Galaxy 55
Installation and User Guide

Issue 1.0

November 29, 2000

Notices

The information in this document is subject to change without notice.

While every effort has been made to ensure that all information in this document is accurate, the Authors accept no liability for any errors that may arise.

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Contents

International Standards

The Galaxy 55 series storage system complies with the requirements of the following agencies and standards:

- CE to IEC 950/EN60951
- UL
- cUL

Potential for Radio Frequency Interference

USA Federal Communications Commission (FCC)

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

Properly shielded and grounded cables and connectors must be used in order to meet FCC emission limits. The supplie is not responsible for any radio or television interference caused by using other than recommended cables and connectors or by unauthorized changes or modifications to this equipment. Unauthorized changes or modifications could void the user's authority to operate the equipment.

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

European Regulations

This equipment complies with European Regulations EN 55022 Class A: Limits and Methods of Measurement of Radio Disturbance Characteristics of Information Technology Equipments and EN50082-1: Generic Immunity.

Safety

Warning **To ensure safe and correct operation of the Galaxy 55 subsystem all safety precautions and instructions referred to in this user guide must be followed thoroughly.**

Caution ***All plug-in modules and blank plates are part of the fire enclosure and must only be removed when a replacement can be immediately added. The system must not be run without all units in place.***

Permanently unplug the subsystem if you think that it has become damaged in any way and before you move it.

- A Galaxy 55 subsystem can weigh up to 57kg (125lb).Two people are required to remove or replace the subsystem.
- The Galaxy 55 subsystem must only be operated from nominal power supply input voltages of 100 - 120V AC or 200 - 240V AC. Ensure that the correct range is selected on each power supply prior to powering on.
- The power supply cord is used as the main disconnect device. Ensure that the socket outlet is located near the equipment and is easily accessible.

- A trifurcated power cord, as supplied with the Galaxy 55 system, must be used in order to safely provide a single power disconnect point.
- If a power cord is not supplied with your Galaxy 55 system, a power cord suitable for the country of destination and for use with the Galaxy 55 system application should be provided. Please refer to 1.5, ”Galaxy 55 Technical Specification”, on page 10 for details.
- If powered by multiple AC sources, disconnect all supply power for complete isolation.
- In order to comply with applicable safety, emission and thermal requirements no covers should be removed and *All* bays must be fitted with either plug-in modules or blanking plates.
- The power connection must always be disconnected prior to removal of the Power Supply/Cooling module from the enclosure.
- *Before* operating the Power Supply/Cooling module, it must be secured by tightening the retaining screw on the module front panel.
- The subsystem must not be run for extended periods without the ESI/Ops Panel Module being in place.
- A safe electrical earth connection must be provided to the power cord. Check the grounding of the enclosure before applying power.
- Provide a suitable power source with electrical overload protection to meet the requirements laid down in the technical specification.

Caution Rack System Precautions

Ensure that the rack system being used for your Galaxy 55 installation meets the following parameters:

The rack design should incorporate stabilizing features suitable to prevent the rack from tipping forward during installation.

The rack should comply with the airflow requirements detailed in the technical specification.

The rack should have a safe electrical distribution and grounding system.

Moving and Handling

Disk drives are very susceptible to physical shock but damage may not be immediately obvious.

Please observe the following precautions before moving and handling the enclosure:

- Always spin down devices prior to removing from the enclosure.
- If the Galaxy 55 enclosure has been installed in a 19 inch rack which is to be moved, remove all drives and other plug-in modules and repackage before transporting them separately.
- Keep all plug-in modules packaged to protect them until they are required for installation.
- Take care not to drop any of the plug-in modules or strike them onto a hard surface.

Data Security

- Power down your host computer and all attached peripheral devices before beginning installation.
- Each enclosure contains up to 12 removable disk drive modules. Disk units are fragile. Handle them with care, and keep them away from strong magnetic fields.
- *All* the supplied plug-in modules and blanking plates must be in place for the air to flow correctly around the enclosure and also to complete the internal circuitry.
- If the subsystem is used with modules or blanking plates missing for more than a few minutes, the enclosure can overheat, causing power failure and data loss. Such use may also invalidate the warranty.
- If you remove any drive module, you may lose data.
  - If you remove a drive module, replace it immediately. If it is faulty, replace it with a drive module of the same type and capacity
- Ensure that all disk drives are removed from the enclosure before attempting to manhandle or move the rack installation.
- Do not abandon your backup routines. No system is completely foolproof.

ESD Precautions

Warning **It is recommended that you check and fit a suitable anti-static wrist or ankle strap and observe all conventional ESD precautions when handling Galaxy 55 plug-in modules and components. Avoid contact with backplane components and module connectors, etc.**

Year 2000 Compliance

It is confirmed that all Galaxy 55 subsystem products have been designed and developed with Year 2000 compliance.

Special Tools and Equipment

There are no special tools required but in order to complete the assembly of some configurations you may need the following (not supplied):

- Cross head and slotted screwdrivers.
- Security keys (one of these should be included with your Galaxy 55 enclosure for use with the drive locks).

Preface

What is in this guide

This user guide gives you step-by-step instructions on how to install, configure and connect the Salient storage subsystem to your host computer system, and how to use and maintain the system.

Who should use this guide

This user guide assumes that you have a working knowledge of the Fibre Channel Arbitrated Loop (FC-AL) environment into which you are installing the Galaxy 55 system. If you do not have these skills, or are not confident with the instructions in this guide, do not proceed with the installation.

Chapter 1
Introduction

1.1 The Galaxy 55 System

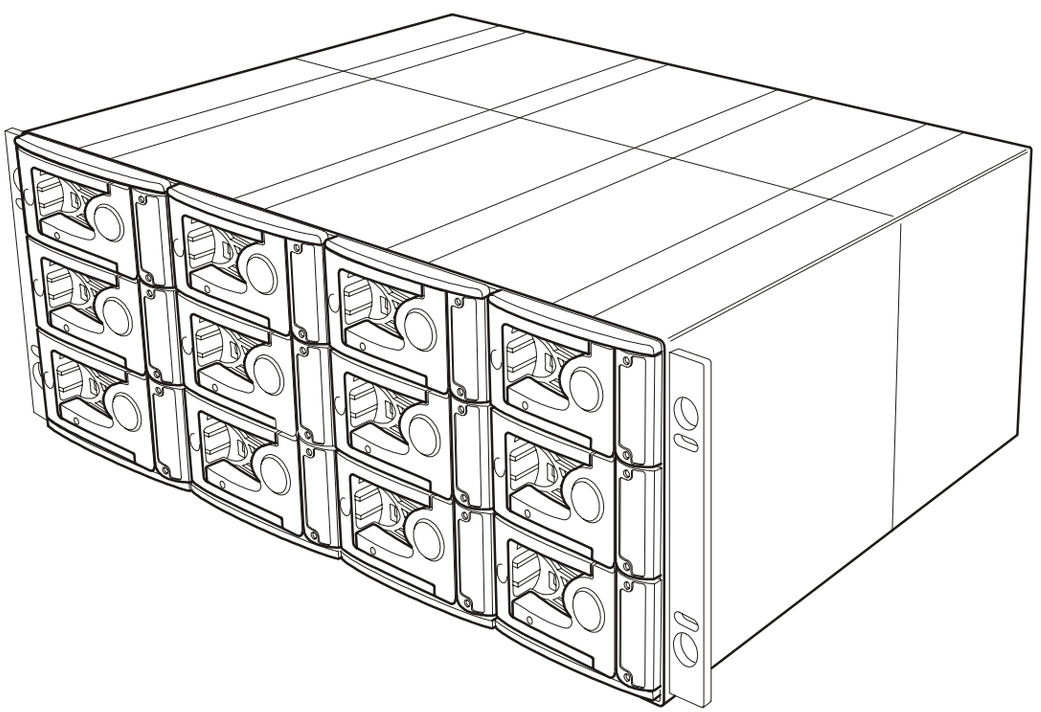

Figure 1–1 The Galaxy 55 System

1.2 The Enclosure Core Product

The Galaxy 55 design concept is based on a subsystem together with a set of plug-in modules. The Galaxy 55 subsystem as supplied comprises:

- Chassis with Backplane installed.
- Power Supply/Cooling plug-in modules, in accordance with your required configuration (see Figure 1–4).

- An Enclosure System Interface/Operators Panel (ESI/Ops) plug-in module (see Figure 1–5).
- Blank plates, as required to complete your required configuration and installation.
- FC-AL Drive Carrier Modules and associated front dummy fascia plates. (See Figure 1–13).
- FC-AL Input/Output Modules. (See Figure 1–9).
- A third Power Supply/Cooling Module may be required to support some 10 000 rpm disk drives.

1.2.1 Enclosure Chassis

The chassis consists of two segmented chassis assemblies, constructed from a number of aluminum extruded sections, with a Backplane PCB between them. The chassis assemblies each contain 12 'Bays', each of which accommodates a plug-in module (larger modules can be accommodated using multiple bay spaces). The Backplane PCB provides logic level signal and low voltage power distribution paths. A Galaxy 55 chassis is shown in Figure 1–2 and Figure 1–3.

- A Bay is defined as the space required to house a single 1.6" high 3.5 inch disk drive in its carrier module. e.g. a 1 x 3 bay module would take the space of 1 drive width by 3 drive bays high (in rack mount configuration).

- A 4 x 3 Chassis fitted with 19 inch Rack mounting features enables it to be fitted to standard 19 inch racks. It uses 4EIA units of rack space.

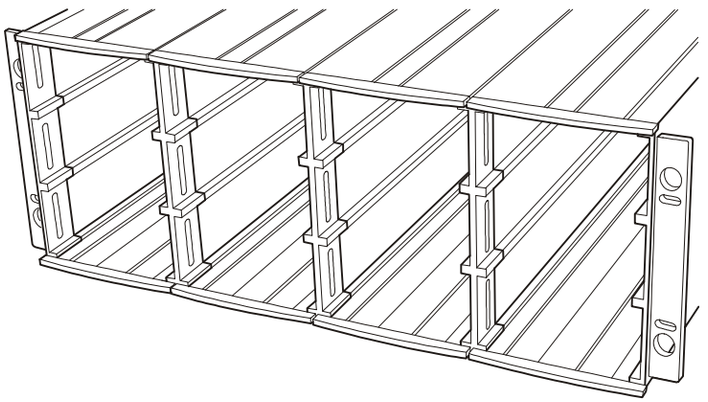

Figure 1–2 Enclosure Chassis (Front)

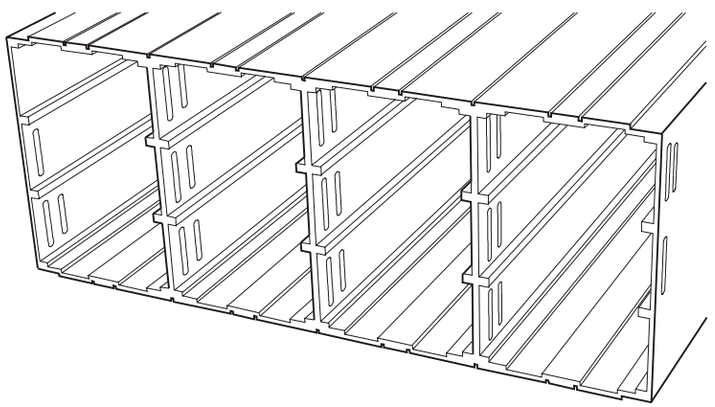

Figure 1–3 Enclosure Chassis (Rear)

1.2.2 Tower Option

An optional tower kit is available, which can be fitted to the rack chassis described here. Separate documentation is provided with this option.

1.3 The Plug-in Modules

A Galaxy 55 Enclosure requires one or more of the following modules for normal operation:

1.3.1 Power Supply/Cooling Module

Two Power Supply/Cooling modules (Figure 1–4) are supplied mounted in the rear of the enclosure as part of the subsystem core product.

Up to three Power Supply/Cooling plug-in modules can be installed in the rear of the Enclosure.

Table 1–1 PSU Characteristics

	SS-PSU-450	SS-PSU-550
Nominal Power	450W	550W
Input Voltage Range	switch	auto-ranging
Power Factor Correcting	no	yes
Cooling	improved	improved
Casing	aluminum extrusion	aluminum extrusion

1.3.1.1 Intermixing Power Supply Units within a Single Enclosure

Important **Mixing of SS-PSU-550 and SS-PSU-450 modules within the same enclosure is not supported.**

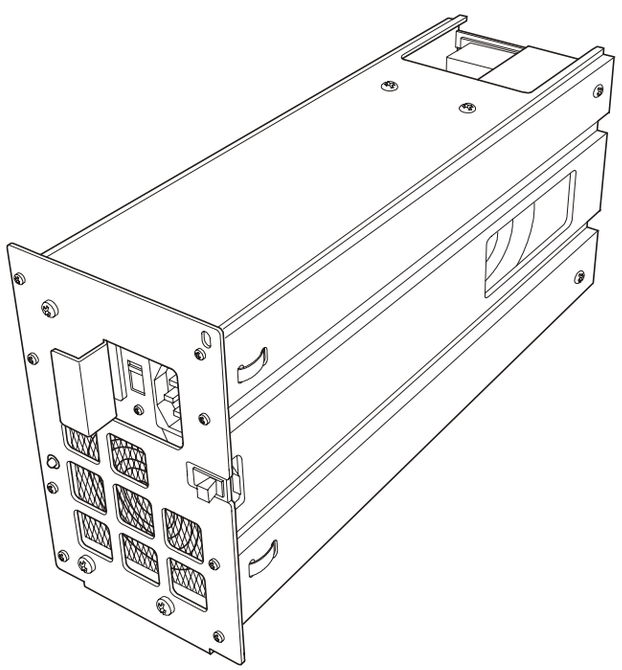

Figure 1–4 Power Supply/Cooling Module

PSU voltage operating ranges are nominally 115V or 230V AC, selected by means of a switch on the front of the PSU, shown in Figure 2–3.

An LED mounted on the front panel of the Power Supply/Cooling Module (see Figure 2–3) indicates the status of the PSU and the fans.

Warning **The Power Supply/Cooling module is not an operator removable part. It should only be removed by a technician who has knowledge of the hazards present within the module.**

1.3.1.2 Multiple Power Supply/Cooling Modules

If you have two or three Power Supply/Cooling modules fitted, they operate together. If one fails the others maintain the power supply and cooling while you replace the faulty unit.

Module replacement should only take a few minutes to perform but must be completed within 20 minutes from removal of the failed module. Alternatively, if there is no replacement module available, a blanking plate could be fitted after removing the faulty module.

1.3.2 Enclosure System Interface/Operators Panel Module

Supplied as part of the Enclosure core product, a typical Enclosure System Interface/Operators (ESI/Ops) panel module is shown in Figure 1–5.

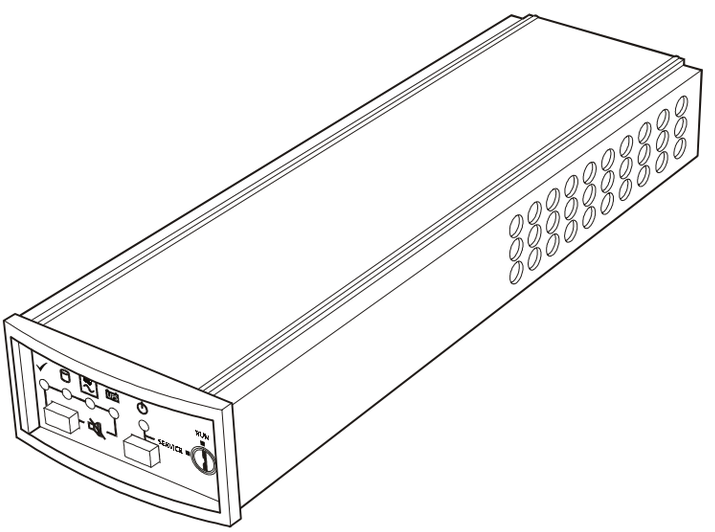

Figure 1–5 ESI/Ops Panel Module

The ESI/Ops Panel provides the enclosure with a micro controller which is used to monitor and control all elements of the Enclosure. Each element (Power, Cooling, Temperature, Device status) is interfaced to the processor using an I^2C (I Square C) Bus.

The SS-OPS2 ESI/Ops panel module variant is used in conjunction with a Galaxy 55 enclosure to provide an enclosure management interface through SCSI Enclosure Services (SES) protocol.

The SES function is communicated via drives in bays 1/3 and 4/3 (bottom left and right) using an SFF 8067 interface.

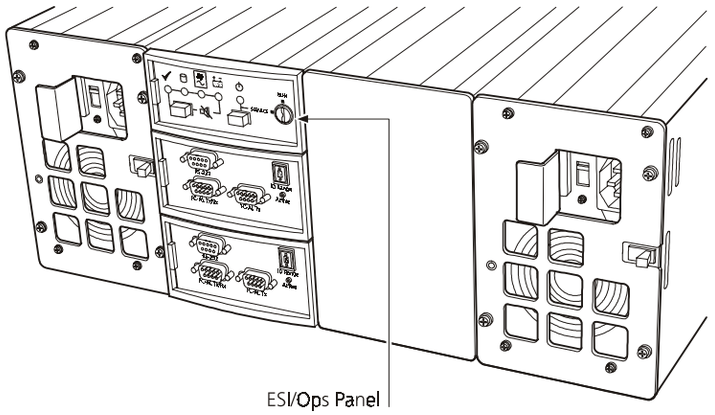

Figure 1–6 ESI/Ops Panel Installation

1.3.2.1 Ops Panel Indicators and Switches

The Operator Panel includes Light Emitting diodes (LEDs) which show the status for all modules and an Audible Alarm which indicates when a fault state is present. The indicators and switches listed in the following table are located from left to right on the panel, as shown in Figure 1–7.

LED Indicator	Symbol
System Status	✓
Drive Status	
Power & Cooling Status	
UPS Status	UPS
Power Standby Status	
Switches Push-button Audible Alarm Mute Push-button Standby/Operational switch Rotary Keylock - Run/Service activate	

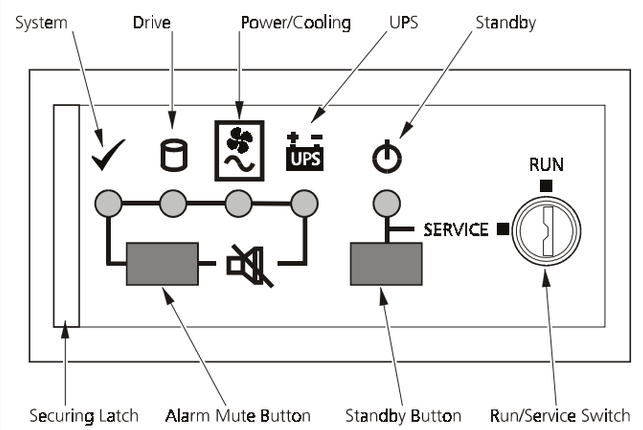

Figure 1–7 Ops Panel Indicators and Switches

1.3.2.2 Drive Auto/Manual Start

A DIL switch is fitted to the rear panel of the ESI/Ops module.

- Switch 1 is used to disable the auto spin start function and allows spin up under Host command. (Please refer to Sections 2.5.2).
- Switch 3 allows switching between alternate SES device slot address reporting schemes (Please refer to Section 2.5.3).

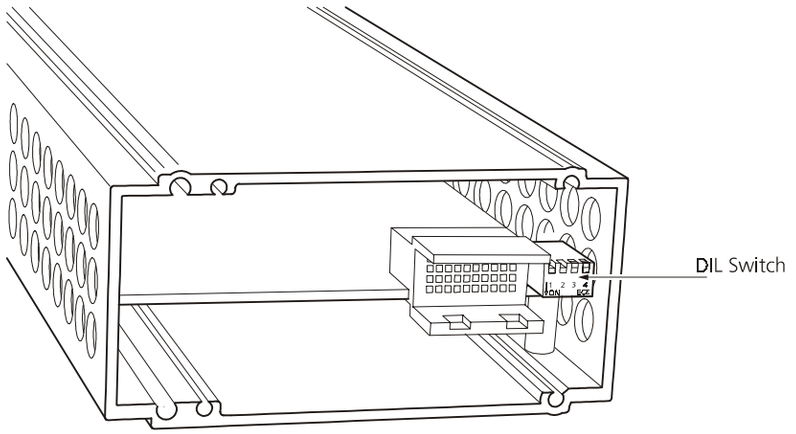

Figure 1–8 ESI/Ops Panel Drive Start Switch

1.3.3 Loop Resiliency Circuit Input/Output Module (FC)

The plug-in Input/Output (I/O) modules have been designed for integration into a Galaxy 55 storage subsystem, utilizing FCAL interfacing with the host computer system.

The FC-AL Backplane incorporates two independent loops formed by Port Bypass Circuits within the Loop Resiliency Circuit (LRC) I/O modules. There are two variants of LRC I/O modules that may be fitted, the SS-1x12-FC-IO and the SS-2x6-FC-DC-IO. Only modules of the same type may be fitted in a single enclosure. Please refer to section 2.6 for more information. An example of a plug-in LRC I/O module is shown in Figure 1–9.

The Galaxy 55 storage subsystem includes an enclosure with rear facing bays which house two I/O modules in Bays 3/2 and 3/3. (Figure 1–10).

The enclosure may obviously be configured with either 1 or 2 modules. If only 1 module is fitted this *Must* be installed in middle Bay 3/2 as the Device ID thumbwheel switches only operate in this bay.

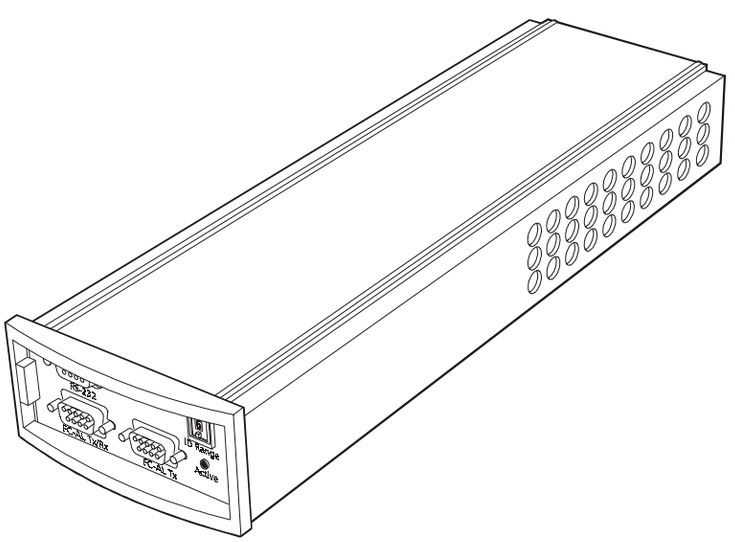

Figure 1–9 FC-AL LRC I/O Module

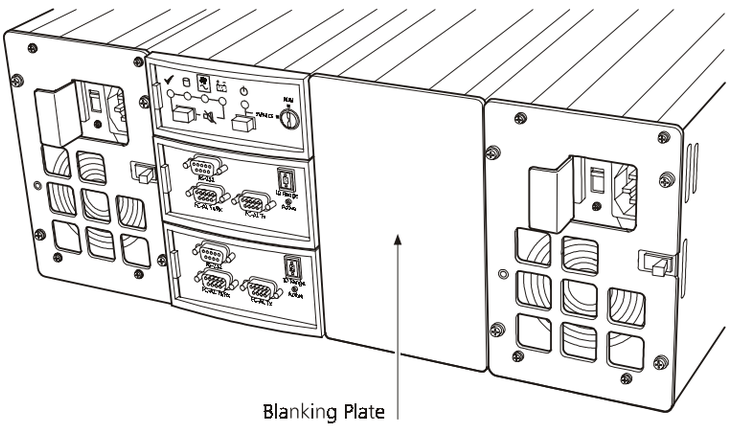

Figure 1–10 Galaxy 55 Enclosure with FCAL LRC I/O Modules Installed

1.3.3.1 SS-1x12-FC-IO

The SS-1x12-FC-IO Modules are fitted in bays 3/2 and 3/3. Each module includes DB9 connectors for FC-AL attachment, shown in Figure 1–11.

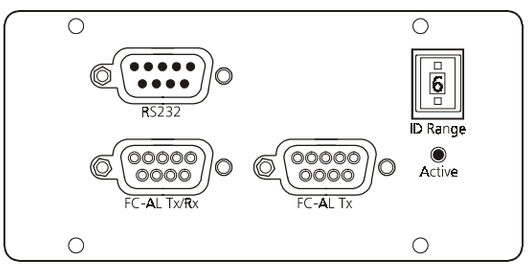

Figure 1–11 LRC I/O Module: Rear Panel Layout

1.3.3.2 SS-2x6-FC-DC-IO

The SS-2x6-FC-DC-IO modules (Figure 1–12) are fitted in bay 3/2 for loop A or bay 3/3 for Redundant loop B. they provide two loops of 6 drives and include hub type functions allowing daisy chaining of any number of enclosures. These modules use HSSDC connector types.

A single 12 drive loop can be created by linking loops 1 and 2 with a short external cable.

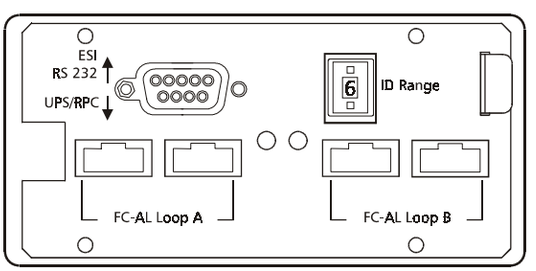

Figure 1–12 SS-2x6-FC-DC-IO Module Rear Panel Layout

LEDs are incorporated in the module panel and used to indicate that an FC-AL signal is present on the input.

Table 1–2 LED Functions

OFF	No loop active
AMBER	Single loop active
GREEN	Dual loop active

1.3.4 Drive Carrier Module

The plug-in FC-AL drive carrier module has been designed for integration into a Galaxy 55 storage subsystem which utilizes a FC-AL interface with the host computer system.

The Galaxy 55 storage subsystem includes an enclosure with front facing drive bays housing up to 12 plug-in drive carrier modules (see Figure 1–13). The drive carrier module comprises a hard disk, mounted in a carrier. Each drive bay will house a single 1.6 inch high, 3.5 inch disk drive in its carrier.

Each disk drive is enclosed in an extruded aluminum carrier which provides excellent thermal conduction, Radio Frequency and Electro Magnetic induction protection and affords the drive maximum physical protection.

The cap also supports an ergonomic handle which provides the following functions:

- Camming of carrier into and out of drive bays.
- Positive 'spring loading' of the drive/backplane connector.
- An anti-tamper lock operated by a socket type key.

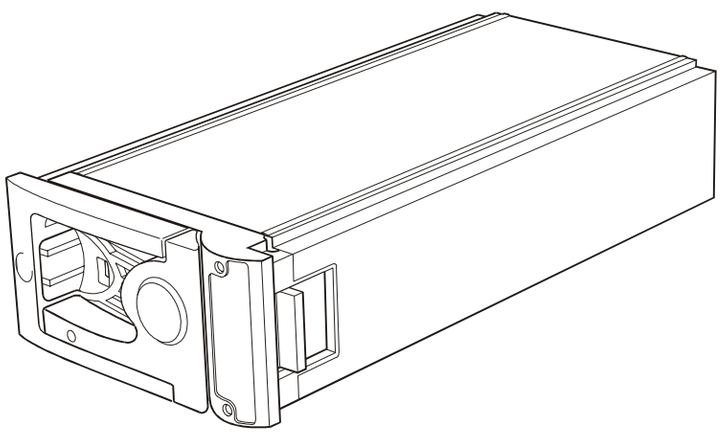

Figure 1–13 Drive Carrier Module

1.3.4.1 Drive LEDs

Each Drive carrier incorporates two indicators, an upper (Green) and lower (Amber). In normal operation the green LED will be ON and will flicker as the drive operates.

1.3.5 FC-AL Front Dummy Fascias

FC-AL front dummy fascias are provided for fitting in all unused drive bays. They are designed as integral drive module front caps with handles and must be fitted to all unused drive bays to maintain a balanced air flow.

1.3.6 Blank Plates

Blank plates must be fitted over all vacant bays at the rear of the enclosure as shown in Figure 1–14. There are three sizes of blank plate available:

- Single bay Rear blank plates
- 1x2 bay Rear blank plates
- 1x3 bay Rear blank plates

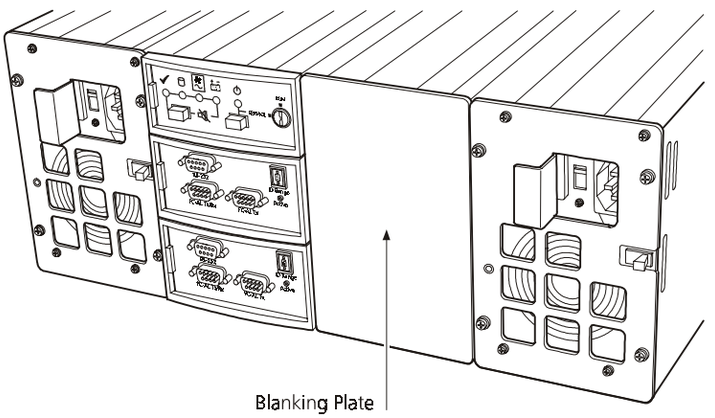

Figure 1–14 Enclosure with Blanking Plates

Warning **Operation of the Enclosure with *ANY* blank plates or rear modules missing will disrupt the airflow and the drives will not receive sufficient cooling. It is *ESSENTIAL* that all rear apertures are filled before operating the unit.**

1.4 Visible and Audible Alarms

The functional modules have associated status LEDs. The ESI/Ops Panel shows a consolidated status for all modules.

LEDs show constant green for good or positive indication and flashing green/red if non-critical conditions exist. Constant Amber LEDs indicate there is a fault present within that module.

The ESI/Ops Panel also incorporates an Audible Alarm to indicate when a fault state is present and also an Alarm Mute push-button.

Warning **The Power Supply/Cooling module is not an operator removable part. It must only be removed by a qualified service engineer who has knowledge of the hazards present within the module.**

1.4.1 Anti-tamper Locks

Anti-tamper locks may be fitted in the drive carrier handles (Figure 1–15) and are accessed through the hole in the lower part of the handle trim piece. These are provided to disable the normal “Push/Push” latch action of the handle.

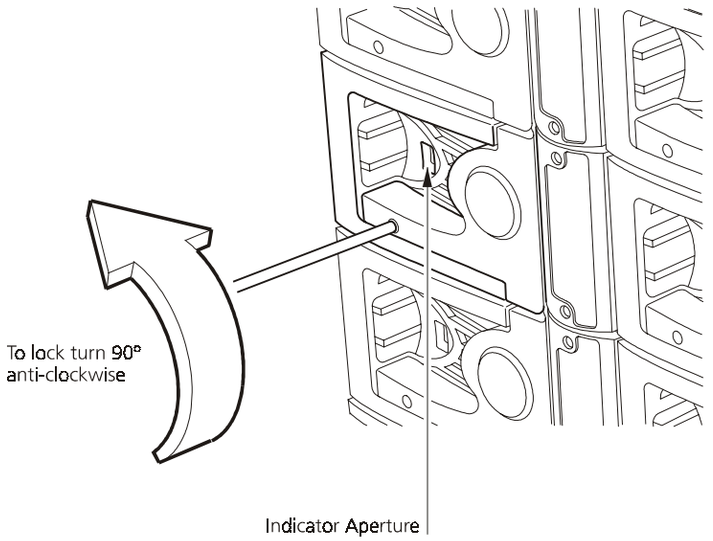

Figure 1–15 Anti-tamper Lock

1.5 Galaxy 55 Technical Specification

1.5.1 Dimensions

Rack Enclosure

Height 177mm, Width 446mm, Depth 586mm

Tower Enclosure

Height 570mm (including wheels), Width 302mm (at base) 183mm (at top), Depth 592mm

1.5.2 Weight

Maximum Configuration	Rack mount:	45kg
	Tower:	57kg
Empty Enclosure (Rack)	13 kg	
Tower Conversion Kit	12 kg	
PSU/Cooling Module	4 kg	

1.5.3 Power

	SS-PSU-450	**SS-PSU-550**
Voltage Range	100-120 / 200-240 VAC	100-120 / 200-240 VAC
Voltage Range Selection	Switched	Automatic
Frequency	47-63 Hz	47-63 Hz
Power Consumption	800VA	750VA
Power Startup Profile	1.1kVA for 20secs	TBD

Operational & Peak Currents	6.5A @ 110V, 10.5A Peak @ 110V	6.5A @ 110V, 10.5A Peak @ 110V
Inrush Current	40/80A @ 110/220VAC (25º cold start 1 PSU)	50A @ 260VAC
Power Factor	<0.6	>0.95
Usage	***PSU Types must not be inter-mixed***	
Harmonics	N/A	Meets IEC 60555-2

1.5.4 Power Cord

(minimum requirements)

Cord Type	SV 0r SVT, 18 AWG minimum, 3 conductor
Plug	250V, 10A
Socket	IEC 320, 250V, 10A

1.5.5 Environment

Table 1–3 Ambient Temperature and Humidity

	Temperature Range	Relative Humidity	Max. Wet Bulb
Operational	10°C to 40°C (35°C if only 1 PSU/ Cooling Module)	20% to 80% non-condensing	23°C
Non-Operational	0°C to +60°C	8% to 80% non-condensing	
Shipping	-20°C to +60°C	5% to 100% non-precipitating	

Altitude	0 to 2133 m
Operational Shock	Vertical axis 5g peak 1/2 sine, 10ms
Operational Vibration	Random vibration power spectrum available on request
Non-Operational Shock	20g 20ms square wave
Acoustics	Free standing enclosure declared ‘A’ weighted sound power level ≤6.8 Bels
Orientation & Mounting	19" Rack mount (4EIA Units)
• Rack Rails	To fit 800mm depth Racks compliant with IEC 297
• Rack Characteristics	Back pressure not exceeding 5 pascals (0.5mm water gauge)
Safety & Approvals	CE, UL, cUL
• EMC	EN55022 (CISPR - A), FCC A

1.5.6 Interfaces

Drive support See drive carrier specification

Attachment

- Dual 12 drive FC-AL Loops

Passive Backplane with 2 Loop Resiliency Circuit (LRC) I/O Module.

FC-AL DB9 cables	Maximum external cable length: Tx/Rx - 30m
	Tx only (daisy chain) - 15m
MIA supported	Tx/Rx connector only

- With 2 loops of 6 drives LRC I/O module

FC-AL HSSDC cables	Maximum external cable length: 30m
	Maximum daisy chain cable length: 10m

  - MIA supported

1.5.7 FC-AL LRC I/O Module Specification

Variants

- SS-1x12-FC-IO Connectors 2 x FC-AL DB9
  - 1 Wired for Tx and Rx with MIA support
  - 1 Wired for Tx only (allows Daisy chain with Y Cable)
  - 1 x RS232 DB9 When installed in bay 3/2
  - 1 x UPS/RPC when installed in bay 3/3

  Current Limit 1A for MIA Support
- SS-2x6-FC-DC-IO Connectors 4 x HSSDC
  - Creates Dual connections to 2 Loops of 6 drives when installed in 12 drive enclosure
  - Provides Full Tx/Rx FC_AL with MIA Support
  - 1 x RS232 DB9 When installed in bay 3/2
  - 1 x UPS/RPC when installed in bay 3/3

  LED Functions

OFF	No loop active
AMBER	Single loop active
GREEN	Dual loop active

  Current Limit 1A for MIA Support

Power Dissipation 8W

1.5.8 Drive Carrier Module Specification

Dimensions	Height 48.8mm Width 125.35mm Depth 256mm
Weight	1.2kg (1.6” 9Gb drive)
Operating Temperature	10° C to 40° C (when installed in a Galaxy 55 system enclosure)
Power Dissipation	28 Watts maximum

The following disk drives have been qualified for use with the Galaxy 55 series enclosure:

Manufacturer	Family	Model	Capacity	Speed	Drive types supported*	Min. no. of PSU/ Cooling Modules for Redundant Operation	
						450W	550W
Seagate	Barracuda	ST39173FC	9.1GB	7,200	1, (2), 3, 7F	2	2
Seagate	Barracuda	ST118273FC	18GB	7,200	1, (2), 3, 7F	2	2
Seagate	Cheetah	ST19101FC	9.1GB	10,000	(3)	2	2
Seagate	Cheetah	ST39102FC	9.1GB	10,000	1, (2), 3, 7F	2	2
Seagate	Cheetah	ST18202FC	18GB	10,000	1, (2), 3, 7F	2	2

* () indicates recommended type

Chapter 2
Getting Started

2.1 Introduction

In this chapter, you are shown how to install your Galaxy 55 Enclosure and plug-in modules into an industry standard 19 inch rack cabinet.

Caution *When connecting up the Galaxy 55 subsystem, use only the power cords supplied or cords which match the specification quoted in section 1.5.4.*

2.2 Planning Your Installation

Before you begin installation you should become familiar with the configuration requirements of your Galaxy 55 system, detailed in Table 2–1. The correct positions of each of the optional plug-in modules are shown in Figure 2–1. Please refer to section for details of FC-AL configurations and installation.

Table 2–1 Galaxy 55 Configuration

Module	**Location**
Drive Bays	ALL drive bays must be filled with either a drive carrier module or a front dummy fascia, no bays should be left completely empty.
Power Supply/Cooling Modules *See Table 2-2*	• Single Power Supply/Cooling module: if redundancy is NOT required and the installed disk drives are low power, a single Power Supply/Cooling module must always be fitted to rear Bay 2. Single modules with a full compliment of drives will limit: – the maximum operating temperature of the enclosure. • Two Power Supply/Cooling modules: full power and cooling redundancy is provided while a faulty module is replaced. Install the Power Supply/Cooling modules in rear Bays 1 & 4. Refer to Table 2–2 for details of limitations • Three Power Supply/cooling Modules: full power and cooling redundancy with high power drives is maintained while a faulty module is replaced. Install the modules in bays 1, 2 and 4.
I/O Modules	The Primary Module must be fitted in Bay 3/2. A second module (providing a second loop path to all drives) may be fitted in Bay 3/3.

Table 2–1 Galaxy 55 Configuration

Module	Location
ESI/Ops Panel	Install in Rear Bay 3/1
Blank plates	Rear blank plates MUST be fitted to ALL unused bays, there will be inadequate drive cooling if any are left off.

Table 2–2 Minimum PSU Configurations

Average Operating Drive Power	Minimum No. PSUs (12 drives of same type installed)	No. PSUs with Redundancy
<13	1	2
14 - 21	2	2
22 - 28	3	3

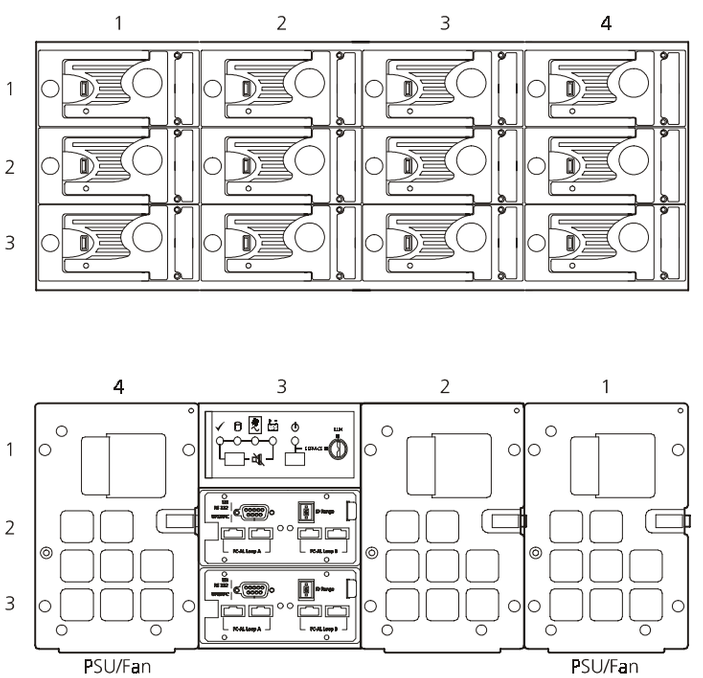

Figure 2–1 Module Locations

2.2.1 Enclosure Bay Numbering Convention

The enclosure bay numbering convention is shown in Figure 2–1. A Bay is defined as the space required to house a single 1.6" high 3.5 inch disk drive in its carrier module. e.g. a 1 x 3 bay module would take the space of 1 drive width by 3 drive bays high (in the rack mount configuration).

The Galaxy 55 subsystem is housed in a 4 x 3 enclosure, i.e. 4 bays wide by 3 bays high. The front bays are numbered 1 to 4 from left to right, viewed from the front. The rear bays are numbered 1 to 4 from right to left, viewed form the rear. Bays are numbered from 1 (top row) to 3 (bottom row). Module locations are identified from a matrix of the top and side numbers, e.g. the ESI/Ops Panel should only be installed in rear bay 3/1 (top, middle row, when viewed from the rear).

2.3 Enclosure Installation Procedures

Caution *The Galaxy 55 Enclosure with all its component parts installed is too heavy for easy installation into a Rack cabinet. The following procedures describe the installation of the Galaxy 55 enclosure and highlights any critical co-requisite requirements and good handling practices which we encourage you to follow so as to ensure that a successful installation is achieved in the easiest manner.*

Warning **Ensure that you have checked and fitted a suitable anti-static wrist or ankle strap and observe all conventional ESD precautions when handling Galaxy 55 modules and components. Avoid contact with Backplane components and module connectors, etc.**

2.3.1 Pre-Requisites

The Galaxy 55 Enclosure is designed for installation into an industry standard 19 inch cabinet capable of holding the unit.

- Minimum depth 580 mm from front flange to rear metalwork (excludes rear cabling).
- Weight (35 to 45 kg dependent upon configuration) per enclosure.
- A minimum gap of 25mm (1inch) clearance between the rack cover and front of drawer; and 50mm (2 inches) rear clearance between rear of drawer and rear of rack is recommended in order to maintain the correct air flow around the enclosure.
- The rack should present a maximum back pressure of 5 pascals (0.5mm water gauge).

2.3.2 Rack Mounting Rail Kit

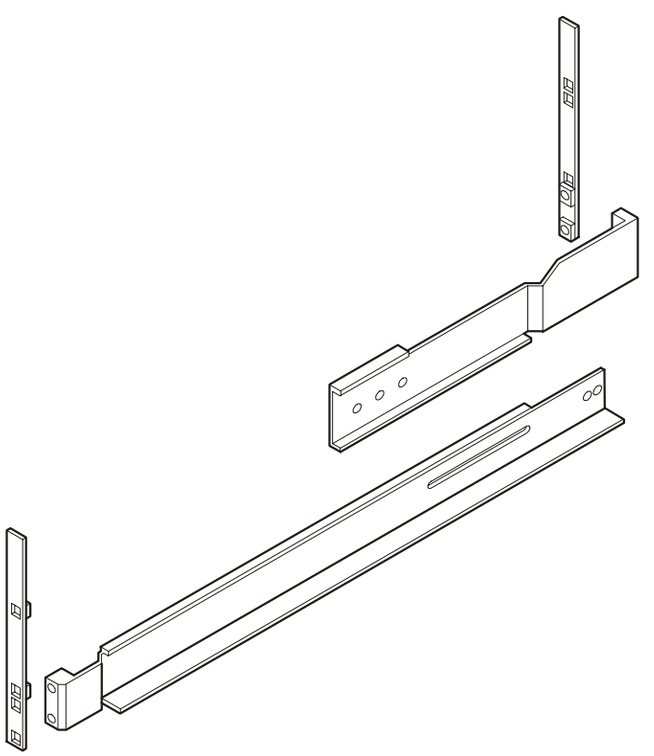

Figure 2–2 Rack Mounting Rail Kit

A set of mounting rails is available for use in 19 inch rack cabinets. These rails have been designed and tested to handle the maximum enclosure weight and to ensure that multiple Galaxy 55 enclosures may be installed without loss of space within the rack. Use of other mounting hardware may cause some loss of rack space.

The rack mounting rail kit also incorporates a rear hold down mechanism to ensure shock and vibration immunity.

Please contact us to ensure suitable mount rails are available for the rack you are using.

2.3.2.1 Parts Check List

- Rack Mounting Rail Kit.

2.3.2.2 Installation Procedure

Please see detail drawings supplied with the rack mounting rail kit for assembly details.

2.3.3 Chassis Installation

2.3.3.1 Parts Check List

- Chassis (complete with Backplane installed but excluding all plug- in modules).
- Rack mount front flange mounting screws (4 off).

2.3.3.2 Procedure

1. Check for damage.
2. Slide the chassis assembly onto the rack rails until the front flanges engage on the rack. Ensure the chassis is centrally located.
3. If in doubt about correct orientation, the drive bays (at front) should have their black drive connectors toward the bottom of each bay.
4. If supplied, fit the rear hold down brackets at the rear of the unit (4 screws) do not tighten.
5. Screw the 4 front rack mount screws through the flanges and tighten.
6. If supplied, tighten the rear hold down bracket ensuring the bracket is in tight contact to both the side and top of the chassis to avoid any movement of the chassis in the rack.

2.4 Power Supply/Cooling Module Installation

2.4.1 Parts Check List

- 1, 2 or 3 Power Supply/Cooling Modules: either SS-PSU-450 or SS-PSU-550.

2.4.2 Procedure

1. Check that all modules are of the same type, (SS-PSU-450 or SS-PSU-550).
2. Check for damage, especially to the rear connector on the supply.

Warning **Handle the module carefully and avoid damaging the connector pins. Do not install the module if any pins appear to be bent.**

3 If you are installing SS-PSU-450 modules, Set the red Voltage Range Selector switch (Figure 2–3) adjacent to the mains inlet socket to either 115V or 230V as required for your installation. SS-PSU-550 modules are auto-ranging.

Important **The mixing of SS-PSU-450 and SS-PSU-550 modules within the same enclosure is not supported.**

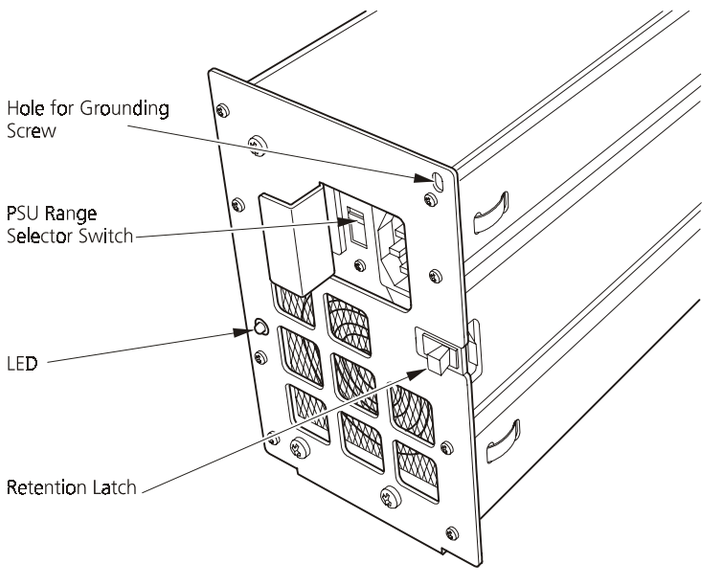

Figure 2–3 Power Supply Voltage Range Selector Switch

Warning **SS-PSU-450 Power Supply/Cooling modules are *NOT* auto-ranging, failure to select the correct range *WILL* damage the PSU.**

4 Install the Power Supply/Cooling modules in the rear of the chassis in the positions indicated below. (Please refer to Table 2–1 for Configuration details).

- Single Power Supply/Cooling module - Install in Bay 2
- 2 Power Supply/Cooling modules - Install in Bays 1 & 4
- 3 Power Supply/Cooling modules - Install in Bays 1, 2 & 4

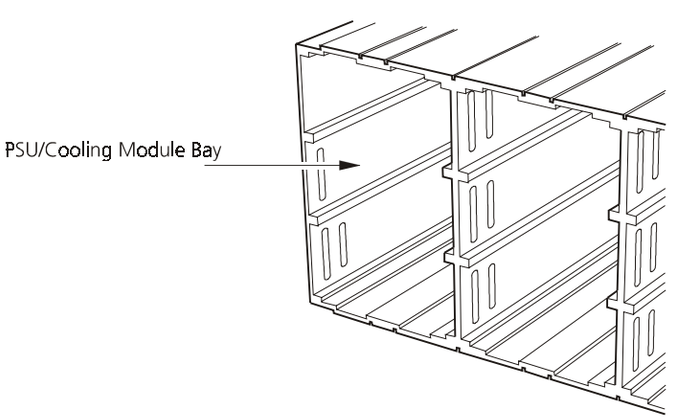

Figure 2–4 Power Supply/Cooling Module Location (Bay 4 shown)

5 Hold the latch while pushing the module gently home into the bay, ensure that it is fully engaged and that the retention latches are engaged into the chassis (See Figure 2–5).

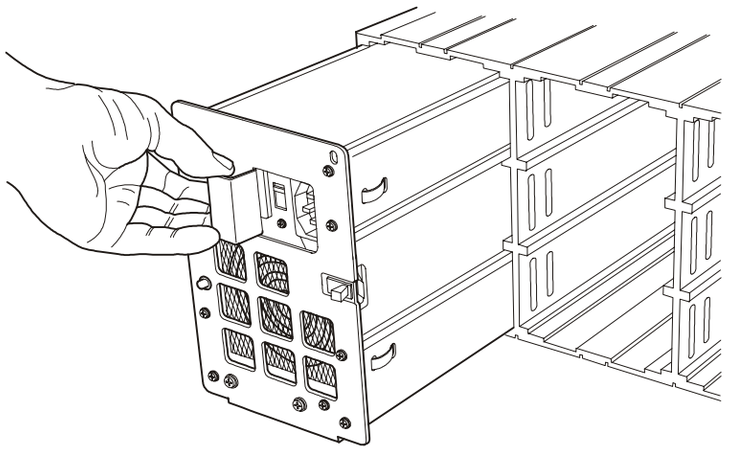

Figure 2–5 Installing a Power Supply/Cooling Module in Bay 4

6 Fit and tighten the retaining screw on the front panel to secure the module (see Figure 2–6).

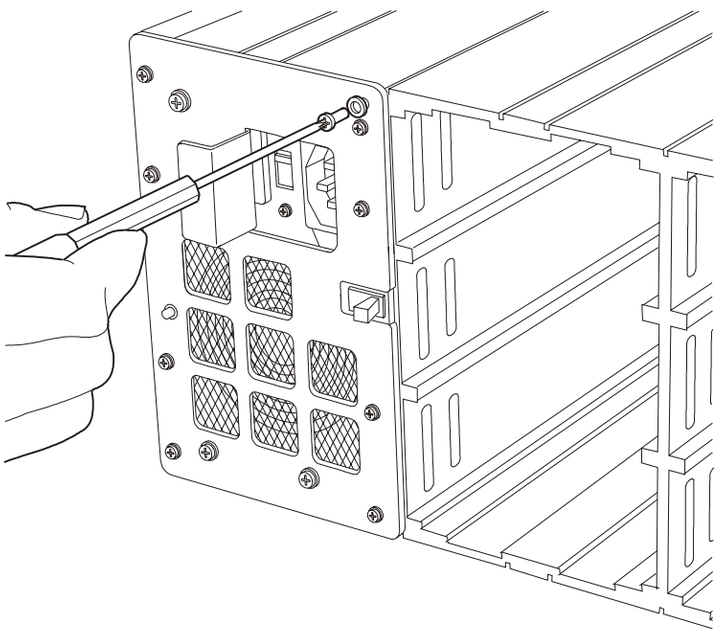

Figure 2–6 Fitting the Earth Screw

2.5 ESI/Ops Panel Module Installation

2.5.1 Parts Check List

- ESI/OPS2 Panel Module
- Ops panel key(s)

2.5.2 Disk Drive Auto/Manual Start Switch

DIL switch 1 is provided to disable the auto spin start function.

Caution *If this switch is ON the Enclosure services will **not** attempt to auto start any of the drives in the enclosure.*

- To set the enclosure to automatically start all devices at Power On, set DIL Switch 1 to the OFF (Up) position.
- To enable Host motor start only: Set Switch 1 to the ON (Down) position.

2.5.3 SES Device Slot Address Reporting

Each device bay reports its address via SES. Two alternative address schemes are provided for, selected by using DIL Switch 3 on the ESI/Ops panel.

- To select slot reporting using device AL_PA, set Switch 3 to the OFF (up) position.

  Note: This is the correct setting for use with Mylex RAID solutions (e.g. Galaxy enclosures).

- To select slot reporting using Select ID (SEL_ID), set Switch 3 to the ON (down) position.

Other switches on the ESI/OPS2 module are reserved and should be set to the OFF (up) position.

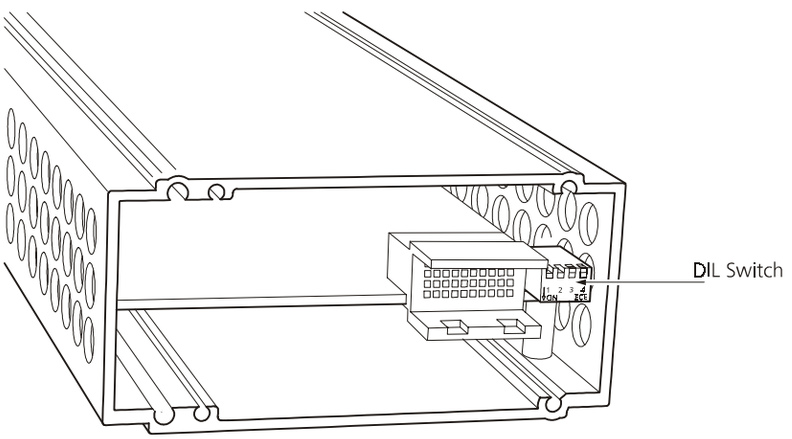

Figure 2–7 Disk Drive Start Switch

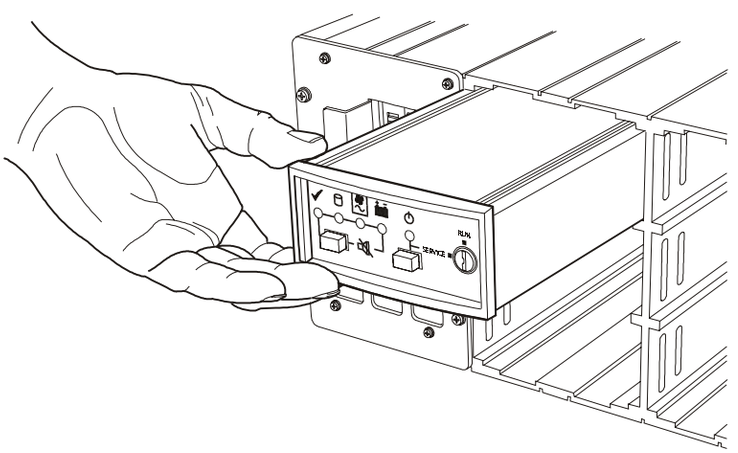

Figure 2–8 Installing the ESI/Ops Panel

2.5.4 Installation Procedure

Caution *Check that the Ops panel keys are included with the module. If they cannot be accounted for they may have been discarded with the packaging.*

Install the module by sliding into rear Bay 3/1, ensuring the module has docked with the connector and the retention clip has engaged with the chassis.

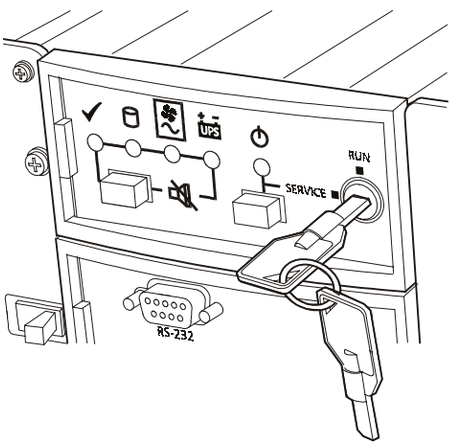

Figure 2–9 ESI/Ops Panel Installation

2.5.5 SES Function

The SCSI Enclosure Services (SES) interface provides the FC-AL enclosure with an ANSI SCSI-3 SES standard compliant enclosure management interface. This specification is extremely flexible and provides for a control and status interface to a wide range of element types (an element could be a PSU, Fan or UPS etc.

It is important to recognize that the Galaxy 55 product handles all management requirements of the enclosure's power, cooling and temperature, no control action is required by a host processor. Status information is available to allow effective use of the internal conditions for decision making and user interfacing.

Management of the disk devices are the responsibility of the Host processor (or RAID controller) as it has the capability of detecting device miss-operation. The SES interface provides a path to indicate to the user (through carrier LEDs) which device is causing the problem.

The device element status fields also provide the necessary mapping of device bays to device FC-AL physical address (AL_PA).

Important **Please refer to the full SES Interface specification document (IFSALSES) for complete definition of the SES protocol supported.**

Please refer to the ANSI SCSI-3 SES specification and Drive manufacturers' FC-AL interface specifications for details of interfacing to the ESI processor through the two activated devices within the Galaxy 55 enclosure.

- SFF 8067 Interface from 2 Drive bays (1/3 and 4/3) communicate with ESI processor.
  - Provides 2 alternative paths to enclosure data.
  - ESI processor housed in Ops Panel module
  - Polled system
  - No timed disconnect
  - No Asynch event reporting

2.6 FC-AL I/O Module Configurations

Important **Please refer to section 2.10 for information on FCAL drive configurations.**

2.6.1 FC-AL Internal Loop Structures

Two loop structures can be created with the Galaxy 55 enclosure.

- One 12 drive dual loop.
- Two six drive dual loops.

These options are provided by alternative plug-in LRC I/O modules.

Please refer to section 2.6.2 for details of 1 x 12 drive loops or section 2.6.3 for 2 x 6 drive loops

2.6.2 1 x 12 Drive Dual Loop Structure with 2 x SS-1x12-FC-IO Modules Installed

The dual 12 drive loop internal connection structure as shown in Figure 2–10. Connection to the 2 internal loops is achieved via two rear mounted plug-in, Loop Redundancy Circuit (LRC) I/O Modules in Bays 3/2 and 3/3 which contain Port Bypass Circuits (PBC) that provide loop resiliency in the event of unplugged or failing drives.

Note Figure 2–10 shows the logical routing of the FC-AL interface through the drive bays, this figure does not represent the physical wiring of the enclosure.

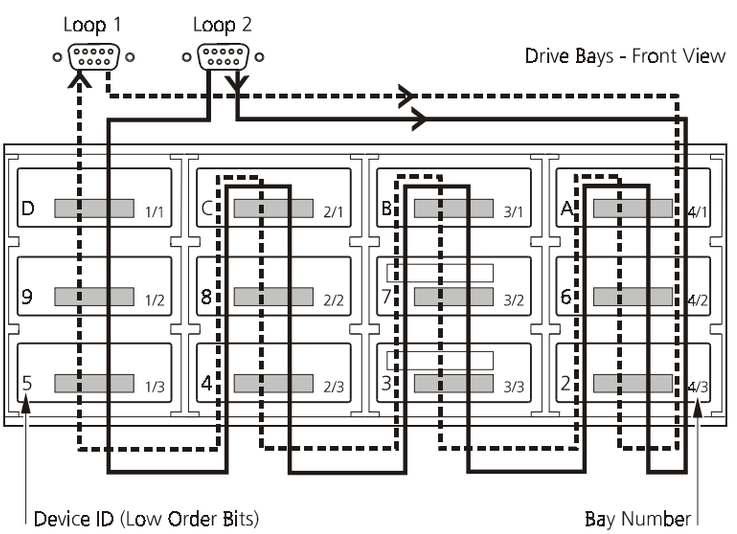

Figure 2–10 Dual 12 Drive Loop Layout

2.6.2.1 FC-AL Physical Organization

Figure 2–11 shows the two FC-AL loops, these are each routed through independent LRC I/O cards fitted in the rear of the enclosure. Either of these may be removed while the other is operating, thus providing fully redundant FC-AL operation

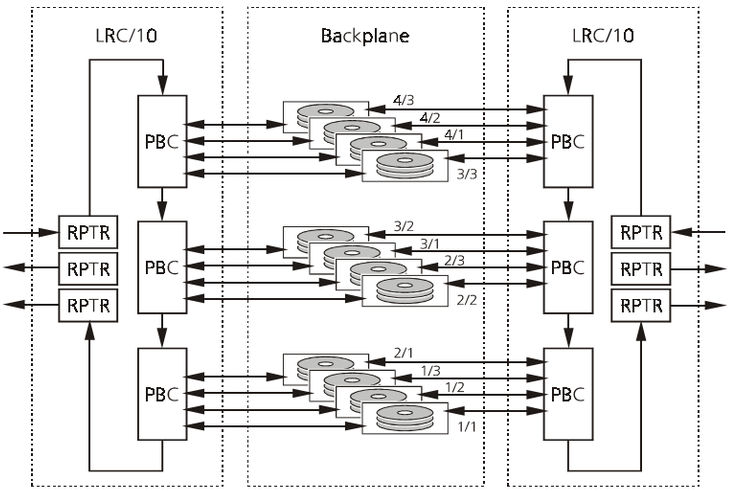

Figure 2–11 Physical Organization - Dual 12 Drive Dual Loop

2.6.3 2 x 6 Drive Dual Loop Structure with 2 x SS-2x6-FC-DC-IO Modules Installed

The 2 x 6 drive dual loop internal connection structure as shown in Figure 2–12. Connection to the 4 internal loops is achieved via two rear mounted plug-in, Loop Redundancy Circuit (LRC) I/O Modules in Bays 3/2 and 3/3 which contai Port Bypass Circuits (PBC) that provide loop resiliency in the event of unplugged or failing drives.

Note Figure 2–12 shows the logical routing of the FC-AL interface through the drive bays, this figure does not represent the physical wiring of the enclosure.

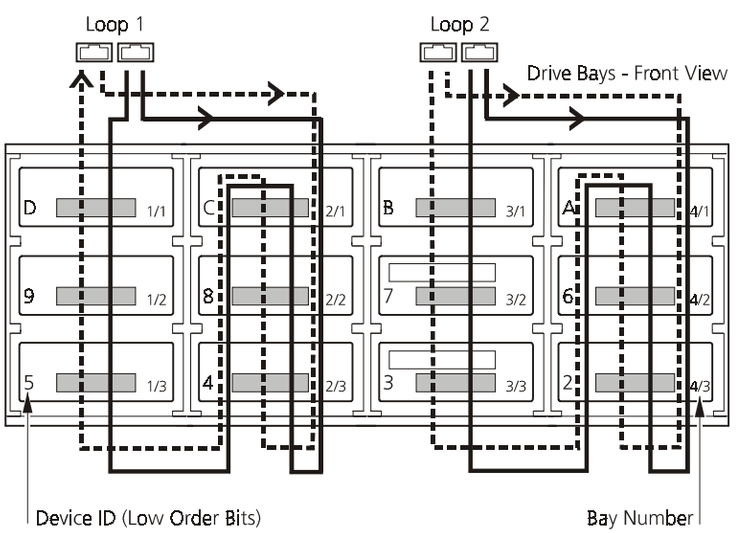

Figure 2–12 2 x 6 Drive Dual Loop Layout

2.6.3.1 FC-AL Physical Organization

Figure 2–13 shows the two FC-AL loops, these are each routed through independent LRC I/O cards fitted in the rear of the enclosure. Either of these may be removed while the other is operating, thus providing fully redundant FC-AL operation

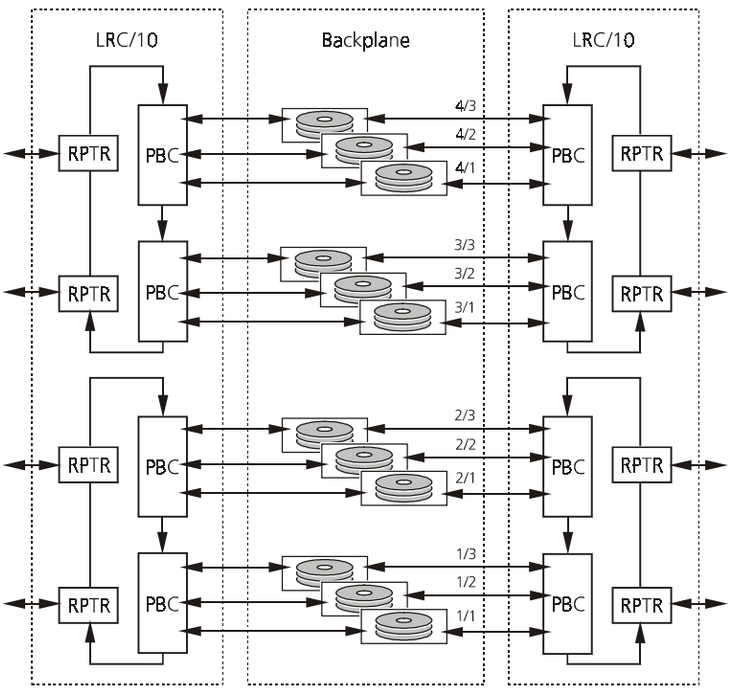

Figure 2–13 Physical Organization

2.7 FC-AL Interface

The (I/O) interface module provides an FC-AL interface via DB9 or HSSDC connectors for copper (Cu) cable connection. The interface has been wired to accept a Media Interface Adaptor (MIA), enabling the use of optical media

Each I/O or Loop Resiliency Circuit board houses Port Repeater chips that re-drive the Fibre Channel signals. Each of the LRC I/O boards also houses a number of Port Bypass circuits. The function of these circuits is to bypass the loop connections to empty drive bays or any disk drive which is not operating correctly

The two LRC I/O boards enable the dual loops within the enclosure to be maintained independently of one another; for example: if a Port Bypass fails that board may be replaced while the other loop is functioning normally.

Notes **1** A suitable dual loop host attachment will also be required to use this function.

2 There are no external terminators required with Fibre Channel architecture and any drive may be hot plugged during operation.

2.7.1 Connecting Multiple Enclosures (1x12-FC-IO Module)

A daisy chained loop application is used to connect multiple enclosures.

“Daisy chain” connection of multiple enclosures can be accommodated by linking between the FC-AL Tx connector on one enclosure and the Tx/Rx connector on the next enclosure.

Standard DB9 FC-AL cables are used to link the Tx connector on one enclosure to the Tx/Rx connector of the next and so on for the required number of enclosures in the chain, as shown in Figure 2–14. The loop is completed by linking the Tx connector on the last enclosure in the chain back to the host computer

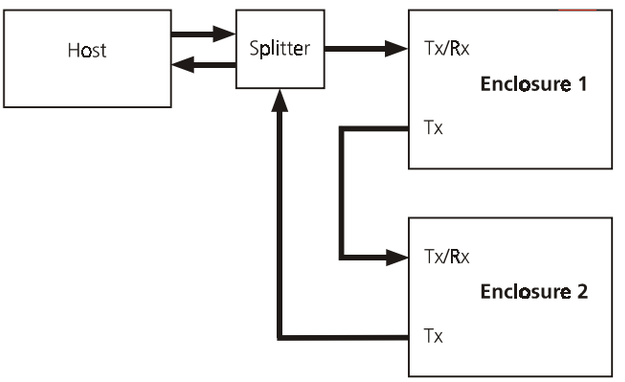

Figure 2–14 Daisy Chaining Multiple Enclosures

Note If the host connections are via a single connector a splitter must be used to separate the Tx and Rx signals.

Important **Loss of power to any enclosure within such a loop will cause the loop to fail. The use of a FC-AL hub (Figure 2–15) to connect to each enclosure will allow the removal of any enclosure (through physical removal or power loss) without loss of the entire FC-AL loop.**

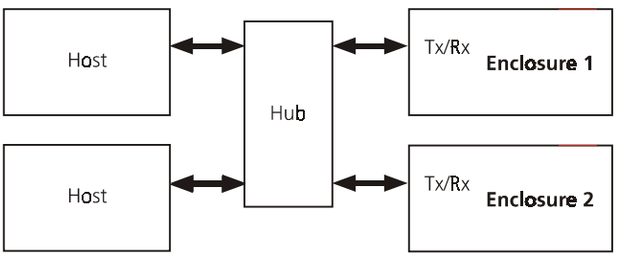

Figure 2–15 FC-AL Hub

2.7.2 Connecting Multiple Enclosures (2x6-FC-DC-IO Module)

You may use either one of each pair of HSSDC connectors to connect to another device or enclosure within the loop LED indicators are fitted for each pair of connectors.

- If a Single connection is made the LED will illuminate Amber.
- If Both connections have a valid FC_AL signal the LED will illuminate Green.

2.7.3 Connecting Multiple Enclosures (2x6-FC-DC-IO Module) Expansion to Galaxy

The following rules apply when you are attaching Galaxy 55 enclosures to an Galaxy RAID enclosure:

- Each enclosure should use “hard addressing”. To ensure that this is the case, Set the ID (AL_PA) thumbwheel switch on each expansion enclosure to a different setting 1 to 7).

Important **Do not use a setting of 0 as this is the RAID enclosure ID range.**

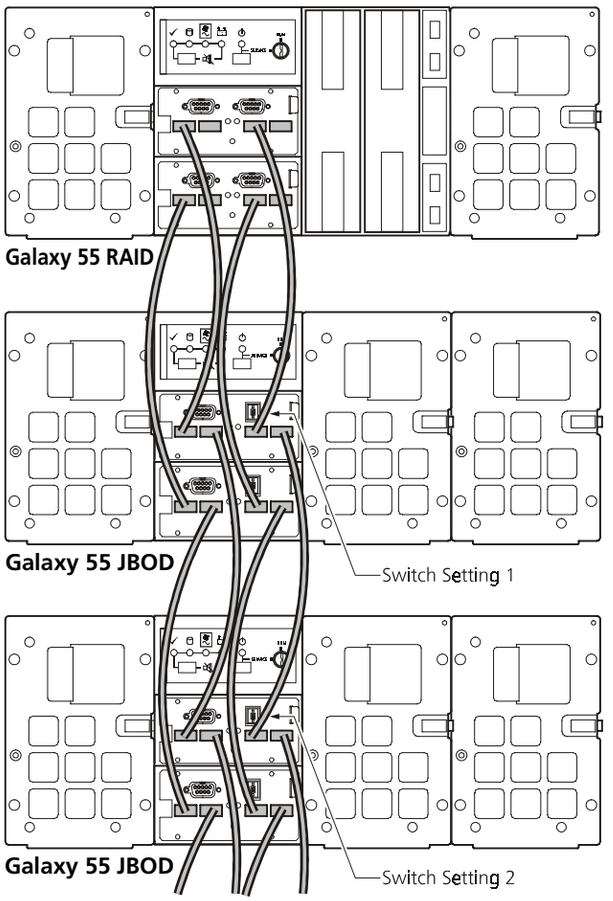

Figure 2–16 Expansion Enclosures

2.8 LRC I/O Module Installation

2.8.1 Part Check List

- LRC I/O Module

Important **Please check that you have received the correct I/O module variant. Refer to section 1.5.7 for the FCAL LRC I/O module specification.**

2.8.2 Procedure

Check for damage especially to the interface connector, do not install if any pins are bent.

1 The modules should be installed in rear bays 3/2 and 3/3 (third from right, middle and bottom bays) of the chassis (Figure 2–1).

2 Insert the module in the bay and press fully home (Figure 2–17).

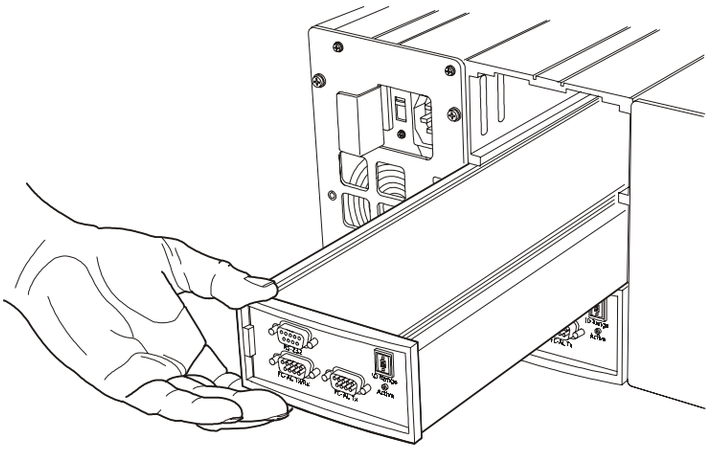

Figure 2–17 Installing a FCAL LRC I/O Module

Note Removal is achieved by pushing the latch to the right and pulling the module out.

2.9 Select ID and AL_PA

The Select ID of each drive bay can be set to one of eight ranges. these settings are read by the disk drives on SEL_0 to SEL_6 lines. The low order 4 Bits are fixed according to the position of the drive in the enclosure. The following table shows the relationship between the Bay Position and the Drive Select ID bits:

	Bay 1/1	**Bay 1/2**	**Bay 1/3***	**Bay 2/1**	**Bay 2/2**	**Bay 2/3**	**Bay 3/1**	**Bay 3/2**	**Bay 3/3**	**Bay 4/1**	**Bay 4/2**	**Bay 4/3***
Select ID	Dh	9h	5h	Ch	8h	4h	Bh	7h	3h	Ah	6h	2h
1x12 Loop	Tx	<	<	<	<	<	<	<	<	<	<	Rx
Loop 1, 2x6 IO	Tx	<	<	<	<	Rx						
Loop 2, 2x6 IO							Tx	<	<	<	<	Rx

***** Bays 1/3 and 4/3 provide SES communications and must be populated.

2.9.1 Selecting Alternate Select ID Ranges

A Range switch is located on the rear of the LRC I/O module

The Drive Select ID bits, and hence the Arbitrated Loop Physical Address (AL_PA) range, can be changed by setting the Range switch as follows:

Important **Although there is a range switch fitted to each module, only the switch located on the *UPPER* module will be active. This is indicated by the LED on the rear of the LRC I/O module, see Figure 1–11.**

Arbitrated Loop - Physical Address (AL_PA)

Within the FC-AL protocol each device on a loop is allocated a unique Physical Address (AL_PA). This is derived from the Select ID set described above. Please refer to Appendix A , ”Arbitrated Loop Physical Address (AL_PA)

Values", on page 49. Alternatively a device may use a Soft Address such that its AL_PA is dynamically allocated during loop initialization. The Soft Address mode is selected by setting the Port ID Range switch to 8.

Note If conflicting IDs are selected the FC-AL initialization process will use soft addressing to allocate AL_PAs, this could make the identification of particular devices difficult.

Table 2–3 shows the hexadecimal AL_PA values selected with each range switch setting.

Table 2–3 Hexadecimal AL_PA Values

Switch Setting	0	1	2	3	4	5	6	7	8	9
Bay 1/1 AL_PA	01	29	45	5A	75	9E	B5	D2	Soft	N/A
Bay 2/1 AL_PA	02	2A	46	5C	76	9F	B6	D3	Soft	N/A
Bay 3/1 AL_PA	04	2B	47	63	79	A3	B9	D4	Soft	N/A
Bay 4/1 AL_PA	08	2C	49	65	7A	A5	BA	D5	Soft	N/A
Bay 1/2 AL_PA	0F	2D	4A	66	7C	A6	BC	D6	Soft	N/A
Bay 2/2 AL_PA	10	2E	4B	67	80	A7	C3	D9	Soft	N/A
Bay 3/2 AL_PA	17	31	4C	69	81	A9	C5	DA	Soft	N/A
Bay 4/2 AL_PA	18	32	4D	6A	82	AA	C6	DC	Soft	N/A
Bay1/3 AL_PA	1B	33	4E	6B	84	AB	C7	E0	Soft	N/A
Bay 2/3 AL_PA	1D	34	51	6C	88	AC	C9	E1	Soft	N/A
Bay 3/3 AL_PA	1E	35	52	6D	8F	AD	CA	E2	Soft	N/A
Bay 4/3 AL_PA	1F	36	53	6E	90	AE	CB	E4	Soft	N/A

Note SES may be configured to report either the Select ID (SEL_ID) or AL_PA address of each device bay. Please refer to Section 2.5.3 for more information.

2.10 Drive Carrier Configuration

2.10.1 Planning and Configuring Your Installation

2.10.1.1 System Configuration

Important **Before you begin installation you should become familiar with the configuration requirements of your Galaxy 55 system. Please refer to Section 2.2 for information on your overall system configurations.**

There must be a drive present in Bay 1/3 or 4/3 to enable SES Communications to operate. Installing drives in both of these bays will provide redundant SES communication paths.

When planning your system configuration, please remember that:

- All Galaxy 55 enclosure drive bays must be filled with either a drive carrier or front dummy fascia, no bays should be left completely empty.

2.10.1.2 Drive Configuration

Important **After you have installed the drive carrier modules in your Galaxy 55 enclosure, please refer to Section 2.6 for configuration information relevant to the I/O module you are installing and instructions for setting the Drive Select ID bits.**

2.11 Drive Carrier Installation

2.11.1 Parts Check List

- Drive module or Front Dummy Fascia

2.11.2 Procedure

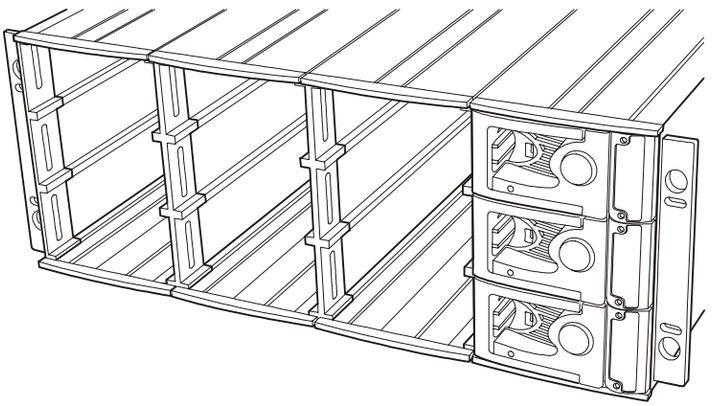

Figure 2–18 Galaxy 55 Drive Bay

1 Release the carrier handle by pressing on the small indentation area on the left of the carrier fascia (Figure 2–19).

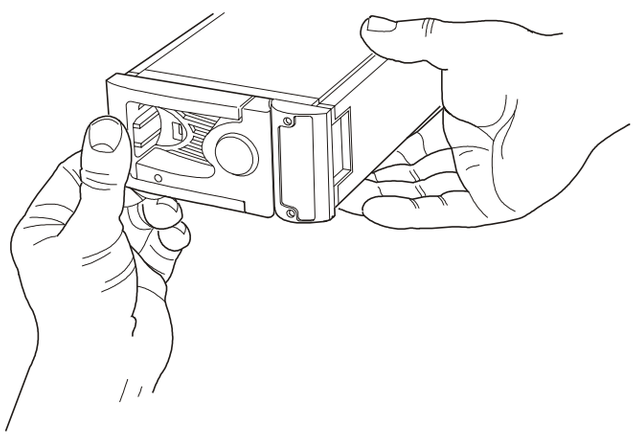

Figure 2–19 Installing an FC-AL Drive Carrier Module (1)

2 Insert into chassis (Figure 2–20).

3 Push the carrier gently home until it is stopped by the camming lever on the right of the carrier (Figure 2–21).

4 Cam the carrier home - Press on the handle, the camming lever on the right of the carrier will engage into a slot in the chassis, (Figure 2–22) Continue to push firmly until the handle fully engages with the carrier cap. A click should be heard as the latch engages and holds the handle closed.

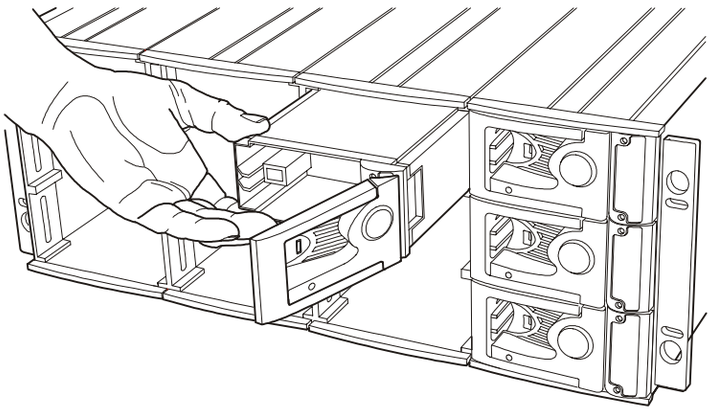

Figure 2–20 Installing an FC-AL Drive Carrier Module (2)

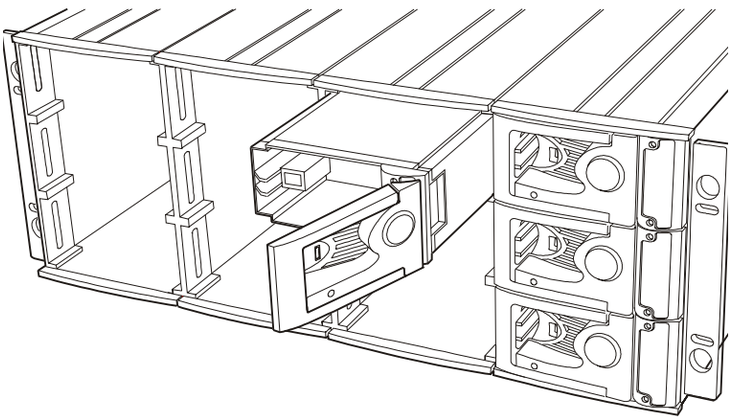

Figure 2–21 Installing an FC-AL Drive Carrier Module (3)

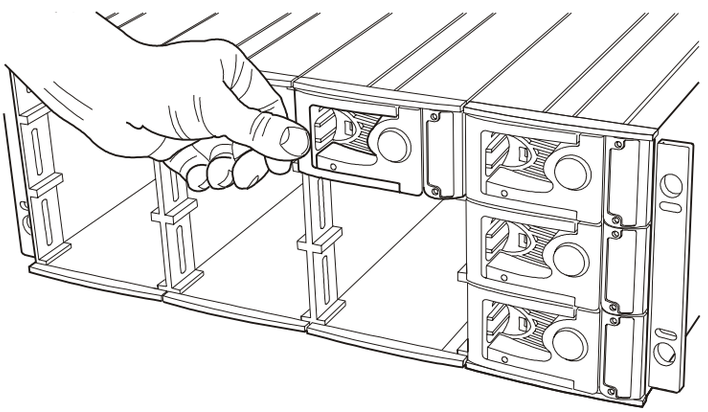

Figure 2–22 Installing an FC-AL Drive Carrier Module (4)

Note Removal Is the reverse of this procedure (press on the indentation to release the latch).

Important **Ensure that all plug-in modules are installed *BEFORE* fitting blanking plates (see Section.2.13).**

2.12 Engaging the Anti-tamper Locks

The Anti-tamper locks are fitted in the drive carrier handles and are operated through the small round cutout in the lower part of the handle trim piece. In the locked position a red indicator is visible in the centre rectangular aperture in the handle. (see Figure 2–23)

Drives are supplied with the locks set in the unlocked position.

2.12.1 Activating the Locks

1 Carefully insert the lock key provided into the cutout in the handle trim.

2 Locate the key into its socket.

3 Rotate the key through 90 degrees in an anti-clockwise direction until the indicator visible in the centre aperture of the handle shows green.

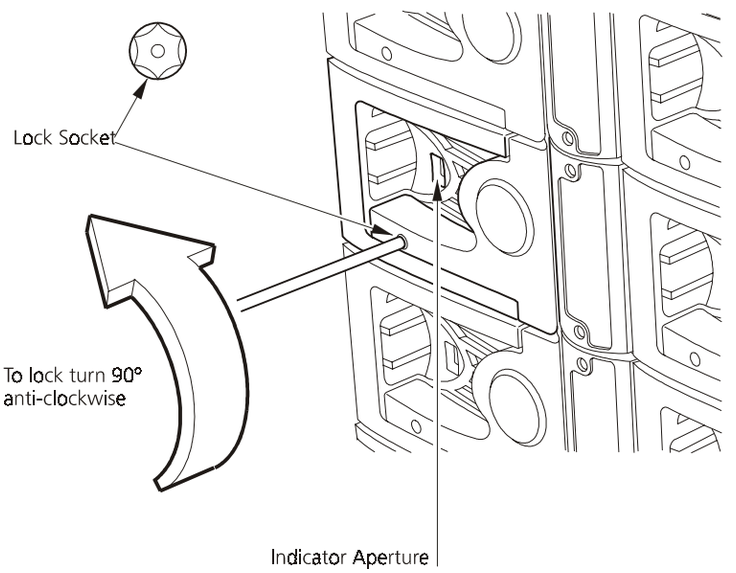

Figure 2–23 Activating the Anti-tamper Lock

4 Remove the key.

De-activation is the reverse of this procedure, that is:

- Rotate the key through 90 degrees in a clockwise direction until the indicator visible in the centre aperture of the handle shows black.

Note A drive carrier cannot be installed if its anti-tamper lock is activated outside the Enclosure.

2.13 Blank Plates

2.13.1 Parts Check List

where applicable:

- Single bay Rear Blank plates
- 1x2 bay Rear Blank plates
- 1x3 bay Rear Blank plates

Warning **Operation of the enclosure with *ANY* blank plates or rear modules missing will disrupt the airflow and the drives will not receive sufficient cooling. It is *ESSENTIAL* that all rear apertures are filled before operating the unit.**

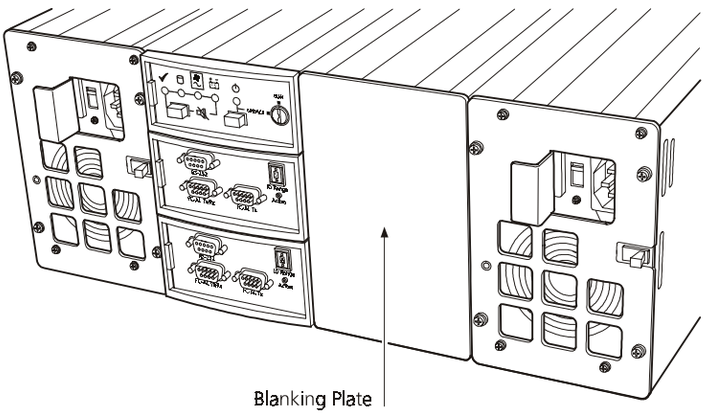

Figure 2–24 Typical Blanking Plate Installation

2.13.2 Procedure

Clip the correct size blank plates into the rear bay apertures as required.

2.14 Power Cord Connection

Warning **Ensure that you select the correct voltage range *on the SS-PSU-450* Power Supply/Cooling module *BEFORE* connecting the power cords. These Power supplies are *NOT* auto-ranging, failure to select the correct range *WILL* damage the PSU.**

2.14.1 Parts Check List

- Trifurcated power cord
- Power cord to requisite local standards

2.14.2 Procedure

1 Attach the Triifurcated power cord to the Power Supply/Cooling Modules,

2 Attach the power cord to the in-line IEC connector in this cord.

Caution *These power splitting cables are provided so that the system is operated from a SINGLE power source thus providing a single point of disconnect.*

3 A STANDBY LED on the ESI/Ops panel indicates whether AC mains power is present.

Caution *The power connections must always be disconnected prior to removal of the Power Supply/Cooling module from the enclosure.*

2.15 Grounding Checks

Perform these checks to ensure that a safe grounding system is provided.

- If a rack distribution system is being used.
  - Ensure power is removed from the rack.
  - Connect the Galaxy 55 power cord to the rack distribution and the enclosure.
- If a direct connection is made with the Galaxy 55 power cord, ensure that it is connected to the enclosure.

Warning **Some electrical circuits could be damaged if external signal cables or power control cables are present during the grounding checks.**

- Check for continuity between the earth pin of the IEC 320 connector on one of the Power Supply/Cooling modules and any exposed metal surface of the Galaxy 55 enclosure.

Chapter 3
Operation

3.1 Before You Begin

Before powering up the enclosure please ensure that all the modules are firmly seated in their correct bays and that Blank plates are fitted in any remaining bays.

3.2 Power On

Do not operate the subsystem until the ambient temperature is within the specified operating range. If the drives have been recently installed ensure they have had time to acclimatize before operating them.

Warning **If you are using SS-PSU-450 modules, check that the Voltage Range selector switch on the rear of each Power Supply/Cooling module has the correct voltage range (115V or 230V) selected *before* applying power to the equipment.**

Note Please refer to Section 3.3 for details of the Operator Panel LEDs and related fault conditions.

3.2.1 Standby Mode

Use this mode of operation on initial installation or whenever manual control of the enclosure power is required.

Follow the procedure below to power up the enclosure.

1 Set the Run/Service keyswitch on the Ops Panel (Fitted either in the front or rear of the enclosure) to the SERVICE position.

2 Apply AC Mains Power to the enclosure.

3 The STANDBY LED on the Ops Panel should be lit (Green).

4 Press and hold the STANDBY push-button switch (positioned directly beneath the STANDBY LED) for >1.5 seconds, until the enclosure power is activated.

The Power Supply/Cooling LED on the Ops Panel should be lit (Green) when the enclosure power is activated (and if auto start mode is set the disk drive motors should start).

5 The enclosure will toggle between STANDBY Mode (all drives will be powered down) and OPERATION Mode whenever the Standby push-button is depressed. Press and hold the STANDBY push-button switch for >1.5 seconds to switch off the enclosure power.

Notes

1. *All* LEDs on the Ops panel should be lit Green at power up to indicate that the system is functioning correctly. (The UPS LED will be lit Green with or without UPS fitted.)

2. If any alarms sound shortly after power on then a problem exists and the procedure in Chapter 4 , ”Troubleshooting and Problem Solving” should be followed.

Important **If mains power is lost for any reason, the enclosure will power down in STANDBY Mode and the STANDBY push-button must be pressed to power the enclosure up.**

Turning the Keyswitch from Service to Run positions will activate the power. Returning it to the Service position, the enclosure will remain powered ON until the STANDBY push-button is depressed

To protect against accidental operation, the STANDBY push-button is designed with an inherent delay in operation. The button must be depressed for approximately 1 second before the power is enabled or disabled.

3.2.2 Run Mode (Normal Operation)

Use this mode in an un-attended installation where the enclosure is required to default to Power On whenever AC mains power is present.

1. Turn the Run/Service keyswitch to the Run position.

2. The Standby button is now disabled. If mains power is interrupted the system will return to the Power On condition when mains power is restored.

3. Follow the procedure for powering on as described in Section 3.2.1 above.

Important **The Run/Service keyswitch may be turned to the Service position at any time, the enclosure will remain powered on until the Standby push-button is pressed.**

3.3 Operator Panel LEDs

The Ops Panel LEDs are shown in Figure 3–1.

LED Indicator	Symbol
System Status	✓
Drive Status	
Power & Cooling Status	
UPS Status	UPS
Power Standby Status	
Switches Push-button Audible Alarm Mute Push-button Standby/Operational switch Rotary Keylock - Run/Service activate	

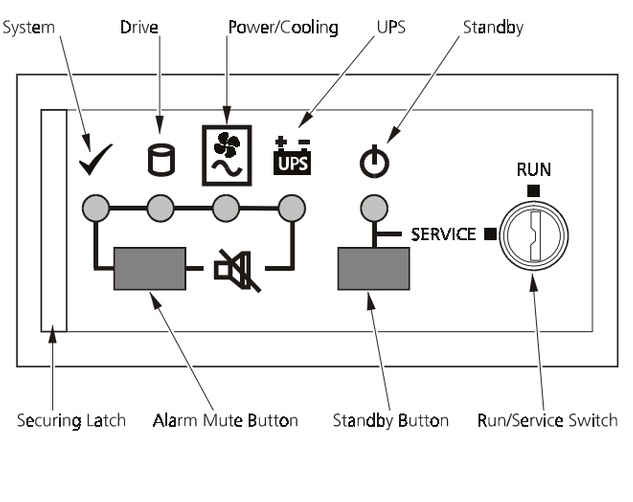

Figure 3–1 Ops Panel Indicators and Switches

- Under Normal conditions the LEDs should all be illuminated constant GREEN
- If a problem is detected the ESI processor will change the color of the relevant LED to AMBER.
- For non critical conditions the LEDs flash GREEN.

Refer to Chapter 4, ”Troubleshooting and Problem Solving” for details of any fault indication.

3.4 Starting the Drives

Unless otherwise selected during installation, all drives in the enclosure should automatically start their motors in a delayed sequence after power is applied. If this has not occurred one of the following conditions may exist.

- The disk drive DIL switch has been set in the ESI/Ops panel module during installation, thus disabling the drive auto start function. If manual start has been selected, then Drive Start commands must be issued to each drive in order to start their motors

- There is a power problem (an alarm and power fault indication would normally be active).

3.4.1 Disk Drives LEDs

Each drive carrier incorporates two indicators, an upper (GREEN) and lower (AMBER). In normal operation the Green LED will be ON and will flicker as the drive operates.

3.5 Power Down

To power the enclosure down,

either

- Place the Enclosure in STANDBY Mode (See Service Mode operation above).

or

- Remove AC Mains at the power source

Chapter 4
Troubleshooting and Problem Solving

4.1 Overview

The Galaxy 55 Enclosure includes a processor and associated monitoring and control logic to enable it to diagnose problems within the enclosure's power, cooling and drive systems.

The Enclosure Services Processor is housed along with the Operator Panel in the rear of the enclosure.

The sensors for power, cooling and thermal conditions are housed within the Power Supply/Cooling modules. There is independent monitoring for each unit.

If a fault is indicated on the Operator Panel (Ops Panel), please refer firstly to Table 4–1 and then to the section referenced within that table.

4.1.1 Initial Start-up Problems

4.1.1.1 Faulty Cords

First check that you have wired up the subsystem correctly. Then, if:

- cords are missing or damaged
- plugs are incorrect
- cords are too short

Call your supplier for a replacement.

4.1.1.2 Alarm Sounds On Power Up

Please refer to Section 4.3.

4.1.1.3 Computer Doesn't Recognize the Galaxy 55 Subsystem

1. Check that the FC-AL interface cables from the Galaxy 55 enclosure to the host computer are fitted correctly.
2. Check the Drive Select ID settings on your Galaxy 55 subsystem and on your system host.
3. Check that the LEDs on all installed drive carrier modules are illuminated Green. Note that the drive LEDs will not be lit during drive spinup.
4. Check that all drive carrier modules have been correctly installed.
5. Check that there is a valid FC_AL signal present at the I/O connector (see section 2.7.2).

6 Check the I/O module setup as follows:
- Check that the I/O module has been correctly installed and all external links and cables are securely fitted.
- Check the maximum cable length has not been exceeded.

4.2 LEDs

Green LEDs are always used for good or positive indication, flashing Green/Amber if non-critical conditions exist. Amber LEDs indicate there is a critical fault present within the module.

The Operator Panel displays the aggregated status of all the modules. The Ops Panel LEDs are shown in Figure 4–1 and the LED status conditions are listed in Table 4–1.

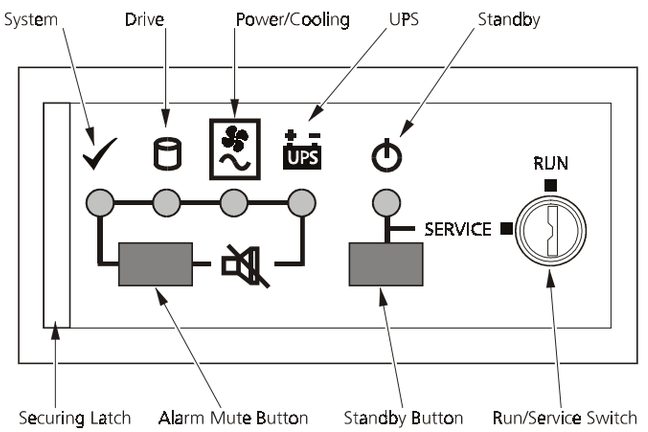

Figure 4–1 Ops Panel LEDs and Switches

For details on how to remove and replace a module see Section 4.9.

Warning **Whenever replacing a module NEVER leave an EMPTY space in the rear of the enclosure, obtain a replacement before removing the problem part.**

4.3 Audible Alarm

The Operator Panel also includes an Audible Alarm which indicates when a fault state is present. The following conditions will activate the Audible Alarm:

- Drive Fault
- Fan slow
- Voltage out of range
- Over temperature
- Thermal overrun
- UPS two minute warning
- System fault

4.3.1 Audible Alarm Mute

When the Audible Alarm sounds, it may be muted by pressing the Alarm Mute push-button until a double beep is heard (approximately 1 second). The Alarm Mute push-button is located beneath the indicators on the Operator Panel (see Figure 4–1).

When the alarm is muted it will continue to sound with short intermittent bleeps to indicate that a problem still exists, It will be silenced when all problems are cleared. (See also Thermal Shutdown states, Section 4.5.5).

4.4 Test Mode

A Test Mode is available whenever there are no faults present within the sub-system. In this mode the Amber and Green LEDs on each of the drive carrier modules are flashed on and off in sequence.

To Activate Test Mode (with no other faults present)

Press the Alarm Mute push-button until a double beep is heard. The LEDs will then flash until reset, either by pressing the Alarm Mute push-button again or if any actual fault occurs.

4.5 Troubleshooting

The following sections describe common problems, with possible solutions, which can occur with your Galaxy 55 system.

Table 4–1 Ops Panel LED Status

LED	Off	Green Steady	Green/Amber Flashing	Amber Steady	Section Ref No.
System Status ✓	Power off or Standby	ESI functions all OK	System Configuration Error	ESI / I2C function failure	4.5.1
Drive Status	Power off or Standby	No fault reported	SES data transfer in progress	Not Used	4.6
Power/Cooling	Power off or Standby	All PSU/Fans OK	Not Used	Any PSU or Fan fault	4.5.2
UPS Status	*Not used on 1x12-FC I/O modules*				
UPS	Power Off or Standby	UPS operational AC power OK	UPS indicates Power Failure	Two minute warning from UPS	
Standby	No AC supply	Standby or Power good	Not Used	Machine in Standby due to ESI Thermal Shutdown	4.5.4/ 4.5.5

4.5.1 System Faults

Symptom	Cause	Action
1 The SYSTEM LED will illuminate AMBER **2** Audible Alarm sound	The ESI processor has detected an internal fault (e.g. failure of an internal communications path)	**1** Check for other AMBER LED indications on the Power Supply/Cooling modules. If there is a PSU error present there may be a communications problem with that Power Supply/Cooling module. Remove and then re-fit the module, if the problem persists then change the module. **2** Check for other AMBER LED indications on the drives carriers. If none are evident then there may either be an ESI processor problem or a Backplane problem. **3** Change the ESI/Ops Panel module (see 4.9.2).

Note See also Section 4.5.5.

4.5.2 Power Supply/Cooling Faults

Symptom	Cause	Action
1 Operator Panel Power Supply/Cooling LED AMBER (~ and Fan Symbol). **2** An AMBER LED on one or more Power Supply/ Cooling Modules. **3** Audible Alarm Sounding.	**1** Any power fault. **2** A fan failure. **3** A thermal condition which could cause PSU overheating.	**1** Check Power On/Off Switch on rear of Power Supply/Cooling module is switched ON.(not accessible on later models) **2** Check AC Mains Connections to Power Supply/Cooling module is live. **3** Check PSU Voltage Range Selector switch is correctly set. **4** Disconnect the Power Supply/Cooling module from mains power and remove the module from the system, Re-install: if problem persists, replace Power Supply/ Cooling Module. **5** Reduce the ambient temperature.

4.5.3 Thermal Control

The Galaxy 55 Enclosure uses extensive thermal monitoring and takes a number of actions to ensure component temperatures are kept low and also to minimize acoustic noise.Air flow is from front to rear of the enclosure.

Symptom	Cause	Action
If the ambient air is cool (below 25 °C) and the fans are observed to increase in speed then some restriction on airflow may be causing additional internal temperature rise. **Note:** This is not a fault condition.	The first stage in the thermal control process is for the fans to automatically increase in speed when a thermal threshold is reached. This may be caused by higher ambient temperatures in the local environment and may be perfectly normal. **Note:** This threshold changes according to the number of drives and power supplies fitted.	**1** Check the installation for any airflow restrictions at either the front or rear of the enclosure. A minimum gap of 25mm at the front and 50mm at the rear is recommended. **2** Check for restrictions due to dust build-up, clean as appropriate. **3** Check for excessive re-circulation of heated air from rear to the front, use in a fully enclosed rack installation is not recommended. **4** Check that all Blank plates/modules are in place. **5** Reduce the ambient temperature.

4.5.4 Thermal Alarm

Symptom	Cause	Action
1 Operator Panel Power Supply/Cooling LED AMBER (~ and Fan Symbol). **2** An AMBER LED on one or more Power Supply/Cooling Modules. **3** Audible Alarm Sounding. **4** Air temperature exiting PSU above 55°C.	If the internal temperature measured in the airflow through the enclosure exceeds a pre-set threshold a thermal alarm will sound.	**1** Check local ambient environment temperature is below the upper 40°C specification. **2** Check the installation for any airflow restrictions at either the front or rear of the enclosure. A minimum gap of 25mm at the front and 50mm at the rear is recommended. **3** Check for restrictions due to dust build-up, clean as appropriate. **4** Check for excessive re-circulation of heated air from rear to the front, use in a fully enclosed rack installation is not recommended. **5** If possible shutdown the enclosure and investigate the problem before continuing.

4.5.5 Thermal Shutdown

Symptom	Cause	Action
1 ALL AMBER LEDs on the Operator Panel and on ALL drive bays illuminated flash. **2** Audible Alarm sounds almost continuously and cannot be muted.	At a higher threshold than the Thermal Alarm (this should already have been activated) the Enclosure is programmed to shutdown in order to protect itself and the disk drives from damage. OR - All fans have failed. OR - Only 1 fan operating and the internal temperature is 40° C or above.	**1** Check for airflow restrictions. **2** Check Power Supply/Cooling module faults. **3** Check for excessive local temperatures.

Important: The Enclosure will SHUTDOWN 10 seconds after the above Symptoms are observed. This will leave the following indications active.

1 STANDBY LED Illuminated AMBER **2** PSU STATUS LED illuminated AMBER **3** Enclosure powered off	**1** Clear the source of the overheating **2** Leave for a period to cool down. **3** Remove AC Mains power from the enclosure for at least 30 seconds to reset the shutdown condition **4** Re-start enclosure using normal operating procedure **5** Check for re-occurring cooling faults (especially fan failure).

4.5.6 Power Supply/Cooling Module Detection

Symptom	Cause	Action
1 Flashing System LED **2** PSU LED is constant **3** Audible alarm sounding	The system has been configured to expect redundant Power Supply/ Cooling modules. Insufficient modules have been detected.	**1** Check the number of PSUs present and operational. **2** Check for an amber LED on one or more Power Supply/Cooling modules,.or a PSU has been removed and not replaced.

4.6 FC-AL Drive Carrier Module Faults

Disk drive status is monitored by a Green LED and an Amber LED mounted on the front of each Drive Carrier Module, providing the following indications:

Table 4–2 LED Functions

State	Green	Amber
No drive fitted	Off	Off
Enclosure Thermal overrun	N/A	ON (forced condition)
Drive Power on	On	Off
Drive Activity	Blink off	Off
Drive Fault	On	On*
Drive Spin-up or Formatting	Flashing	Off

* SES controlled function.

4.6.1 Front Dummy Fascias

Front dummy fascias must be fitted to all unused drive bays to maintain a balanced air flow.

4.6.2 Auto Start Failure

Unless otherwise selected at installation time, all drives in the enclosure should automatically start their motors after power is applied. If this has not occurred one of the following conditions may exist/

- The disk drive start switch has been set on the ESI/Ops Panel module during installation, thus disabling the drive auto start function.
- There is a power problem (An alarm and power fault indication would normally be active).
- Only 1 Power Supply/Cooling module is fitted in an enclosure with:
  - drive Type 3 selected
  - eight or more drives installed.

  A full complement of two Power Supply/Cooling modules are required to auto start.

  Note: The SYSTEM LED will flash Green/Amber.

4.7 Dealing with Hardware Faults

Ensure that you have obtained a replacement module of the same type *before* removing any faulty module.

Warning **If the Galaxy 55 subsystem is powered up and you remove any module, replace it immediately. If the subsystem is used with modules or blanking plates missing for more than a few minutes, the Enclosure can overheat, causing power failure and data loss. Such use will invalidate the warranty.**

- Replace a faulty drive with a drive of the same type and capacity.
- All drive bays must be fitted with either a Drive Carrier Module or a front dummy fascia in order to maintain a balanced air flow.
- All the supplied plug-in power supply units, electronics modules and Blank plates must be in place for the air to flow correctly around the cabinet.

4.8 Continuous Operation During Replacement

Depending on how the subsystem is set up, if a disk unit fails, it can normally be replaced without interrupting the use of the system.

In addition, each enclosure can contain one, two or three power supply units, any of which can maintain power and cooling to the subsystem while one of the others is replaced.

4.9 Replacing a Module

Please refer to Chapter 2 , ”Getting Started” for information on the initial installation of the plug-in modules in the Galaxy 55 enclosure.

Warning **Observe all conventional ESD precautions when handling Galaxy 55 modules and components. Avoid contact with Backplane components and module connectors, etc.**

4.9.1 Power Supply/Cooling Module

4.9.1.1 Removing the Module

Warning **Do not remove the faulty Power Supply/Cooling module unless you have a replacement unit of the correct type ready for insertion.**

If a power supply unit or its fan is faulty, you must replace the whole power supply/cooling module.

If you have two or three power supply units installed, you can continue working while replacing the faulty module.

1. If you have more than one power supply unit installed, make sure you identify the faulty module correctly.
2. Remove the power cord from the faulty Power Supply/Cooling module.
3. Remove the earth screw and washer from the module front panel.
4. Release and hold the retention latch.
5. Grip the metal flange on the power supply unit front panel firmly between finger and thumb and slide the unit out of the Enclosure bay (Figure 4–2).

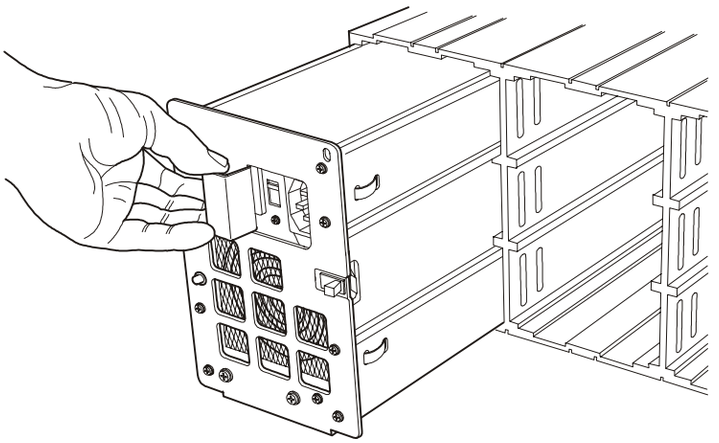

Figure 4–2 Removing a power supply/Cooling module

4.9.1.2 Inserting the Module

1. Push the replacement module gently home into the bay, ensure that it is fully engaged and that the retention latches are engaged into the chassis.
2. Fit and tighten the earth screw and washer on the front panel to secure the module (Figure 4–3).
3. If required, check that the correct voltage range has been selected.
4. Insert the power cord.

Note The alarm will sound until the new Power Supply/Cooling module is operating correctly.

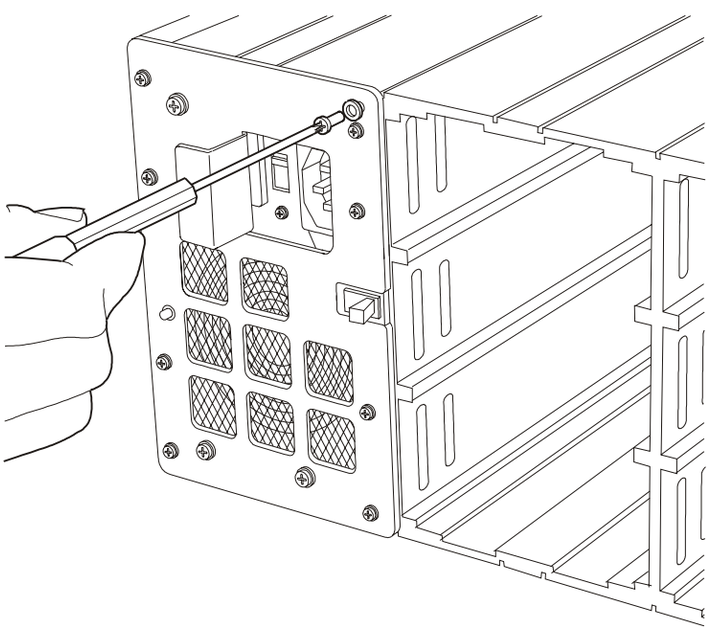

Figure 4–3 Fitting the Grounding Screw

4.9.2 ESI/Ops Panel Module

4.9.2.1 Removing the Module

Important **This module is designed for Hot Plug replacement. In order to ensure that there is no loss of system availability during replacement, the enclosure DEFAULT state with the ESI module removed is Power On.**

1. Release the catch on the side of the ESI/Ops Panel module.
2. Grip the front panel surround or the key (turned to the Service position0 firmly and slide the unit out of the enclosure bay.(Figure 4–4)
3. The subsystem must not be run for extended periods without the ESI/Ops Panel module being in place.

4.9.2.2 Inserting the Module

Install the module by sliding into the correct rear bay 3/1 ensuring the module has docked with the connector and the retention clip has engaged with the chassis. (Figure 4–4)

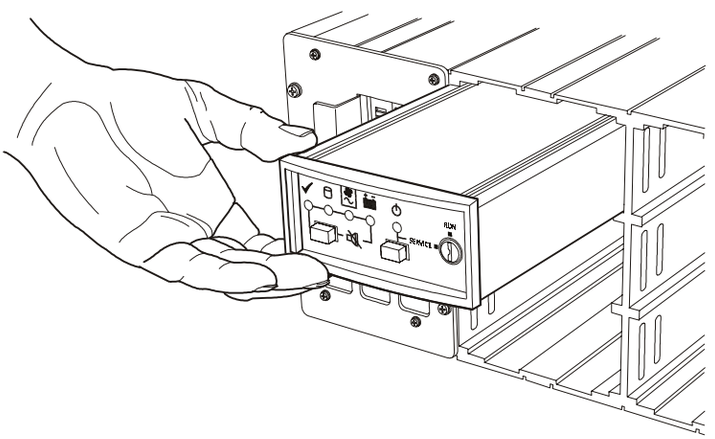

Figure 4–4 Installing an ESI/OpsPanel Module (Rear Mounting)

4.9.3 LRC I/O Module

Please refer to section 2.8, ”LRC I/O Module Installation”, on page 27 for full information on installing the I/O module.

4.9.3.1 Removing the Module

1. Release the catch on the side of the I/O Module.
2. Grip the front panel surround firmly and slide the unit out of the enclosure bay.
3. The subsystem must not be run for extended periods without an I/O Module being in place.

4.9.3.2 Inserting the Module

Install the module by sliding into the correct bay, ensuring the module has docked with the connector and the retention clip has engaged with the chassis. (Figure 4–5)

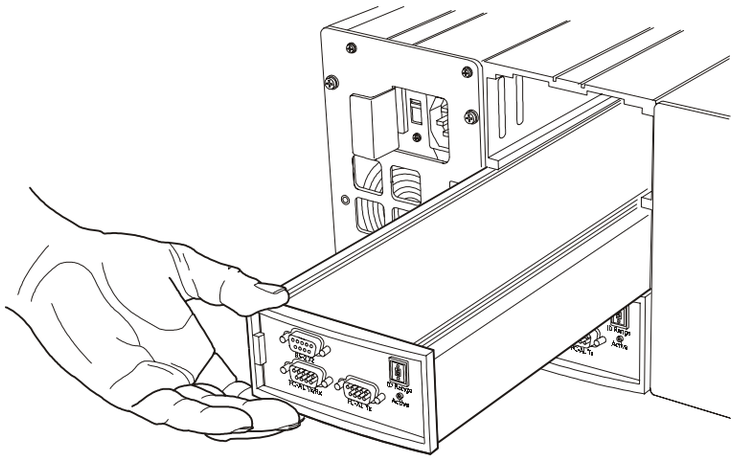

Figure 4–5 Inserting an I/O Module

4.9.4 Drive Carrier Module

Please see section 2.11, ”Drive Carrier Installation”, on page 30 for information on the initial installation of the plug-in modules in the Galaxy 55 enclosure.

Warning **Observe all conventional ESD precautions when handling Galaxy 55 modules and components. Avoid contact with backplane components and module connectors, etc.**

4.9.4.1 Removal and Replacement

Caution ***Drive spin down***
Damage can occur to a drive if it is removed while still spinning. If possible use the operating system to spindown the drives prior to removal. If this is not possible we recommend that you perform ***all*** *steps of the following procedure to ensure that the drive has stopped prior to removal:*

1 Release the Handle by pressing on the small indentation area on the left of the carrier fascia.

Note The anti -tamper lock must be off.

2 Gently withdraw the module approximately 1 inch (25mm) and wait 30 seconds.

3 Withdraw the module from the drive bay and fit a replacement module in accordance with the instructions in section 2.11.

4.10 List of Spare Parts and Ancillary Items

The following replaceable parts are available for the Galaxy 55 subsystem:

- Chassis (including Backplane)
- AC Power Supply/Cooling Module
- Drive Carrier Module
- I/O Module
- External FC-AL Signal Cables
- Bifurcated power cords
- All documentation
- 19 inch rack mounting rail kit
- ESI/Ops Panel module
- Front dummy fascia plates
- Blank plates (1x1, 1x2 or 1x3)
- (Country specific) power cords
- Keys for ESI/Ops Panel and Drive Carrier modules.

Appendix A
Arbitrated Loop Physical Address (AL_PA) Values

 Indicates AL_PAs selectable within Galaxy 55.

Table A–1 AL_PA Values

AL_PA (hex)	SEL ID (hex)	Setting (dec)
EF	00	00
E8	01	01
E4	02	02
E2	03	03
E1	04	04
E0	05	05
DC	06	06
DA	07	07
D9	08	08
D6	09	09
D5	0A	10
D4	0B	11
D3	0C	12
D2	0D	13
D1	0E	14
CE	0F	15
CD	10	16
CC	11	17
CB	12	18
CA	13	19

AL_PA (hex)	SEL ID (hex)	Setting (dec)
A3	2B	43
9F	2C	44
9E	2D	45
9D	2E	46
9B	2F	47
98	30	48
97	31	49
90	32	50
8F	33	51
88	34	52
84	35	53
82	36	54
81	37	55
80	38	56
7C	39	57
7A	3A	58
79	3B	59
76	3C	60
75	3D	61
74	3E	62

AL_PA (hex)	SEL ID (hex)	Setting (dec)
4D	56	86
4C	57	87
4B	58	88
4A	59	89
49	5A	90
47	5B	91
46	5C	92
45	5D	93
43	5E	94
3c	5F	95
3A	60	96
39	61	97
36	62	98
35	63	99
34	64	100
33	65	101
32	66	102
31	67	103
2E	68	104
2D	69	105

Table A–1 AL_PA Values

AL_PA (hex)	SEL ID (hex)	Setting (dec)
C9	14	20
C7	15	21
C6	16	22
C5	17	23
C3	18	24
BC	19	25
BA	1A	26
B9	1B	27
B6	1C	28
B5	1D	29
B4	1E	30
B3	1F	31
B2	20	32
B1	21	33
AE	22	34
AD	23	35
AC	24	36
AB	25	37
AA	26	38
A9	27	39
A7	28	40
A6	29	41
A5	2A	42

AL_PA (hex)	SEL ID (hex)	Setting (dec)
73	3F	63
72	40	64
71	41	65
6E	42	66
6D	43	67
6C	44	68
6B	45	69
6A	46	70
69	47	71
67	48	72
66	49	73
65	4A	74
63	4B	75
5C	4C	76
5A	4D	77
59	4E	78
56	4F	79
55	50	80
54	51	81
53	52	82
52	53	83
51	54	84
4E	55	85

AL_PA (hex)	SEL ID (hex)	Setting (dec)
2C	6A	106
2B	6B	107
2A	6C	108
29	6D	109
27	6E	110
26	6F	111
25	70	112
23	71	113
1F	72	114
1E	73	115
1D	74	116
1B	75	117
18	76	118
17	77	119
10	78	120
0F	79	121
08	7A	122
04	7B	123
02	7C	124
01	7D	125
Host	7E	126
Soft	7F	127

Glossary

In glossary definition*s, italics* are used for items defined elsewhere in the glossary and **bold** is used for the items shown in brackets after the main heading of the entry.

ASCII American Standard Code for Information Interchange. A 7-bit binary code (0's, 1's) used to represent letters, numbers, and special characters such as $,!, and /. Supported by almost every computer and terminal manufacturer.

Attribute Setting that controls access to a specific file. Often used to protect important files (such as the Registry files) from accidental change or deletion. Set using the ATTRIB command in MS-DOS.

Backplane A printed circuit board incorporated in the Rorke Data chassis assembly to provide logic level signal, and low voltage power distribution paths.

Bay The slot that a unit or media device fits into.

Byte A group of binary digits stored and operated upon as a unit. A byte may have a coded value equal to a character in the ASCII code (letters, numbers), or have some other value meaningful to the computer. In user documentation, the term usually refers to 8-bit units or characters.
1 kilobyte (K) is equal to 1,024 bytes or characters; 64K indicates 65,536 bytes or characters.

Cable Throughout this Galaxy 55 user guide this term is used in accordance with the preferred US context of: “an insulated flexible electric wire used for the transmission of data signals between computer equipment.”

Note: Cable is UK preferred terminology for either a power cord or a data cable:

Character A representation, coded in binary digits, of a letter, number, or other symbol.

Characters Per Second A data transfer rate generally estimated from the bit rate and the character length. For example, at 2400 bps, 8-bit characters with Start and Stop bits (for a total of ten bits per character) will be transmitted at a rate of approximately 240 characters per second (cps).

Chassis a number of aluminum extruded sections which are bonded together to form a segmented assembly containing a number of 'Bays', Each bay can accommodate a plug in module. Two of these assembled sections are then secured together and between these a Backplane PCB is 'sandwiched' to form the chassis assembly.

Configure To set up a hardware device and its accompanying software.

Data Communications A type of communications in which computers and terminals are able to exchange data over an electronic medium.

Disk (drive, carrier, module) A FC-AL disk **drive** mounted in an extruded aluminum **carrier**. You can have up to twelve disk drive carrier **modules** in each Galaxy 55 enclosure.

Enclosure The chassis assembly which houses the plug-in modules that make up the Galaxy 55 storage subsystem.

ESI/Ops module A plug-in module which can be fitted in the enclosure either front or rear facing. used to monitor and control all elements of the Enclosure.

Hot plugging A device with the capability of being connected to a subsystem without interrupting the power supplies to that subsystem.

Hot swap Hot swapping is the term used for manually swapping a failed disk unit with a replacement while the Galaxy 55 subsystem is in normal use.

Hz (Hertz) a frequency measurement unit used internationally to indicate cycles per second.

Initialize To prepare a hardware device for use.

LED Light Emitting Diode. A small light displayed on the cabinet, disk units and power supply units.

LRC Loop Resiliency Circuit: Circuits within the I/O modules which provide loop resiliency in the event of a drive failing or being unplugged.

LRC I/O module A plug-in module used to connect the internal FC-AL channels from the Galaxy 55 backplane to the rear of the enclosure.

Module (power supply, drive, ESI/Ops, I/O) A module is a power supply, disk drive or electronics unit held in a carrier that plugs into a bay inside the enclosure. A Galaxy 55 enclosure can contain twelve **drive** modules and three **power supply**/cooling modules, an **ESI/Operating Panel** module and two **LRC I/O** modules.

Operating system The software running the host computer. For example, on PCs it is often Windows 95, Windows NT or OS/2 and on Hewlett-Packard machines it could be HP-UX.

Parallel Transmission The transfer of data characters using parallel electrical paths for each bit of the character, for example, 8 paths for 8-bit characters. Data is stored in computers in parallel form, but may be converted to serial form for certain operations. See Serial Transmission.

Power Cord Throughout this Galaxy 55 user guide this term is used in accordance with the preferred US context of: “an insulated flexible electric wire fitted with connectors at each end and used for the transmission of electrical power to computer equipment.

Protocol A system of rules and procedures governing communications between two or more devices. Protocols vary, but communicating devices must follow the same protocol in order to exchange data. The format of the data, readiness to receive or send, error detection and error correction are some of the operations that may be defined in protocols.

Redundant Not essential.

Serial Transmission The transfer of data characters one bit at a time, sequentially, using a single electrical path. See Parallel Transmission.

Trifurcated (power cord) Throughout this user guide, the term is used as the UK equivalent of the US term furcated.

A trifurcated power cord is a three branched cord joined together by a yoke.

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