power supply unit is in the unlocked position.

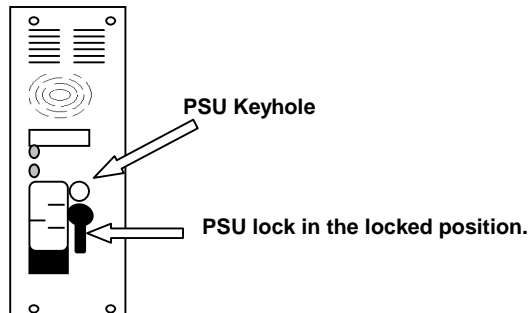


PSU lock turned 90° to the right in unlocked position.

5. You can remove the power supply unit from the *FibreArray-12* when the PSU lock is in the unlocked position.
6. To remove the power supply unit, hold the power supply unit (PSU) handle and gently pull the power supply unit towards you. The power supply unit should slide out towards you from the guide rails.
7. To re-insert a power supply into the *FibreArray-12*, check that the PSU lock is in the unlocked position and gently guide the PSU along the guide rails and back into the *FibreArray-12*. Once the PSU is re-inserted into the *FibreArray-12* you can lock the PSU into place using the instructions under the heading on the following page, *To Lock a Power Supply Unit*.

To Lock a Power Supply Unit

1. To lock the power supply unit, turn the power supply 90° to the left to return to the locked position. The power supply unit is now secured into position in the *FibreArray-12*. If you want to remove the PSU from the *FibreArray-12*, you will need to use the PSU key again to unlock the PSU.



Power Supply lock in the locked position.

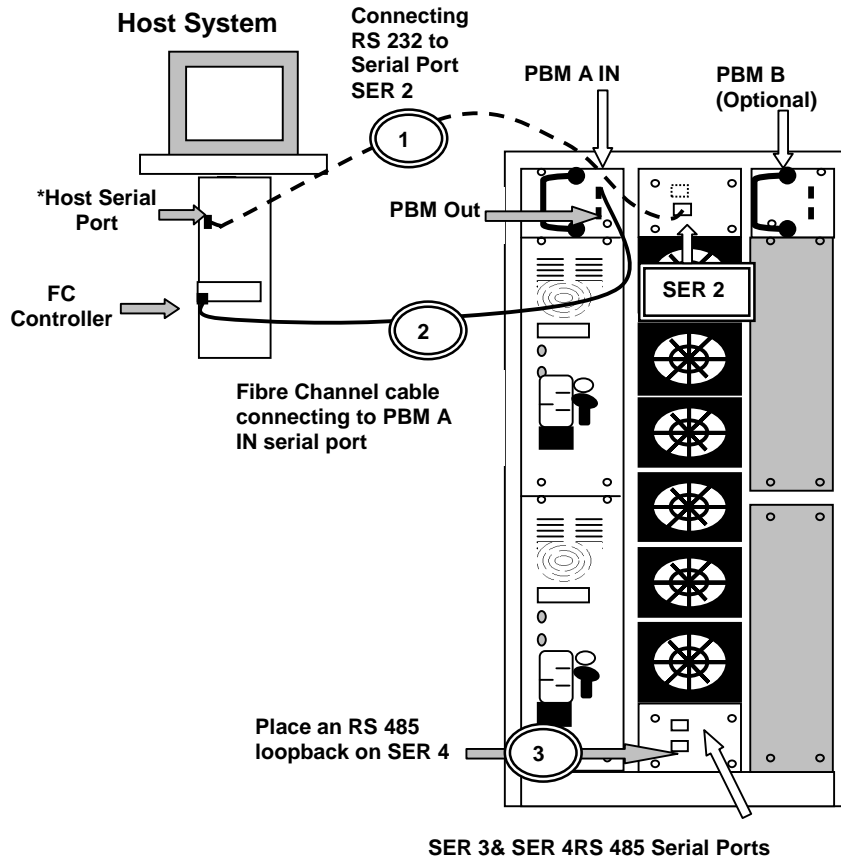
Cable Connections for Single Enclosure Configuration

1. Connect an **RS 232 cable** from a host **serial port** on the **host system** to **SER 2** on the *FibreArray-12* (enclosure 0). This cable runs *FCRAIDmanLITE-12* (or if necessary, the *EAM Configuration Serial Tool*) software.
2. Connect a **Fibre Channel cable** from the **FC controller** on the **host system** to the **PBM A IN** port on the *FibreArray-12* (enclosure 0).
3. Use an **RS 485 loopback** to plug the **SER 4 serial port** on the **last enclosure** in the configuration.

NOTE: *You do not need terminators for the PBM. The PBM is a self terminating PBM.*

Single Enclosure Configuration

The following diagram shows the cable connections between the host system and the *FibreArray-12* enclosure.



FibreArray-12 Enclosure 0

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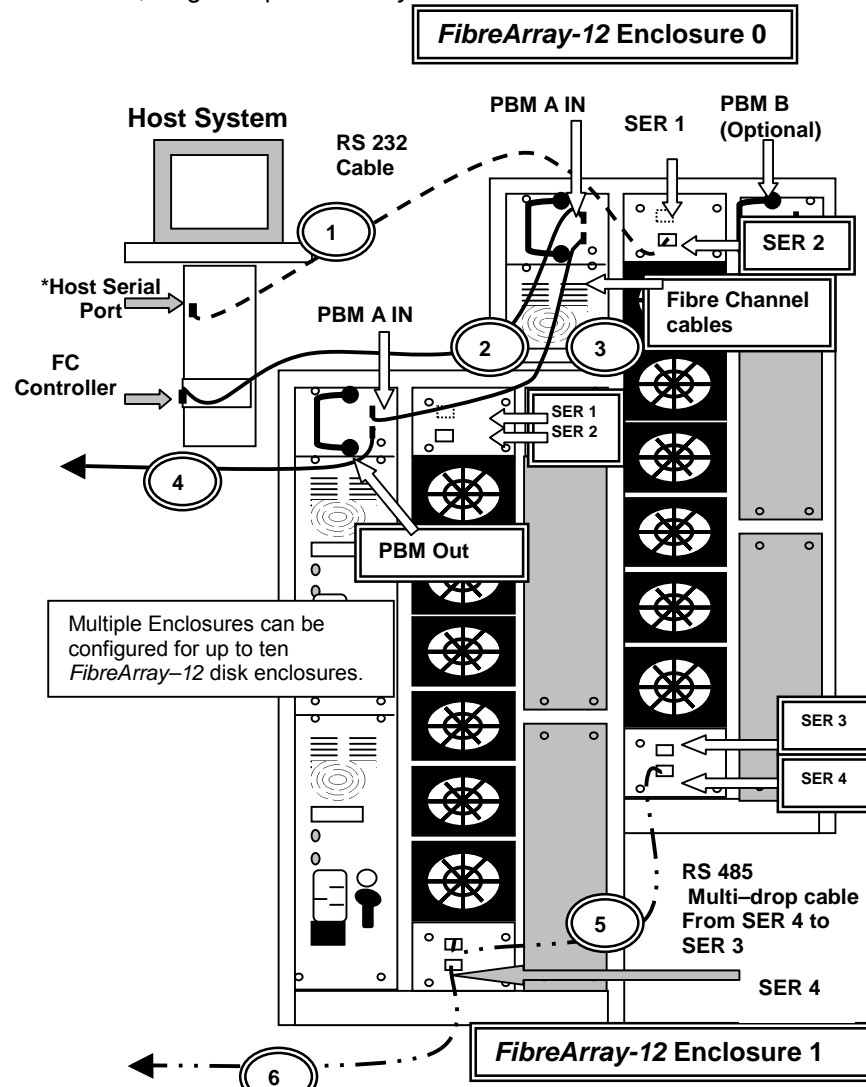
Cable Connections for Multiple Enclosure Configuration

1. Connect an **RS 232 cable** from a **host serial port** on the **host system** to **SER 2** on the **FibreArray-12** (enclosure 0). This cable runs *FCRAIDmanLITE-12* (or if necessary, the *EAM Configuration Serial Tool*) software.
2. Connect a **Fibre Channel cable** from the **FC host controller** on the **host system** to the **PBM A IN port** on (enclosure 0).
3. Connect a **Fibre Channel cable** from the **PBM A OUT port** to on the rear of the **FibreArray-12** enclosure (0) to the **PBM A IN port** on (**enclosure 1**).
4. Connect the **next Fibre Channel cable** from the **PBM A OUT port** on (enclosure 1) to the **PBM A IN port** on (enclosure 2). Continue with this procedure until you have connected all your enclosures up to the maximum of ten enclosures.
5. Connect an **RS 485 multi-drop cable** from **SER 4** on the **FibreArray-12 (enclosure 0)** to **SER 3** on (**enclosure 1**).
6. Connect the **next RS 485 multi-drop cable** from **SER 4** on (**enclosure 1**) to **SER 3** on (**enclosure 2**).
- Continue with these two steps until you have connected all your enclosures up to a maximum of ten *FibreArray-12* disk enclosures.
7. Use an **RS 485 loopback** to plug the **SER 4 serial port** on the **last enclosure** in the configuration.

NOTE: *You do not need terminators for the PBM. The PBM is a self terminating PBM.*

Multiple Enclosure Configuration

The following diagram shows the cable connections for multiple enclosures, single loop *FibreArray-12*.



Multiple Enclosures can be configured for up to ten *FibreArray-12* disk enclosures.

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5. ENCLOSURE CONFIGURATION

This chapter describes how to configure each enclosure using the LCD Control Panels on the front of each *FibreArray-12* enclosure.

To begin enclosure configuration, you must first configure each enclosure's ID. You can do this through each individual *FibreArray-12* enclosure's LCD panel.

If your enclosures **do not have LCD panels** you can configure your enclosure IDs via EAM Configuration using Serial Tool. You can also use this option to enable temperature probes and to set temperature thresholds. For more information on this option, refer to *Chapter 6. EAM Configuration using Serial Tool*.

Use the following instructions to:

- Configure the *FibreArray-12* (enclosure 0) ID.
- Enable temperature setting.
- Change Buzzer settings (optional).
- Configure expansion enclosures' IDs and enable temperature settings.

Once you have used either of these options, to configure enclosure IDs, enable temperature sensors and set temperature thresholds you can use *FCRAIDmanLITE-12* to monitor and reconfigure any changes in the enclosures in your subsystem.

NOTE 1: *When you enter the LCD Configuration Menu all GUI communications are disabled.*

NOTE 2: *The LCD control panel is a factory fitted option with the *FibreArray-12* enclosure. In instances where your *FibreArray-12* enclosures do not have LCD panels you will need to configure enclosures IDs via EAM Configuration using Serial Tool (see Chapter 6. *EAM Configuration using Serial Tool*) before you can use *FCRAIDmanLITE-12* to monitor the enclosures in your configuration.*

Quick Configuration Checklist

The following checklist outlines the basic steps involved in getting your *FibreArray-12* enclosure(s) up and running. Consult the specific configuration sections of this manual for instructions on how to perform each step.

- ✓ Verify all enclosure hardware and software (adapter and *FCRAIDmanLITE-12*) components are installed on your host system connected to the *FibreArray-12* disk enclosure.
- ✓ Verify in both single and multiple enclosure configurations, that there is an RS 485 serial loopback on SER 4 on the last enclosure in the configuration.
- ✓ Configure all the *FibreArray-12* enclosure IDs via the LCD control panel on the front of each enclosure or (if your enclosures do not have LCD panels) via EAM Configuration using Serial Tool.

NOTE 1: *The Master Unit FibreArray-12 enclosure must be set to Enclosure ID 0 to enable serial port (SER 2) communication with the host system for use with the FCRAIDmanLITE-12 software.*

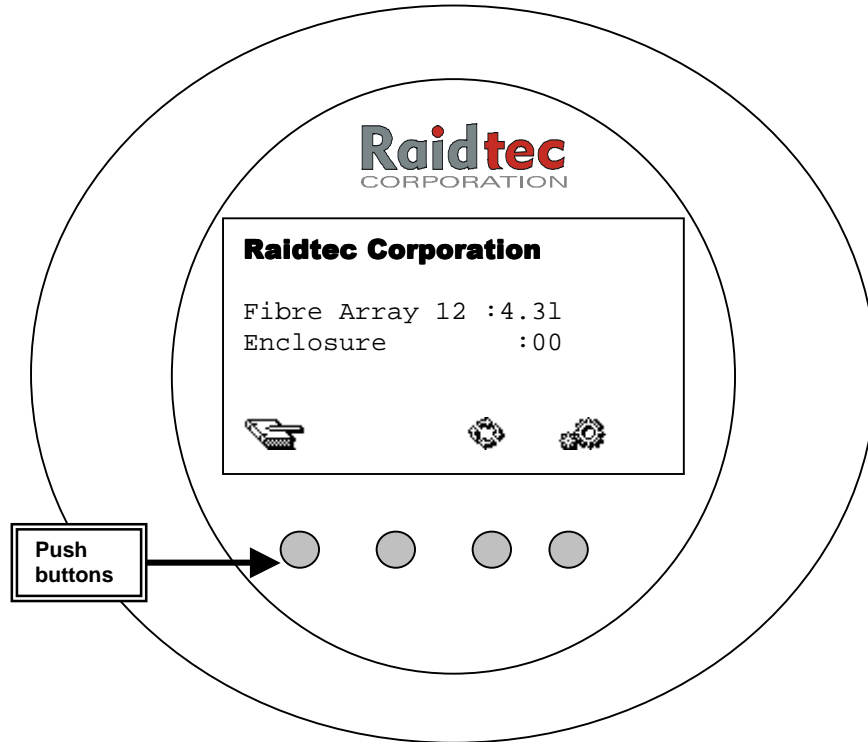
NOTE 2: The **Master Unit** in a multiple enclosure implementation **does not** control the expansion enclosures' settings when configuring via the LCD Panel. When configuring enclosures via *FCRAIDmanLITE-12*, you first of all, enter enclosure ID information for each *FibreArray-12* in the configuration through each individual unit's LCD control panel. If the expansion enclosures do not have LCD control panels you need to enter each enclosures' ID using the EAM Configuration Serial Tool. (See Chapter 6. of this manual for more information).

- ✓ Configure enclosure temperature sensors via LCD control panel or *FCRAIDmanLITE-12* (optional) or via the EAM Configuration Serial Tool.

LCD Control Panel Diagram

NOTE: *The LCD Control Panel is a factory fitted option.*

The following diagram illustrates the button locations and other visible features of a *FibreArray-12* Subsystem LCD control panel. Your LCD panel looks similar to the following example.



Use the tables on the following page to as a guide to using the buttons on the LCD panel.





LCD Panel Tables

Refer to these tables as a guide to the uses and functions of the *FibreArray-12* LCD Panel. The LCD panel has two sets of menu icons that represent the functions of the LCD buttons under the display.

- Main Menu Icons. Provide access to the various menus.
- Sub Menu Icons. Allow users to select options.




Main Menu Icon Table

The Main menu icons and their functions are as follows:

Button Label	Main Menu Icon	Function
ALARM RESET (ERROR LOG)	 	Displays only when the Error Log Alarm sounds. Press to halt the alarm and enter the Error Status Menu. Displays the Error Log.
RECREATE DRIVE (View/Rebuild RAIDset) SELECT		Not available in JBODS. This icon rotates when you perform an action on the RAIDmanLITE software and each time <i>RAIDmanLITE</i> sends a command to the EAM (every four or five seconds). The button clears the LCD display.
ENTER (CONFIGURATION)		Displays Configuration Menu.

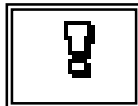
Sub Menu Icon Table

The sub menu icons allow users to select and enter the options in the LCD panel sub menu.

Button	Sub Menu Icon	Function
UP		Scrolls up utility menu choices.
DOWN		Scrolls down utility menu choices.
ENTER		ENTER button, accepts choices.

Alarm Reset/Error Log

If the *FibreArray-12* alarm sounds, the book icon changes to an exclamation mark icon. To quiet the alarm, you need to acknowledge the new error message on the error log. Use the instructions on the following page to quiet the alarm and acknowledge the alarm error details.



This option appears as a book icon during normal operation. If you click on the Error Log book icon button during normal operation it will display any previous error messages recorded on the *FibreArray-12* enclosures in your configuration, up to the maximum of nine error messages.



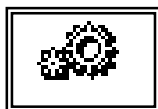
Select (RAIDman Activity)



This icon rotates when you perform an action on the *FCRAIDmanLITE-12* software and each time *FCRAIDmanLITE-12* sends a command to the EAM (every four or five seconds). The button directly under this icon allows you to clear the LCD display.

Enter (Configuration)

When you press the Configuration button on the main menu, you enter the Configuration Menu. From this menu you can configure your enclosure. You will find the detailed instructions for these options on the following pages of this chapter.



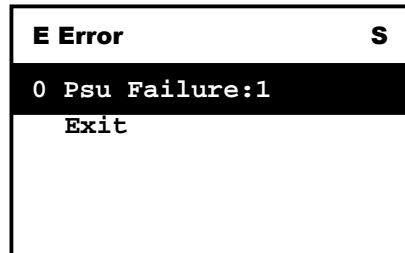
To Quiet the Error Log Alarm



Once the alarm sounds the Error Log icon changes to an exclamation mark icon.

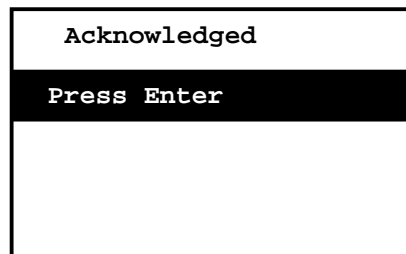
NOTE: The **Master enclosure** (enclosure 0) displays **all Alarm Log Errors** for all FibreArray-12 enclosures in your configuration.

1. Press the **AlarmReset/Error Log Alarm button** directly underneath the exclamation mark icon to view details of the alarm. The alarm stops while you are viewing the Error State screen. Here is an example of a power supply error.

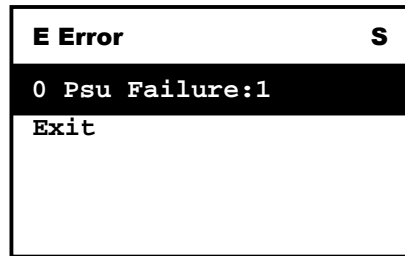


NOTE: For a detailed explanation of the error messages refer to the *LCD Error Number Table* in Chapter 9. *Technical Reference*, in this manual.

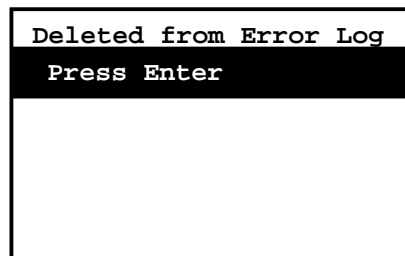
2. Press the **ENTER <J** button to acknowledge the error. (If you do not press the **ENTER <J** button, the alarm will continue to sound when you return to the initial LCD panel display.) The following message displays.



3. If you want to delete an error from the Error Log press the **ENTER** \leftarrow button again to display the following message.



Use the **UP/Down** buttons to select the Error you want to delete from the Error Log, then, press the **ENTER** \leftarrow button. The following message appears.



NOTE: *The Error Log can display a maximum of nine error messages. When the Error Log is full a message appears on the main menu. If a new error is created the Error Log automatically deletes the oldest recorded error and records the new error.*

4. To exit the Error Log, use the **UP/DOWN** buttons to select the **Exit** option. Then press the **ENTER** \leftarrow button to return to the initial LCD panel display.

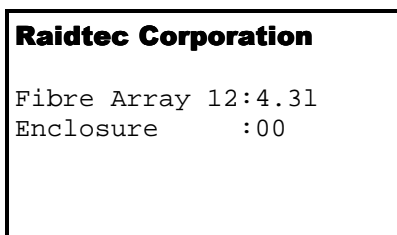
To Initiate the LCD Configuration Menu

You can access the Configuration Menu from the LCD control panel on the front of a *FibreArray-12* enclosure. The *FibreArray-12* enclosure connected to the host system is known as the **Master Unit**. All other enclosures are expansion enclosures. Remember to set the Master enclosure's ID at 0 to run *FCRAIDmanLITE-12*.

The enclosure configuration menu contains options that allow you to:

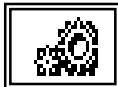
- **Set an enclosure's ID.**
- **Configure ambient temperature sensor with appropriate thresholds (optional).**
- **To change Buzzer setting (optional).**

The *FibreArray-12* LCD Configuration Main Menu looks similar to the following example:

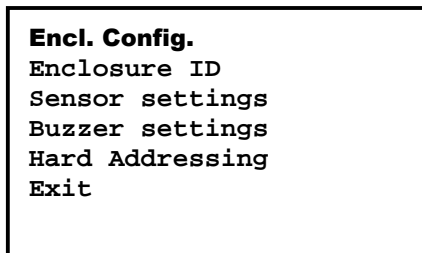


Use the following instructions to initiate the Configuration Utility Menu.

1. Power on the power switches at the rear of the *FibreArray-12* enclosure. Power on both switches one immediately after the other to avoid setting off the power supply alarm.
2. Press the Enter/Configuration button to display the Enclosure Configuration Menu.



Enter/Configuration icon.



4. Press the **UP/DOWN** buttons to select a menu option. The option you select will be highlighted.
5. Press the **ENTER <J** button to enter the menu option.

The **EXIT** option is the last option on the Enclosure Configuration Menu.

When you select **EXIT**, the Enclosure Configuration session ends and the normal operating mode status displays.

To Set an Enclosure ID

You can use the enclosure ID setting option to give a number value ID to a particular *FibreArray-12* enclosure in a multiple enclosure configuration. With this option you can select an enclosure ID value from 0-9.

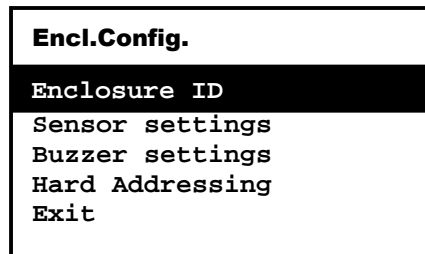
NOTE 1: *The LCD Control Panel only configures the individual enclosure it is attached to.*

NOTE 2: *The Master Unit FibreArray-12 enclosure must be set to Enclosure ID 0. This enables serial port (SER 2) communication with the host system for use by the FCRAIDmanLITE-12 software.*

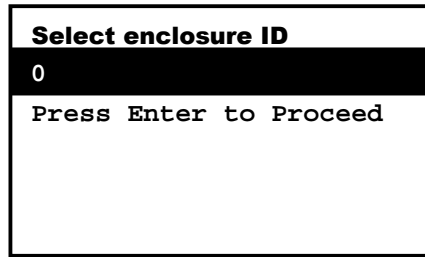
Enclosure IDs on a single FC loop must be unique. Do not assign the same ID to more than one enclosure on the same loop.

Use the following instructions to set an enclosure ID.

1. Press the **Enter/Configuration** button to display the Enclosure Configuration Menu, use the **UP/DOWN** buttons to select the Enclosure ID setting option.



2. Press the **ENTER <J** button to display the Enclosure ID Menu.



3. Use the **UP/DOWN** buttons to scroll through the number options. In the case of the **Master Unit**, enter the enclosure ID as **0**.
4. Press the **ENTER <J>** button to return to the Enclosure Configuration Menu.
5. Power off the enclosure and power it back on again (power on both power switches consecutively to avoid setting of the power supply alarm) to accept the new enclosure ID setting on your *FibreArray-12* enclosure.

To Enable Temperature Sensor Settings

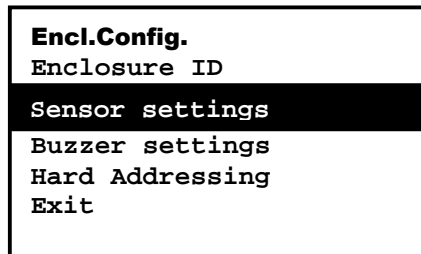
The *FibreArray-12* Environment Array Manager (EAM) contains a sensor which measure enclosure temperature.

This option allows you to:

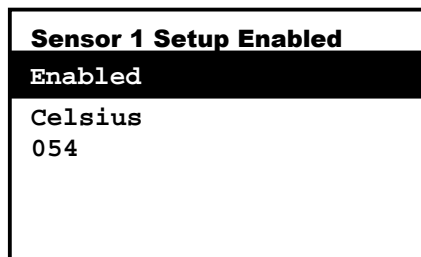
- Enable temperature sensor.
- Set the ambient temperature threshold for enabled sensor.

NOTE: The temperature *Sensor* is enabled by default in each *FibreArray-12* enclosure.

1. From the Enclosure Configuration Menu use the **UP/DOWN** buttons to select the Sensor Settings option.



2. Press the **ENTER** <␣> button to display the Sensor Setup Menu. The default sensor setting is enabled on the *FibreArray-12*.



- To change the temperature sensor settings, you can use the **UP/DOWN** buttons to select the temperature option, then press the **ENTER <J** button to adjust the temperature settings as in the following example.

Sensor 1 setup
Enabled
Celsius
38

You can select an appropriate ambient temperature threshold. Depending upon the scale you select, temperature values between 24° & 54° Celsius and 74° & 129° Fahrenheit will automatically display.

- You can use the **UP/DOWN** down buttons to select **Celsius** then press the **ENTER <J** button to display the temperature in Fahrenheit as in the following example.

Sensor 1 setup
Enabled
Fahrenheit
100

Use the following information to disable the temperature sensor settings.

1. Use the **UP/DOWN** buttons to select the **Enabled** option.
2. Press the **ENTER <J>** button to toggle to the **Disabled** option and the following menu displays.

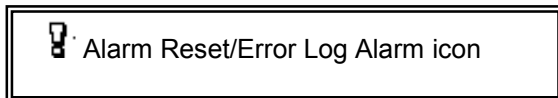
Sensor 1 setup
Disabled
N/A
N/A
Exit

You have now disabled the Temperature Sensor settings. (If you want to return to the **Enabled** option press the **ENTER <J>** button again.)

To exit the **Disabled** option, use the **UP/DOWN** buttons to select the exit option, then press the **ENTER <J>** button to return to the Enclosure Configuration Menu.

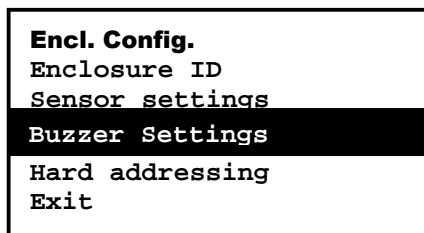
To Change Buzzer Settings

You can use the Buzzer Settings option to **Enable** or **Disable** the Error Log Alarm. The default setting for the Error Log Alarm is **Enabled**. When the Error Log alarm is disabled, the alarm will no longer sound only the Error Log alarm icon displays on the LCD panel.

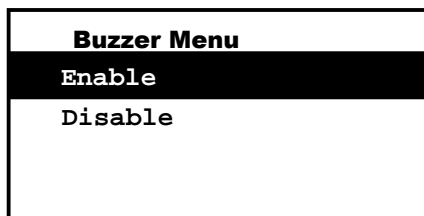


NOTE: *Raidtec Corporation recommends maintaining the Error Alarm Log at the default settings on your FibreArray-12 enclosure.*

1. From the Enclosure Configuration Menu, use the **UP/DOWN** buttons to select the **Buzzer Settings** option.



2. Press the **ENTER** \leftarrow button to display the following menu.



3. On the Buzzer Menu, use the **UP/DOWN** arrows to select the option you want to use. (The default setting is **Enable**.)
4. Then, press the **ENTER** \leftarrow button to return to the Enclosure Configuration Menu.

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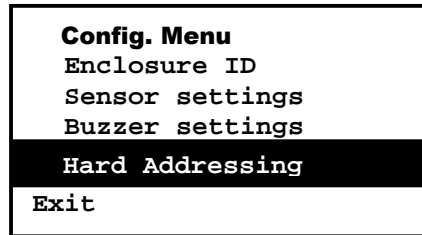
NOTE: If you select **Disable**, the Error Log Alarm will no longer sound when an error log is recorded, only the Error Log Alarm icon will display on the LCD panel.

Hard Addressing

Hard addressing identifies the drives in a *FibreArray-12* by using a fixed addressing scheme based on the slot address. Hard addressing is the default setting for all *FibreArray-12* enclosures.

NOTE: You cannot disable hard addressing when configuring a *FibreArray-12* for use with a Raidtec FibreRAID-HI controller. You cannot disable Hard addressing via the LCD panel.

For more details on Hard Addressing, refer to Chapter 9. *Technical Reference*.



NOTE: Repeat these steps if your additional enclosures have LCD displays. If your enclosures do not have LCD displays you need to configure the enclosures using the EAM Serial Tool. Please refer to Chapter 6. *EAM Configuration using Serial Tool* for more information.

6. EAM CONFIGURATION USING SERIAL TOOL

This chapter provides information on the following functions using the EAM Configuration using Serial Tool software:

- How to configure the *FibreArray-12* in instances where *FlexArray-12* enclosures do not have LCD panels.
- How to update the flash with a new version of the EAM firmware code in consultation with Raidtec Technical Support.

If you do not need to complete either of these functions, proceed to Chapter 7. *FCRAIDmanLITE-12 User's Guide*.

NOTE 1: Use this option in instances where your *FibreArray-12* enclosures **do not have LCD panels** you need to configure your enclosure IDs using the EAM Configuration Serial Tool.

NOTE 2: The Serial Tool is located on a 3.5" floppy diskette labeled Disk 1.

NOTE:3 When you configure enclosures via EAM Configuration using Serial Tool take great care to configure enclosure IDs correctly. Raidtec recommends that you configure all enclosures in numerical order, beginning with enclosure (0), enclosure (1), up to the maximum number of ten enclosures in a multiple enclosure configuration (enclosure 9 would be the tenth enclosure). It is also advisable that once you configure an enclosure ID that you label each enclosure accordingly to avoid configuration errors.

Cable Connections

1. Connect the RS 232 cable from SER 2 on the *FibreArray-12* to either COM 1 or COM 2 on your host system. For more details refer to Chapter 4. *Cable Connections for Single and Multiple Enclosure Configurations*.
2. Power on your host system.

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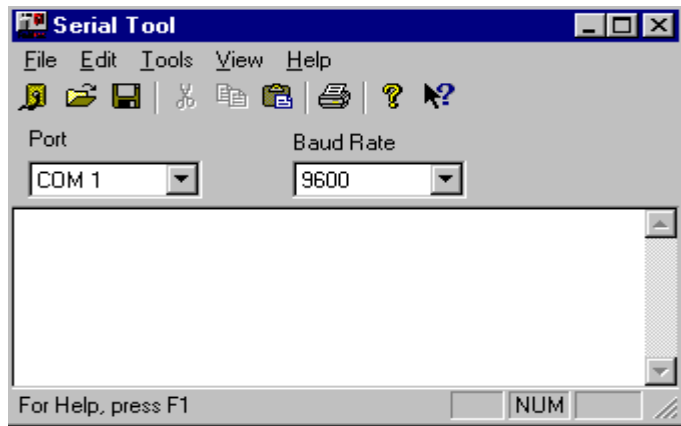
To Install Serial Tool on Windows 95/98 and Windows NT

1. Make a backup copy of the **Serial Tool** diskette. Use this backup copy as your working diskette and retain the original in a safe place.
2. Start up Windows NT or Windows 95/98 on your host system computer.
3. Insert the **EAM Configuration Serial Tool** diskette into your 3.5" disk drive now.
4. Double click **My Computer**.
5. Double click on **3.5" floppy (A:)**.
6. Double click on **SETUP.EXE** to start the **Serial Tool** installation.
7. Click **Next**.
8. The screen displays a destination folder for Serial Tool. Click **Next**.
9. Select the components you want to install (**SerialTool**). Click **Next**.
10. **SerialTool** displays in the program section. Click **Next**, to install **SerialTool**.
11. A dialog box appears displaying the **SerialTool** icon. Click **Finish** on the main window.

Your installation of **SerialTool** is now complete.

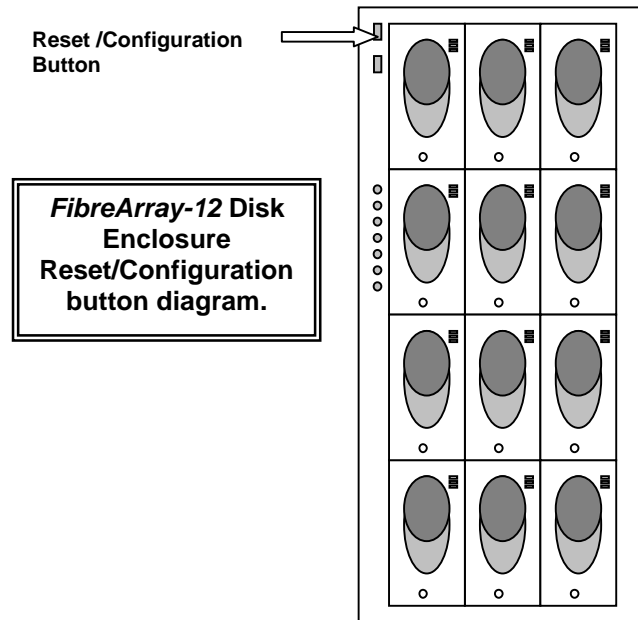
To Run Serial Tool

1. On your host system click, **Start → Programs → SerialTool**.
2. Click on the **SerialTool** icon to display the following screen.



3. From the initial screen display, select the **COM Port** you have connected to on your host system, **COM 1** or **COM 2**.
4. Select the **Baud Rate** at **9600**.
5. Click on **File → New Connection**.

6. Power up the *FibreArray-12* enclosure by **simultaneously** switching on the **two power switches at the rear** of the enclosure **and the Reset/Configuration button on the front** of the enclosure *FibreArray-12*. Hold the **Reset/Configuration button in** until text appears on the host system's Serial Tool main menu screen.

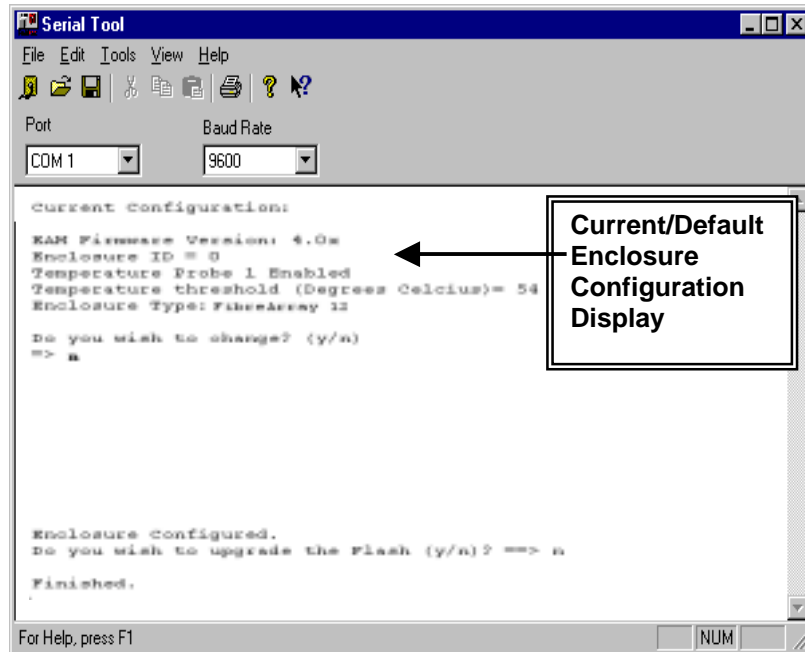


To configure the enclosure, refer to the following page for more information.

Enclosure Configuration

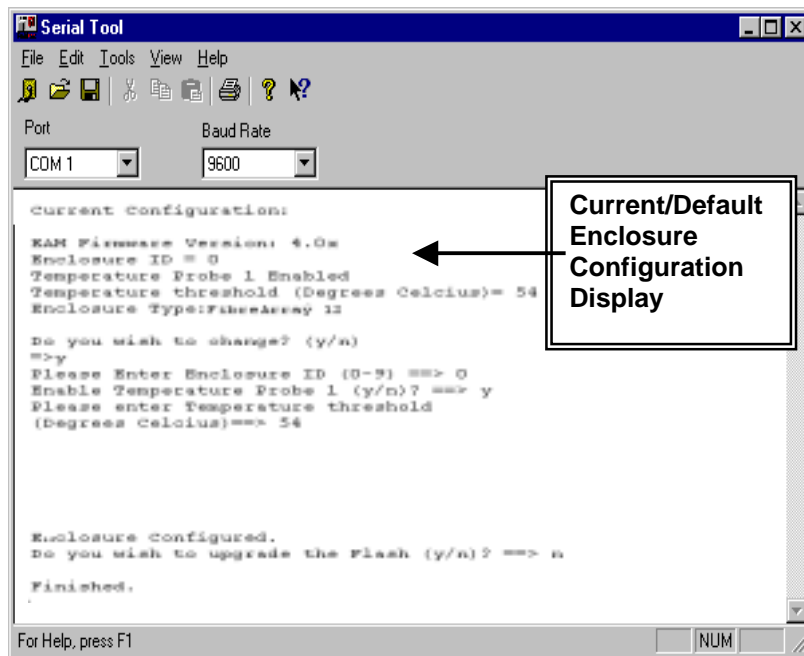
NOTE: Depending on how you configure your enclosure IDs, you can either accept or change the existing configuration settings. In most instances, you will need to change the enclosure configuration settings.

The main screen displays the current/default enclosure configuration, similar to the following example.



To Configure an Enclosure

To configure the enclosure you need to do the following:



1. Answer the, “Do you wish to change? (y/n)” section of the menu, by typing **y**.
2. To configure an Enclosure ID type the number of the Enclosure from numbers **(0-9)**.
3. To enable Temperature Probe 1 type **y** from **(y/n)**.
4. To enter the Temperature Threshold in Degrees Celsius type the temperature threshold you want to use. You can select temperature values between 24° & 54° *Celsius*.

NOTE: *When you configure enclosures via EAM Configuration using Serial Tool take great care to configure enclosure IDs correctly. Raidtec recommends that you configure all enclosures in numerical order, beginning with enclosure (0), enclosure (1), up to the maximum number of ten enclosures in a multiple enclosure configuration (enclosure 9 would be the tenth enclosure in the configuration). It is also advisable that once you configure an enclosure ID, you label each enclosure accordingly to avoid configuration errors.*

5. The message, **Enclosure Configured** displays.
6. “Do you want to **upgrade the flash?**”. Type **n**.

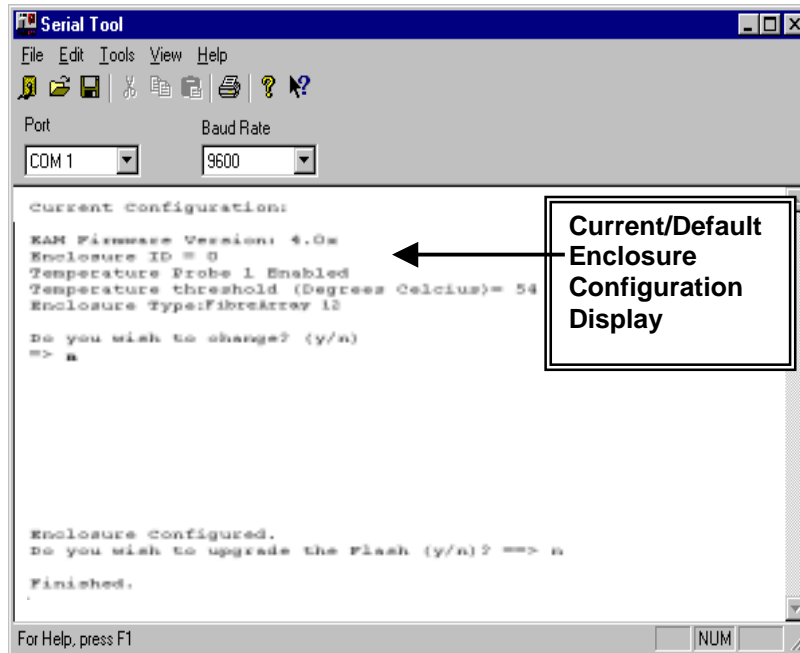
NOTE: *Consult Raidtec Technical Support for information on Upgrading Flash.*

7. Select **File** → **Exit** to exit the application.
 - When you have configured the enclosure, the EAM continues with normal operations.
8. For enclosure (0) remove the RS 232 cable from SER 2 serial port on the *FibreArray-12* enclosure and connect it to SER 2 in the next enclosure (1). Repeat this step for all the enclosures in your configuration up to a maximum of ten enclosures (enclosure 9 is the tenth enclosure).

Repeat the steps from the **Cable Connections, To Run Serial Tool** and **To Configure an Enclosure** sections of this chapter until you have configured all the enclosures in your subsystem.

9. Once you have configured all the enclosure IDs on your system, disconnect the RS 232 cable from SER 2 on the last enclosure on your subsystem and reconnect the RS 232 cable to SER 2 on enclosure 0 to run *FCRAIDmanLITE-12*.
10. In a multiple enclosure configuration, ensure there is an RS 485 serial loopback on SER 4 on the last enclosure. Now that you have configured all the enclosures in the configuration, you can monitor the enclosures in the configuration using *FCRAIDmanLITE-12*.

To Accept the Existing Configuration Settings



1. Answer the "Do you wish to change?" question by typing **n**.
2. Serial Tool accepts the existing enclosure configuration and moves to the following question.
3. Next, you are asked, "Do you want to Upgrade the Flash?", type **n**.

NOTE: Consult Raidtec Technical Support for information on Upgrading Flash. Refer to the previous heading for information on Upgrading the Flash.

When you accept the existing enclosure configuration. The EAM continues with normal operations.

4. From the main menu, select **File** → **Exit** to exit the application.

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CORPORATION

5. For enclosures (1-9) remove the RS 232 cable from the SER 2 serial port on the *FibreArray-12* enclosure and connect it to the SER 2 serial port on the next enclosure in the configuration.
6. When you have configured all the enclosures in the configuration, disconnect the RS 232 cable from SER 2 on the last expansion enclosure in your configuration and reconnect the RS 232 cable to SER 2 on enclosure 0 to run *FCRAIDmanLITE-12*.
7. In a multiple enclosure configuration check that there is an RS 485 loopback on SER 4 on the last enclosure in your configuration.

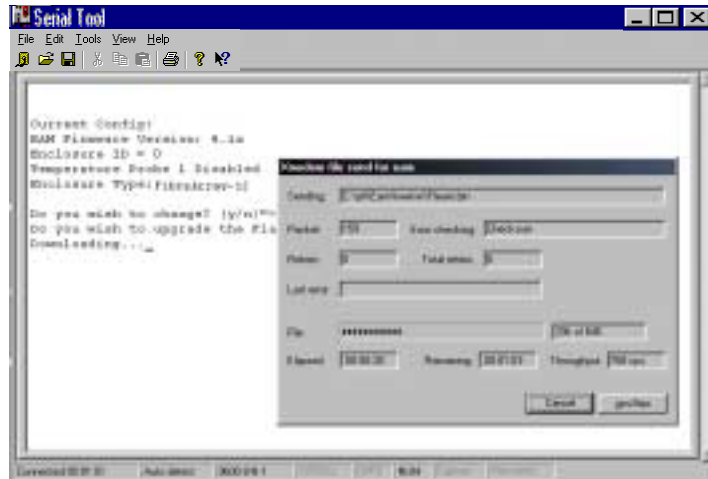
To Upgrade the Flash

NOTE: Contact Raidtec Technical Support for information on upgrading Flash.

Use this option when you need to Upgrade the Flash ONLY!

If you want to update the Flash with a new version of the EAM firmware code you will need to upgrade the Flash.

1. On the main menu screen, You are asked, "Do you want to Upgrade the Flash?" If you need to update the Flash type, "Y".

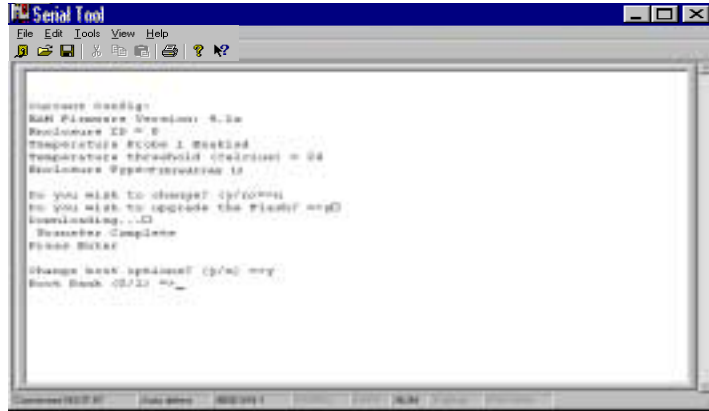


2. Once you type in "Y" downloading begins and a progress bar displays on the screen the progress bar disappears once the download is complete and a "transfer complete" message appears on the screen.
3. Press Enter to continue.

4. You then have the following option “Change boot options? (y/n)”
5. To change boot options type “Y”, this allows you to upgrade the EAM firmware code to the Flash Prom.

The next option to display is boot (0/1).

- 0 denotes the factory fitted prom.
- 1 denotes the upgrade prom.



6. Type in 1 to upgrade the prom with the new version of the EAM firmware code.
7. From the Main menu select **File** → **Exit** to exit the application.

7. FCRAIDMANLITE-12 USER'S GUIDE

You can use *FCRAIDmanLITE-12* to monitor the following:

- Disk drive presence.
- Enclosure temperature readings.
- Power Supply and Fan status.
- Alarm history log.

You can use *FCRAIDmanLITE-12* to complete the following functions:

- Enable temperature sensors.
- Set temperature threshold alerts.

System Requirements

To run *FCRAIDmanLITE-12* you will need the following:

System Component	Specifications
Computer	PC with minimum processor, clock speed, and RAM as required by operating system.
Operating System	Windows 95/98 Windows NT 3.51 & 4.x
Cable	Null modem

FCRAIDmanLITE-12 is provided on a 3.5" diskette, which contains the programs necessary to install the software on Windows 95/98 and Windows NT environments.

To Connect Cables

1. Connect the **RS 232 cable** from **SER 2** on the *FibreArray-12 enclosure 0* (Master Unit) to a serial port on your host system where *FCRAIDmanLITE-12* will be running.
2. Check that **all remaining cables are intact** and an **RS 485 serial loopback** is in place on **SER 4** on the **last enclosure** in the configuration before you power up your host system.

NOTE: *For detailed information on cable connections refer to Chapter 4. Hardware Installation; Cable Connections for Single and Multiple Enclosure Configuration.*

To Install FCRAIDmanLITE-12 on Windows 95/98 and Windows NT

1. Make a backup copy of the *FCRAIDmanLITE-12* diskette. Use this backup copy as your working diskette and retain the original in a safe place.
2. Start up Windows NT or Windows 95/98 on your host computer.
3. Insert the *FCRAIDmanLITE-12* diskette into your 3.5" disk drive now.
4. Double click **My Computer**.
5. Double click on 3.5" floppy (**A:**).
6. Double click on **SETUP.EXE** to start the *FCRAIDmanLITE-12* installation. Click **Next**.
7. **FCRAID** icon displays in a destination folder. Click **Next**.
8. Select the components you want to install. Click **Next**.
9. **FCRAID** appears in the Programs folder. Click **Next**.

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10. An **FCRAID** icon appears on the screen. Click **Finish**.

Your installation of *FCRAIDmanLITE-12* is now complete. To run:

- Click **Start** → **Programs** → *FCRAIDmanLITE-12*.

To Run FCRAIDmanLITE-12

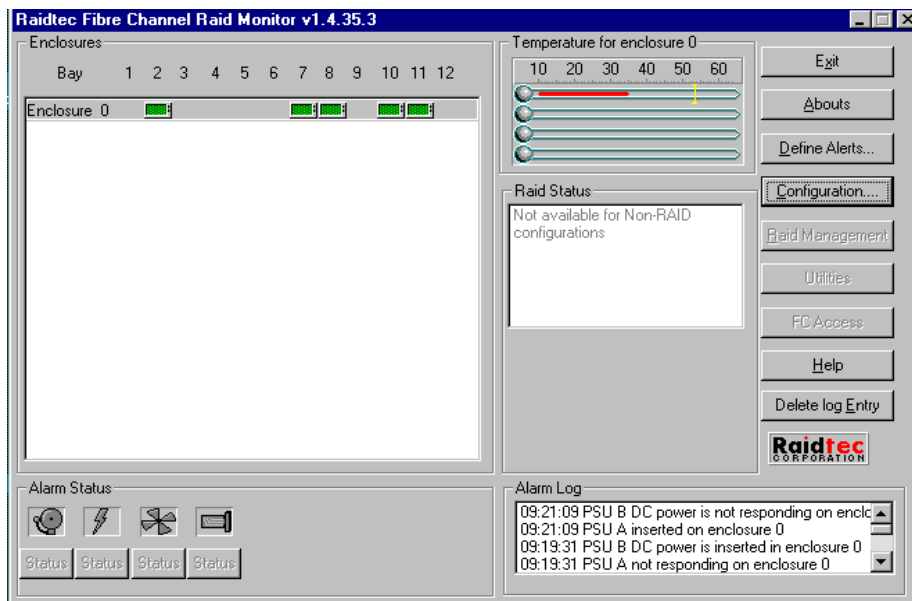
1. Click **Start** → **Programs** → *FCRAIDmanLITE-12*.
2. Click on the FCRAID icon to display the Main Control Panel.

Main Control Panel

The *FCRAIDmanLITE-12* Main Control Panel provides all the information on the current status of the *FibreArray-12* enclosure(s).

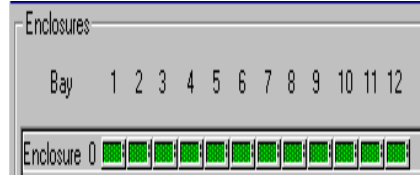
The Main Control Panel screen provides information on the following:

- Disk drive presence.
- Enclosure temperature readings.
- Power Supply and Fan status.
- Alarm history log.

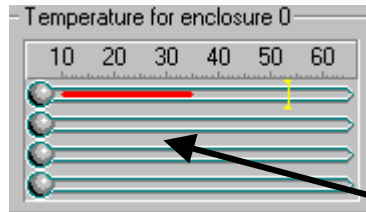


Enclosures Display

The Enclosure display on the left-hand side of the Main Control Panel highlights the available drives in each *FibreArray-12* enclosure. In the display, a green drive icon indicates good drive status.



Enclosure Temperature Display

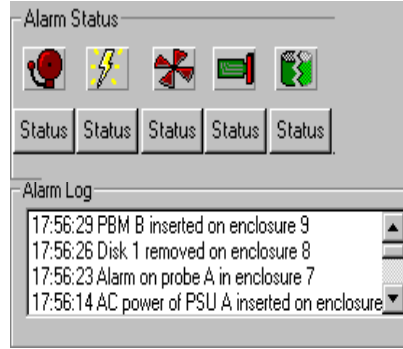







The Enclosure Temperature Display shows the temperature monitored on enabled sensor ports on the selected enclosure. The threshold setting for each sensor displays in yellow. One sensor port is enabled by default for each enclosure.

To display the temperature status for an enclosure, point and click on the enclosure number in the Enclosures display.

Alarm Status and Log Displays

The Alarm Status and associated Alarm log along the bottom of the Main Control Panel provide global alarm information for all *FibreArray-12* enclosures. The alarm status icons flash when an alarm condition is detected for the following conditions.

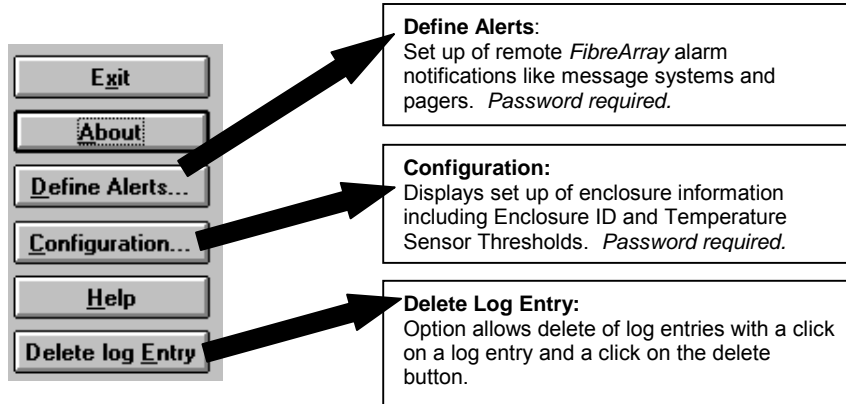


Icon	Function
	Alarm on temperature sensor probe.
	Power supply failure.
	Port Bypass Module (PBM) failure.
	Fan failure.
	Disk drive Failure.

To view details on any of the alarms, point and click on the **STATUS** button below the alarm icon.

Action Buttons

The Action Buttons on the right hand side of the Main Control Panel provide access to the *FCRAIDmanLITE-12* configuration and management options and on-line help system.



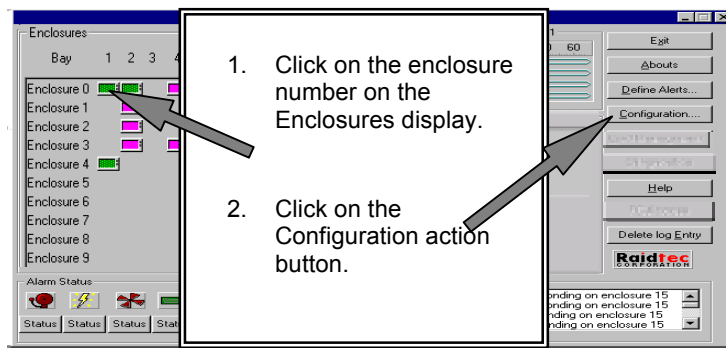
Enclosure Configuration Functions

The Configuration action button on the right hand side of the *FCRAIDmanLITE-12* Main Control Panel accesses options that allow you to:

- Enable temperature probes.
- Set temperature thresholds.
- Set or modify the *FCRAIDmanLITE-12* system password.

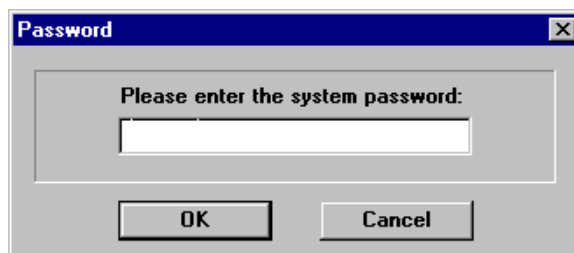
NOTE: When you initially install your *FibreArray-12* enclosure, you need to configure enclosure IDs via each enclosures LCD panel, or, if your enclosure do not have LCD panels you need to configure your enclosures via *EAM Configuration* using *Serial Tool* before you use *FCRAIDmanLITE-12*.

To Configure an Enclosures Sensors

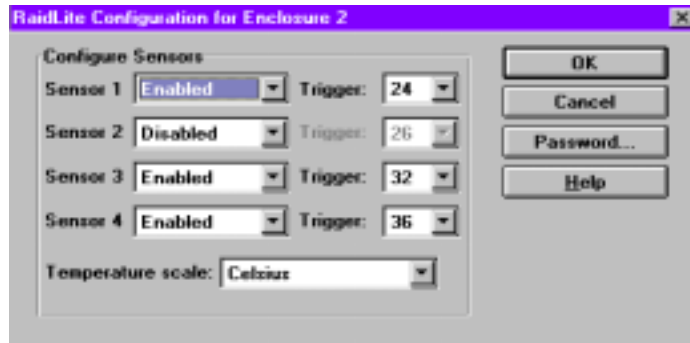


3. You are prompted to enter the *FCRAIDmanLITE-12* system password.

NOTE: *There is **no** default system password. If you have not already set a system password refer to the **To set or modify the system password** section on the following pages.*



4. Type in the system password, then click OK to display the Configuration for Enclosure screen.



To Enable Temperature Sensors

1. Select **Enable** from the sensor options menu. Click **OK**.

To Set Temperature Thresholds.

2. You can use the **Trigger** scrollbars to select an appropriate temperature threshold for each enabled sensor. Depending on the **Temperature scale** you select, temperature values between 24°- 54° Celsius and 74°- 129° Fahrenheit display.

NOTE: *Sensor #1 is installed by default in each FibreArray-12 enclosure.*

To Set or Modify the System Password

You can set or modify the system password from the password action button on the Configuration for Enclosure screen.

NOTE: There is **no** default system password. *Due to the sensitive nature of some of the FCRAIDmanLITE-12 features, Raidtec highly recommends you set a system password.*

To Set or Modify the System Password

1. From the Configuration for enclosure menu, click on the password button to display the following screen.



The image shows a dialog box titled "Define Password" with a close button (X) in the top right corner. Inside the dialog, there is a text prompt "Please enter the new system password:" followed by a text input field. Below that is another text prompt "...and again for verification:" followed by a second text input field. At the bottom of the dialog, there are two buttons: "OK" and "Cancel".

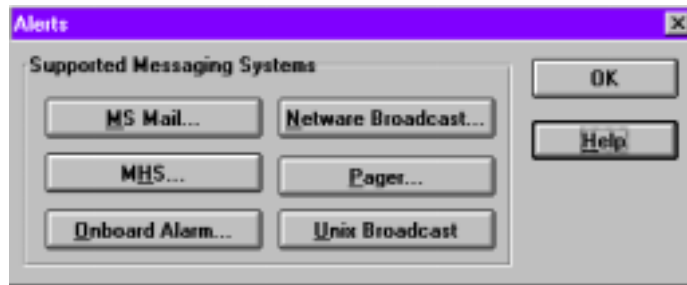
2. Enter the password you want to use, enter it again for verification. Click OK. You have now set a new system password.

When you set or modify a system password, remember to make a note of it and keep it secure!

Define Alerts

The Define Alerts action button on the *FCRAIDmanLITE-12* Main Control Panel accesses options that allow you to identify certain remote recipients of *FibreArray-12* enclosure alarms.

1. From the Main Control Panel, click the Define Alerts action button.
2. Enter the system password to display the following dialog box.



For detailed information on these messaging systems refer to the following pages.

MS Mail

MS-Mail requires a MAPI-compatible mail transport agent be installed. If a fax machine is configured on the MAPI mail system, MAPI may be used to send a FAX message alert.

Define MAPI Alert

Source Mailbox

Name:

Password:

Message

MAPI alert enabled

Recipient:

Subject:

Text:

OK

Cancel

Test

Help

MS-Mail Fields and Descriptions

Mailbox:	
Name	Name of mailbox that sends the message.
Password	Password of source mailbox.
Alert Enabled	Click box to enable MAPI alert.
Message:	
Recipient	MAPI target to receive the message.
Subject	Subject text.
Text	Complete text of alert message.

NOTE: For details on MS-Mail implementation, consult your MS-Mail documentation.

MHS

MHS is supplied with Novell NetWare. MHS implements a simple messaging system that allows messages to be sent to any user or any server that has MHS installed.



MHS Fields and Descriptions

Alert Enabled	Click box to enable MHS alert.
Recipient	Details for MHS recipient.
Subject	Subject text.
Text	Complete text of alert message.

NOTE: *If a FAX machine is installed as part of the MHS system, it is possible to send a FAX alert using this option. Consult your MHS documentation for details.*

NetWare Broadcast

NetWare Broadcast allows for a specific text message to be sent to a named user and server upon receipt of an alarm condition. The recipient must have Broadcast enabled in order to receive the message.

Define Netware Broadcast

Message Broadcast alert enabled

Recipient: Supervisor

on Server: Server_1

Text: Operational Array error

OK
Cancel
Test
Help

NetWare Broadcast Fields and Descriptions

Alert Enabled	Click box to enable Broadcast alert.
Recipient	Account name to receive the message.
On Server	NetWare server on which the recipient's account is maintained.
Text	Complete text of alert message.

Pager

Pager allows a numeric message to be sent to a remote paging device.

NOTE: *The Modem Parameters fields of the Pager Alert screen must correspond with the modem attached to the host system.*

Define Pager Alert

Message

Pager alert enabled

Pager number: [Text Field]

Message delay 1: [Dropdown]

Message delay 2: [Dropdown]

Numeric message: [Text Field]

Message delay 3: [Dropdown]

Modem Parameters

Port: [Dropdown]

Baud rate: [Dropdown]

Parity: [Dropdown]

Stop bits: [Dropdown]

OK

Cancel

Test

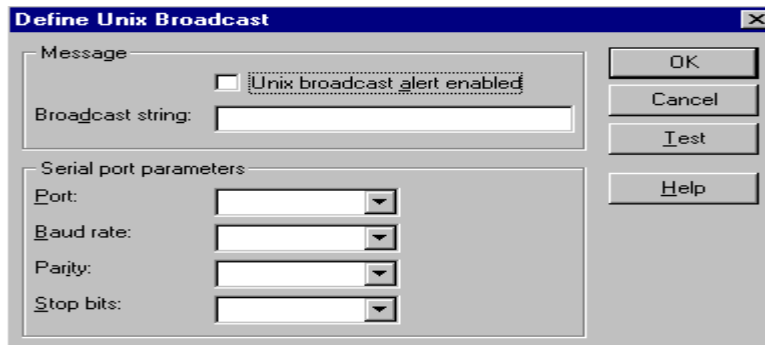
Help

Pager Fields and Descriptions

Message:	
Alert Enabled	Click box to enable Pager alert.
Pager Number	Pager number to be dialed by the modem.
Message Delays	Number of seconds required for delays by the local paging system being used.
Numeric Message	Digits to be transmitted to the pager.
Modem Params:	
Port	COM port of modem.
Baud Rate	Port speed.
Parity	Port parity setting.
Stop Bits	Port stop bits.

UNIX Broadcast

UNIX Broadcast allows a configurable string to be sent to a user-defined serial port.



UNIX Broadcast Fields and Descriptions

Message:	
Alert Enabled	Click box to enable Broadcast alert.
Broadcast String	Information to be transmitted to the serial port.
Serial Port Params:	
Port	COM port on host system attached to UNIX host.
Baud Rate	Port speed.
Parity	Port parity setting.
Stop Bits	Port stop bits.

NOTES: *This option can be used when the FCRAIDmanLITE-12 host system is connected via serial protocol to a UNIX serial port that is accepting input. The broadcast string defines a command that is to be executed on the UNIX host.*

A sample string might be:

“Please check the FibreArray-12 in Accounts Receivable Department for status change.”

The broadcast string will be read by a daemon configured to monitor the serial port and redirect the incoming message to an administrator or support mailbox.

8. TROUBLESHOOTING

This chapter provides troubleshooting information for the FibreArray-12 under the following headings:

- Setup issues action list.
- Enclosure ID problems.
- Drive Failure.

Setup Issues Action List

The following action list contains ideas for resolving problems associated with drives not being found. These problems can arise during the initial setup of your *FibreArray-12* Disk Enclosure.

- ✓ Verify all drives are installed and check the *FibreArray-12* disk drive indicator LEDs. Green LEDs are constantly lit when a drive is installed in the *FibreArray-12* enclosure.

NOTE: *The LCD panel should be in the initial menu display in order to verify LEDs correctly.*

- ✓ Verify the *FibreArray-12* enclosures are configured correctly.

NOTE: *The enclosure connected to the host system via SER 2 (Master Unit) **must be** Enclosure ID=0 and each subsequent enclosure must have a unique, sequential ID.*

- ✓ Verify the *FibreArray-12* enclosures are cabled correctly and that there is an RS 485 serial loopback on SER 4 on the last enclosure.
- ✓ If a particular *FibreArray-12* enclosure loop is not operational, you can position the PBM in Port-B as a means of loop verification to the dual-ported FC-AL drives. If all the red drive LEDs are on, the PBM is not in its slot.
- ✓ If there are no obvious drive or cabling problems, consult your Raidtec supplier.

Enclosure ID Problems

This problem may arise if your *FibreArray-12* enclosures **do not have LCD panels** and you configure enclosure IDs via EAM configuration using Serial Tool.

Problem	Possible Fault	Solution
LEDs on two or more enclosures not functionally normally. Some LEDs on an enclosure are flashing, other LEDs are not functioning at all. LCD Panels go blank.	Two enclosures issued the same enclosure ID number.	Reconnect the EAM Configuration Serial Tool and check the enclosure IDs displaying on the current enclosure display section of the screen. If enclosure IDs are the same for two enclosures, you will need to reconfigure the incorrect enclosure ID.

You will also need to check the remaining enclosure IDs in the subsystem to ensure all enclosure IDs are unique and are in sequence. Refer to *Chapter 6. EAM Configuration using Serial Tool* for detailed information on this procedure.

Test Procedure Cautions

NOTE: *Extreme caution* is advised when physically removing a disk drive from an active FibreArray-12 disk enclosure for test purposes. Removing a disk drive from a live system could result in data loss.

Drive Failure

Disk failures are indicated in the *FCRAIDmanLITE-12* administration software by an alert notification and a red drive indication. Also the drive's Fault LED (Red) will illuminate on the *FibreArray-12* enclosure's disk drive indicator LED panel and an error message will display on the enclosure's LCD control panel.

What to do if a Drive Fails

A failing or failed disk drive needs to be removed and a replacement needs to be installed. If a disk drive is failing or fails in your enclosure, use the following cautions and steps and as a guide.

CAUTIONS:

ALWAYS replace a failing disk drive with a new or thoroughly tested drive.

DO NOT troubleshoot a failing drive while still installed in the *FibreArray-12* Disk Enclosure.

ALWAYS have the most recent, validated system backup on hand when physically replacing drives.

To Replace a Failed Disk Drive

1. Remove the failing disk drive.
2. Verify the replacement disk drive is configured identically to the failed drive prior to installing it into the enclosure.
3. Install the replacement disk drive into the *FibreArray-12* enclosure and allow it to spin up. It will take approximately 15-40 seconds for the drive to come to full speed.

What Happens During Data Reconstruction

The reconstruction of a new drive is a totally transparent operation to the host computer and its operating system **ONLY if an FC RAID controller is managing the *FibreArray-12***. Reconstruction takes place as a background task, during which the system can remain operational and normal processing can continue.

9. FIBREARRAY-12 TECHNICAL REFERENCE

LCD Error Reporting

The bottom line of a *FibreArray-12* LCD screen display is generally reserved for status messages provided by the Environment Array Manager (EAM). This status line displays the Error log icon and when accessed, provides event notification in the form of Enclosure ID, sensor module, and associated error number.

LCD Error Number Table

The following table lists the errors that can appear for the *FibreArray-12* disk enclosure.

ENCLOSURE	SENSOR MODULE	ERROR NO.	DESCRIPTION
Enclosure #	PSU	Psu failure :1	AC & DC fault on power supply 1.
		Psu failure :2	AC & DC fault on power supply 2.
		Psu AC error:1	AC fault on power supply 1.
		Psu AC error:2	AC fault on power supply 2.
		Psu DC error:1	DC fault on power supply 1.
		Psu DC error:2	DC fault on power supply 2.
	Fan	Fan current lo:1	Fan 1 not drawing enough current.
		Fan current lo:2	Fan 2 not drawing enough current.
		Fan current lo:3	Fan 3 not drawing enough current.
		Fan current lo:4	Fan 4 not drawing enough current.
		Fan current lo:5	Fan 5 not drawing enough current.
		Fan current lo:6	Fan 6 not drawing enough current.
		Fan current hi:1	Fan 1 drawing too much current.
		Fan current hi:2	Fan 2 drawing too much current.
		Fan current hi:3	Fan 4 drawing too much current.
		Fan current hi:4	Fan 4 drawing too much current.
		Fan current hi 5	Fan 5 drawing too much current.
		Fan current hi:6	Fan 6 drawing too much current.
	Drive	Drive removed :01	Drive 01 removed.

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		Drive removed :02	Drive 02 removed.
		Drive removed :03	Drive 03 removed.
		Drive removed :04	Drive 04 removed.
		Drive removed :05	Drive 05 removed.
		Drive removed :06	Drive 06 removed.
		Drive removed :07	Drive 07 removed.
		Drive removed :08	Drive 08 removed.
		Drive removed :09	Drive 09 removed.
		Drive removed :10	Drive 10 removed.
		Drive removed :11	Drive 11 removed.
		Drive removed :12	Drive 12 removed.
	Fault	Drive Fault:01	Failure on Drive in Bay-01.
		Drive Fault:02	Failure on Drive in Bay-02.
		Drive Fault:03	Failure on Drive in Bay-03.
		Drive Fault:04	Failure on Drive in Bay-04.
		Drive Fault:05	Failure on Drive in Bay-05.
		Drive Fault:06	Failure on Drive in Bay-06.
		Drive Fault:07	Failure on Drive in Bay-07.
		Drive Fault:08	Failure on Drive in Bay-08.
		Drive Fault:09	Failure on Drive in Bay-09.
		Drive Fault:10	Failure on Drive in Bay-10.
		Drive Fault:11	Failure on Drive in Bay-11.
		Drive Fault:12	Failure on Drive in Bay-12.
	PBM	Pbm removed: A	PBM A removed.
		Pbm removed: B	PBM B removed.
		Pbm fault: A	PBM A fault.
		Pbm fault: B	PBM B fault.
	Temp	Temperature hi:0	Sensor Temperature limit exceeded.

NOTE : *The FLT (fault) is a result of a fault signal generated by a drive. See the drive manual for fault status explanation.*

NOTE : *The PBM not present is only generated if a PBM was previously reporting normal status and subsequently fails or is removed.*

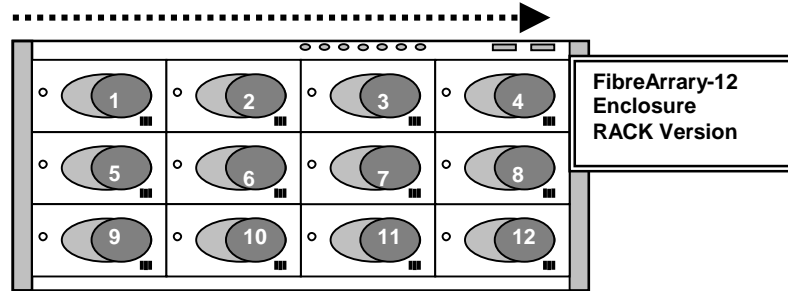
Hard Addressing

The EAM board is used to set the four (4) high SEL lines on the drives.

Enclosure ID Mapping to ALPA (*Arbitrated Loop Physical Address*).

The following diagrams identify the drive IDs for an enclosure in both rack and tower versions of the *FibreArray-12* Disk Enclosure. Refer to the table on the following pages for details of all hard address IDs.

NOTE 1: *On the Rack enclosure the order of the drive IDs runs from left to right, starting at the top left hand corner of the Rack Enclosure and ending at the bottom right hand corner of the enclosure.*



FibreArray-12 Enclosure Tower Version

NOTE 2: *The order of the drive IDs runs from the bottom to the top of the Tower enclosure, starting at the bottom left hand corner, and ending at the top right hand corner of the enclosure.*

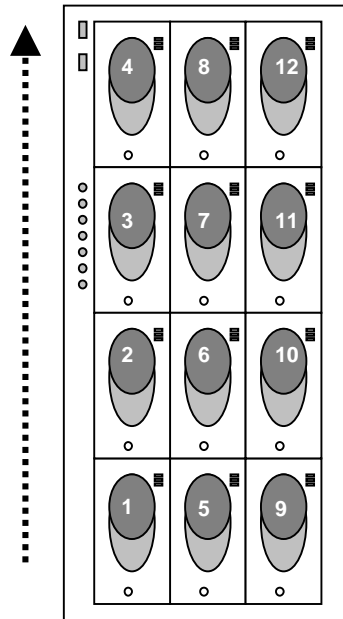


Table of Enclosure IDs Mapping to ALPA

The following table lists the Hard Address IDs for drives in up to ten (10) enclosures for the *FibreArray-12* Disk Enclosure.

Enclosure IDs Mapping to ALPA

Enclosure ID	ALPA	Sel	Sel(decimal)
Enclosure 0			
Drive 1	EF	00	00
Drive 2	E8	01	01
Drive 3	E4	02	02
Drive 4	E2	03	03
Drive 5	E1	04	04
Drive 6	E0	05	05
Drive 7	DC	06	06
Drive 8	DA	07	07
Drive 9	D9	08	08
Drive 10	D6	09	09
Drive 11	D5	0A	10
Drive 12	D4	0B	11
Enclosure 1			
Drive 1	D3	0C	12
Drive 2	D2	0D	13
Drive 3	D1	0E	14
Drive 4	CE	0F	15
Drive 5	CD	10	16
Drive 6	CC	11	17
Drive 7	CB	12	18
Drive 8	CA	13	19
Drive 9	C9	14	20
Drive 10	C7	15	21
Drive 11	C6	16	22
Drive 12	C5	17	23
Enclosure 2			
Drive 1	C3	18	24
Drive 2	BC	19	25
Drive 3	BA	1A	26
Drive 4	B9	1B	27
Drive 5	B6	1C	28
Drive 6	B5	1D	29
Drive 7	B4	1E	30

FibreArray-12 Disk Enclosure
User's Guide
Version 1.2

Raidtec
CORPORATION

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Raidtec Technical Support

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ASYNCHRONOUS TRANSMISSION: A type of data transmission in which each byte of information is synchronized individually through the use of interlocking the REQ and ACK signals.

ANSI: *American National Standards Institute.* A standards development organization, not associated with the federal government, which develops standards for voluntary use in the USA. Standards produced by national organizations are accepted by vendors in that country.

ARBITRATE: A process of selecting one port from a collection of several ports that request use of the arbitrated loop concurrently.

ARBITRATED LOOP: A loop-type of topology where two or more ports can be interconnected, but only two ports at a time can communicate.

BIT: *Binary digit.* The smallest unit of data a computer can process. A bit has a value of either 0 or 1. Bits are arranged into groups of eight called bytes. A byte is the equivalent of one character.

BLOCK: An amount of data moved or addressed as a single unit; the smallest amount of data that can be read or written at a time. Blocks are separated by physical gaps or identified by their track/sector address.

BRIDGE CONTROLLER: A SCSI device which appears as a single ID on the SCSI bus, but which bridges to multiple devices. Each of these devices is assigned a Logical Unit Number or LUN. Bridge controllers are typically used to control remote RAID subsystems.

BYTE: The common unit of computer storage. In 8-bit (octet) construction, eight bits equal one byte which is the equivalent of one character.

CACHE: (Pronounced *cash*) A small portion of high speed memory used for temporary storage of frequently used data. Use of cache

memory reduces the time it takes to access frequently used data because it no longer has to be retrieved from the physical medium.

CHANNEL: A general term for a path on which electronic signals travel; an electrical path for the transfer of data and control information between a disk and a disk controller.

CHECK DISK: The drive dedicated to storing information used to check and/or correct the data found on the other disks in an array. Also referred to as the *parity disk*.

COAXIAL CABLE: A cable made from a single copper wire clad with insulation and a shield through which data is transmitted as electrical pulses. Used for high-speed transmission over short distances.

CPU: *Central Processing Unit*. The part of a computer which performs all the operations needed to carry out a particular task. The CPU is usually contained on a single computer chip called the microprocessor.

DASD: *Direct Access Storage Device*. A data storage device on which information can be accessed directly, as with a hard disk or CD-ROM, as opposed to sequentially, as with a tape device.

DAT: *Digital Audio Tape*. A technology that records noise-free digital data on magnetic tape. Generally used for audio, a DAT cassette can hold up to 2 gigabytes when adapted for data storage.

DIFFERENTIAL: An electrical signal protocol that transmits information via a current loop rather than by changes in voltage. This reduces data susceptibility to electrical interference. Differential SCSI uses RS-485 transceivers to transfer 10MHz data at distances up to 25 meters (82 feet).

DISK ARRAYS: A tightly coupled collection of physically small disk drives across which user data is automatically distributed.

DISK MIRRORING: The process of writing data simultaneously to two disks, thereby improving the reliability of a disk subsystem. Both disks are attached to a single host adapter which handles the data two times.

Should one of the disks fail, the other one can be used to recover the data.

DISK SECTOR: A sub-set of magnetic disk capacity that contains a predetermined amount of data, such as 512 bytes. Disks are typically divided into tracks, each of which contain a number of sectors.

DISK SPANNING: Allows multiple disks to function as one, large disk drive. Data is stored across this *virtual disk* and users do not have to be concerned about which disk contains the data. Disk spanning is not a RAID level and does not improve performance of the array.

DISK STRIPING: A data handling methodology which employs *disk spanning*. Data is written sequentially across multiple disks in system segments (or data blocks). Segment 1 is written to drive 0, segment 2 is written to drive 1, and so forth until a segment has been written to the last drive in the array. The process repeats and continues until the write operation is satisfied.

DMA: *Direct Memory Access*. Allows peripherals access to a computer's random access memory (RAM) without intervention from the CPU. DMA improves system performance because the CPU is free for other tasks.

DUPLEXING: The duplication of a complete disk subsystem including disks, cables, and host controllers. Should one of the controllers fail, the other is still available to provide disk I/O. In addition, depending on how the controller software is written, both controllers may work together to read and write data simultaneously to different drives.

ECC: *Error Correction Code*. Additional information added to a bit stream of data to correct any errors when the data is being read.

EPROM: *Erasable Programmable Read Only Memory*.

EXCLUSIVE OR: *XOR*. An arithmetic function used to calculate the parity code (or check list) necessary to reconstruct data in a failed drive in a disk array system.

FDDI: Fibre Distributed Data Interface. An ANSI standard for 100 megabaud transmission over fiber optic cable.

FAST SCSI: Synchronous transmission rate defined in SCSI-2 to be used between 5 MHz and 10 MHz. Fast SCSI is used in data-in/out phases only.

FAULT TOLERANT: Ability of a device or system to withstand a failure. RAID 1, 2, 3, 4, and 5 subsystems, for example, are fault tolerant because they can provide disk I/O even if one of the disk drives in the subsystem fails.

FIBRE: A wire or optical strand. Spelled “fibre” in the name Fibre Channel.

FIBRE CHANNEL: Open ANSI standard, 1 Gigabit (100MB) per second data transfer interface technology that maps several common transport protocols including IP and SCSI, allowing it to merge high-speed I/O and networking functionality in a single connectivity technology. Fibre channel operates over copper and fiber optic cabling at distances of up to 10 kilometers.

FIBER OPTIC CABLE: Jacketed cable made from thin strands of glass through which light pulses are used to transmit data. Used for high-speed transmission or medium to long distances.

FRAME: An indivisible unit of transfer for information in Fibre Channel.

FRAME CONTENT: Field in a frame between the SOF (start of file) delimiter and the EOF (end of file) delimiter.

FRAME HEADER: First field in the frame content containing addresses and other control information about the frame.

FULL DUPLEX: Communication protocol that permits simultaneous transmission in both directions, usually with flow control.

GIGA: A billion or a thousand million. Used as a prefix for units, as in gigabaud or gigabyte.

GIGABAUD: An encoded bit transmission rate of 1,000,000,000 bits per second.

GIGABYTE: A value normally associated with data storage capacity, meaning a thousand million or a billion bytes. In standard usage, 1000 bytes (a kilobyte) is actually decimal 1024. Therefore, one megabyte (1000 X 1000 X 1000) is actually 1024 X 1024 X 1024, or 1,073,741,824 bytes.

HALF DUPLEX: Communication protocol that permits transmission in both directions, but only one direction at a time.

HIPPI: *High Performance Parallel Interface.* An ANSI standard for high-speed transfer of data in a dual-simplex manner over a short parallel bus.

HIT: A data access in which the requested data is found in the cache.

HIT RATIO: Ratio of cache hits to total disk accesses. A hit ratio of 100% means that all disk accesses can be serviced from the cache.

HOST: A processor, usually a CPU and memory. Typically, a host communicates with peripheral devices over some interface to carry out I/O operations.

HOST ADAPTER: Controller (such as a SCSI or ESDI controller) that routes data to and/or from the central processing unit.

HOT FIX; HOT SWAP; HOT REPLACEMENT: Capability to unplug and physically replace a failed drive or power supply without loss of data while the subsystem continues to operate.

HOT PATCH: Refers to a system in which hot spares are available to replace a failed drive.

HOT STANDBY SPARE: A disk drive that is electrically connected to a CPU system and can take over the operation of a failed disk in the subsystem. The major advantage of a hot standby spare is reduced MMTR (mean time to repair).

INITIATOR: SCSI device (usually a host system) that requests an operation to be performed by another SCSI device (target).

INTERFACE: A set of protocols used between components such as cables, connectors, and signal levels.

I/O: *Input/Output.* The movement of data from the CPU to and from attached peripheral devices.

I/O OPERATION: A logical entity dealing with the work accomplished between two devices in a computer system.

I/O PROCESS: One initial connection and zero or more reconnections, all pertaining to a single command or a group of linked commands.

I/O TRANSACTION: The full execution of one SCSI command. An I/O transaction involves any SCSI command. In a disk array, the execution includes the following cycle: the operating system issues a command to the host adapter; the host adapter sends it to the disk drive; the disk drive sends a response back to the host adapter; and the host adapter completes the cycle back to the operating system.

IP: *Internet Protocol.* A set of protocols developed by the U.S. Department of Defense to communicate between dissimilar computers across networks.

IPI: *Intelligent Peripheral Interface.* An ANSI standard for controlling peripheral devices by host computer.

LOGICAL: A feature not physically present, but applied by software. Sectors on a hard disk are physically arranged contiguously; logically, sectors may be placed anywhere on a hard disk, requiring a software program to arrange them in the correct order.

LOGICAL DISK: A set of contiguous chunks on a physical disk. Logical disks are used in some array implementations as constituents of logical volumes or partitions. Logical disks are normally transparent to the host environment, except when the array containing them is being configured.

LOGICAL UNIT: A physical or virtual device addressable through a target. A physical device can have more than one logical unit.

LUN: *Logical Unit Number.* Numbers 0-7 assigned to SCSI Logical Units or sub-devices. Each SCSI device may contain up to eight Logical Units. Typically, SCSI devices such as disk or tape drives contain only LUN 0.

MEGABYTE: A value normally associated with data storage capacity, meaning a million bytes. In standard usage, 1000 bytes (a kilobyte) is actually decimal 1024. Therefore, one megabyte (1000 X 1000) is actually 1024 X 1024, or 1,048,576 bytes.

MIRRORING: The process of writing data simultaneously to two disks, thereby improving the reliability of a disk subsystem. Both disks are attached to a single host adapter which handles the data two times. Should one of the disks fail, the other one can be used to recover the data.

MODEM: *Modulator-Demodulator.* A device that allows digital signals to be transmitted and received over analog telephone lines.

MTBDL: *Mean Time Between Data Loss.* The average time between events that cause data to be lost.

MTBF: *Mean Time Before Failure.* The average amount of time that a device will run before failing.

MTDA: *Mean Time of Data Availability.* The average amount of time that data is available for the use it was intended.

MTTF: *Mean Time to Failure.* An estimate of the likelihood of a failure in a given time frame. MTTF is calculated by taking the number of operating hours divided by the number of failures in the designated time. For example, if we have fifty computers operating for eight hours a day for 30 days, with two failures occurring, the MTTF is as follows:

$$\frac{50 \times 8 \times 30}{2} = 6,000 \text{ hours MTTF}$$

MTTR: *Mean Time to Repair.* An estimate of the average time it takes to repair a device. MTTR is calculated by adding all of the field time taken to repair failed devices divided by the number of repairs done.

NETWORK: An arrangement of nodes and connecting branches. Also, a configuration of data processing devices and software connected for information exchange.

OPERATING ENVIRONMENT: The environment in which a disk array operates. The operating environment includes the host computer(s) to which the array is attached, any I/O buses and adapters, the host operating system, and any additional software required to operate the array. For host-based arrays, the operating environment includes I/O driver software for the member disks, but does not include Array Management Software, which is regarded as part of the array itself.

PARALLELISM: A concept that describes a number of devices or processes performing the same function through simultaneous actions. For example, two disk drives reading data at the same time can double the effective peak transfer rate.

PARALLEL TRANSMISSION: The transmission of bits over multiple fibers at one time. Accomplished by devoting a fiber for each bit. Parallel data transmission is very fast, but usually is practical for short distances (under 500 feet) because of signal recovery and signal quality problems. Contrast with serial transmission.

PARITY CODE: An error detection mechanism that uses check data calculated by adding the number of bits set to 1 in a data stream. If the sum of the bits is an even number, the parity bit is set to 0 and is called even parity. If the sum of the bits equals an odd number, the parity bit is set to 1 for odd parity. Parity code is usually calculated using an arithmetic function called exclusive OR (XOR).

PARTITION: An array virtual disk made up of logical disks rather than physical ones. Also called a *logical volume*.

PERIPHERAL DEVICE: A component of a computer system, usually a storage or communication device. Examples are disk drives, tape drives, monitors, printers, etc.

POINT-TO-POINT: A topology where exactly two ports communicate.

RAID: *Redundant Array of Independent Disks*. An array of two or more disk drives in a fault tolerant subsystem. The drives in a RAID are configured to provide secure, fault tolerant, data redundancy so if one drive fails in the array, all data is still available without any user recovery action being taken. Briefly, the levels include:

- RAID Level 0 Disk striping without fault tolerance or redundancy.
- RAID Level 1 Disk mirroring where all data is duplicated.
- RAID Level 2 Data bit interleaved across multiple disks, check or parity, information uses hamming code for error protection.
- RAID Level 3 Data byte interleaved across multiple drives with parity written to one dedicated drive.
- RAID Level 4 Data is striped across multiple drives at the block or sector level with parity written to dedicated drive.
- RAID Level 5 Data and parity information are block striped across all disks.

RECONSTRUCTION: The process that occurs after a drive failure to rebuild the drive from the data and parity information on the remaining good drives.

RECOVERY PERIOD: The amount of time spent reconstructing the data for a failed disk. This may be concurrent with normal operations.

SCSI: *Small Computer System Interface* (pronounced "skuzzy"). An industry standard for connecting peripheral devices and their controllers to a microprocessor. The SCSI protocol defines both hardware and software standards for communication between a host computer and a peripheral. Computers and peripheral devices designed to meet SCSI specifications should work together. It can be either SCSI-1, SCSI-2, or SCSI-3.

SCSI ADDRESS: An octal representation of the unique address assigned to a SCSI device. Also called the SCSI ID#.

SHADOWING: Mirroring.

SINGLE-ENDED INTERFACE: An electrical signal configuration using a single line for each signal, referenced to a ground path common to the other signal lines. The advantage of single-ended configuration (compared to differential) is half the number of pins, clips, and PC Board area is used. The disadvantages of single-ended interface is its higher vulnerability to common mode noise and limited (up to 6 meters) cable distance.

SLED: *Single Large Expensive Drive.*

STRIPING: See DISK STRIPING.

SYNCHRONOUS TRANSMISSION: A type of data transmission in which the sending and receiving devices operate continuously at the same frequency and are held in a desired phase relationship by correction device. For buses, synchronous transmission is a timing protocol that uses a master clock and, has a clock period and allowable offset.

TERMINATOR: An electrical connection at each end of the SCSI bus composed of a set of resistors (or possibly other components). A terminator provides a pull-up for open collector drivers on the bus and an impedance match to prevent signal reflections at the ends of the cable. Depending on internal circuitry, a terminator can use simple resistors ('passive termination'), or a combination of a voltage regulator and resistors ('active terminator'). *Terminators for single-ended and differential interfaces are different and are not interchangeable.*

THROUGHPUT: The number of I/O requests satisfied per unit time. Expressed in requests/second, where a request is an application request to a storage subsystem to perform a read or write operation.

TRANSFER RATE: The rate of speed data can be transferred to and from a disk drive under varying conditions.

SERIAL TRANSMISSION: Data communication mode where bits are sent in sequence in a single fiber. Contrast with parallel transmission.

SERIALIZATION: A process of sending transmitted characters one bit at a time by serial transmission.

ULTRA SCSI: A SCSI-3 transfer mode that doubles the bus clock speed to 20 megahertz. The faster bus supports 8-bit narrow transfers at 20 MB/sec and 16-bit wide transfers at 40 MB/sec. Also known as Fast-20.

VIRTUAL DISK: A conceptual drive rather than a physical drive, as in a disk array. Although the virtual drive normally spans multiple drives, from the user's perspective, there is only one drive.

WIDE SCSI: A SCSI protocol and signal definition which provides a greater than 8-bit wide data path. Wide SCSI devices may support either 8 and 16-bit, or 8, 16, and 32-bit data transfers.