System Specification Document

4U60 Storage Enclosure G460-J-12

November 2015

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Revision 1.1

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Contents

Revision History

Date	Revision	Comment
October 2015	Revision 1.0	Initial version
November 2015	Revision 1.1	Updates to content

1 Document Summary

Topics:

- Scope
- Intended Audience
- System Specifications
- References

The following chapter defines the *scope*, *intended audience*, and *references* related to the 4U60 Storage Enclosure System Specification Document.

1.1 Scope

The following document provides the system specification for the form, fit, and function of the 4U60 Storage Enclosure.

1.2 Intended Audience

The following document is intended for users that require a better understanding of the hardware, firmware, software involved in the 4U60 Storage Enclosure. The information also provides a better understanding of the process in which the Mechanical developers, SI engineers, and Product Validation engineers require.

1.3 System Specifications

The following tables contain the system specifications for the 4U60 Storage Enclosure:

Power	
Alternating Current (AC) Power Supply (per power supply, 2 total)	
Wattage	1650W 80 + Gold rated
Voltage	200–240VAC (1650W max), auto-ranging, 50/60 Hz
Maximum inrush current	After AC power is applied to the power supply, any initial inrush current surge or spike of **10** milliseconds or less must not exceed **45** amps peak.

Table 1: Power Specifications

Physical (Chassis)	
Height	6.88 inches (174.8 mm)
Width	16.69 inches (424 mm)
Depth	33.5 inches (850 mm)
Weight	198 lbs (89.81 Kg) (with drives installed)

Table 2: Physical Specifications

Disposition: / Status:

Please verify/update/edit this section

Environmental Temperature	
Non-operating	-30° to 60°C
Operating	5° to 35°C

Table 3: Environmental Temperature Specifications

Maximum Vibration	
Vibration - Operating	Random 0.25 Grms, 5-10Hz 0.05 g sine wave sweep, 10-300Hz
Vibration - Non-Operating	Random 0.6 Grms 10-300Hz

Table 4: Maximum Vibration Specifications

Maximum Shock	
Shock - Operating	3.5g 6ms Pulse vertical shock
Shock - Non-Operating	8g 6ms Trapezoidal

Table 5: Maximum Shock Specifications

Altitude Specifications	
Operating	3280 ft(1000 m) at 35°C
Storage	-984 to 39,370 ft(-300m to 12,000 m)

Table 6: Altitude Specifications

Humidity	
Ambient Operating (Non-condensing	8 to 80% R.H.

Table 7: Acoustic Noise Specifications

Acoustic Noise Vibration	
Sound power	<7.5dB LwA @ 23ºC

Table 8: Acoustic Noise Specifications

1.4 References

- *Serial Attached SCSI*
- *SCSI Enclosure Services*
- *SCSI Primary Commands*
- *IPMI Intelligent Platform Management Interface Specification Second Generation*
- *Storage Bridge Bay (SBB) Specification*

2 For More Information

Topics:

- Points of Contact

The following chapter identifies the contact information for support on the 4U60 Storage Enclosure.

2.1 Points of Contact

For further assistance with an HGST product, contact Cloud Infrastructure Business Unit (CIBU) support. Please be prepared to provide the following information: Serial Number (S/N), product name, model number, and a brief description of the issue.

Telephone:

Region	Telephone Numbers	Support Hours and Additional Information
United States/International	1-408-717-7766	24 hours a day, 7 days a week
North America	1-844-717-7766	24 hours a day, 7 days a week Toll-free

Email:
support@hgst.com

Website:
www.hgst.com/support

3 Product Overview

Topics:

The following chapter provides a product overview of the 4U60 Storage Enclosure.

3.1 Introduction

The 4U60 Storage Enclosure is a 4U, high-density Hard Disk Drive (HDD) enclosure. The enclosure is designed to house up to a full configuration of 60 Ultrastar He8 helium drives and to maximize the performance of these drives, under all operating conditions.

The system contains the following high level features:

Hardware	Details	Number of Component
4U Storage enclosure	4U rack-mounted storage enclosure with slide rail and cable management assembly	1
Canisters Slots	2U half-width SAS Expander Canister–JBOD application (12G version)	2
Power Interface Board	Connects the power supplies to the drive board	1
Drive Board	• Connects the power supplies (with integrated fans) via power interface board, drives, and ESM. • Fully compliant with SAS 3.0 specification for operation up to 12Gbps.	1
3.5-inch HDD with carrier	• **Configuration**: 60 disk drives contained within top accessible chassis. • Hot swappable • Two status LEDs per drive slot, Activity and Fault • Ejector handle allows for easy installation and removal of HDDs	60 Ultrastar He8 helium HDDs
Power Supply Unit (PSU)	• 2U half-width dual 1+1 redundant, 1650W AC power supplies • 200 ~ 240 VAC (1650W) input, 47Hz – 63Hz • +12V and +5V outputs with +5V standby power • 2 integrated fans powered by redundant power rail • Compliant with 80 Plus efficiency Gold level • +/- 5% Voltage margin control on 5V and 12V rails • Trouble history implementation	2

Hardware	Details	Number of Component
	• 5v and 12v DC output at 1650W	
Fans	• N+1 redundant cooling • any one fan can fail and the system will continue to operate	4 (2 in each PSU)

Table 9: High Level Features Specifications

3.2 System Service Indicators

The following section displays the properties necessary to identify the 4U60 Storage Enclosure service indicators.

Note: Each CRU contains various colored LEDs. Generally speaking, an amber LED indicates location, a green LED indicates an operational state, and another green LED means power status.

3.2.1 Visual Indicator Identification

The 4U60 Storage Enclosure displays the following visual indicators:

- **Chassis**
  - ◆ 1 Green—Chassis operational
  - ◆ 1 Red—Chassis nonoperational
  - ◆ 1 Amber—Chassis locate
- Enclosure Storage Module (one set of LEDs per ESM, 2 sets total)
  Main LEDs:
  - ◆ 1 Green—Power on
  - ◆ 1 Red—ESM Error
  - ◆ 1 Amber—ESM locate, controlled by host via SES

  QSFP+ uplink and downlink ports:
  - ◆ On (Green)—link established with any or all SAS ports within the connector that are linked
  - ◆ Off—Loss of link on all of the SAS ports within the connector
- **PSU** (one set of LEDs per PSU, 2 sets total)
  - ◆ RYD Green—Displays the output +12V and +5V are normal with in specification
  - ◆ ACIN Green—Displays the input AC voltage is with in specification
  - ◆ ALM Amber—Displays the PSU report a fault
- **HDD**
  - ◆ 1 Green—Power on and connected
  - ◆ 1 Red—
    - — Solid: HDD Error
    - — Blinking: HDD Locate

3.3 System Block Diagram

The following figure displays the major electrical subsystems of the 4U60 Storage Enclosure:

Figure 1: 4U60 Storage Enclosure Block Diagram
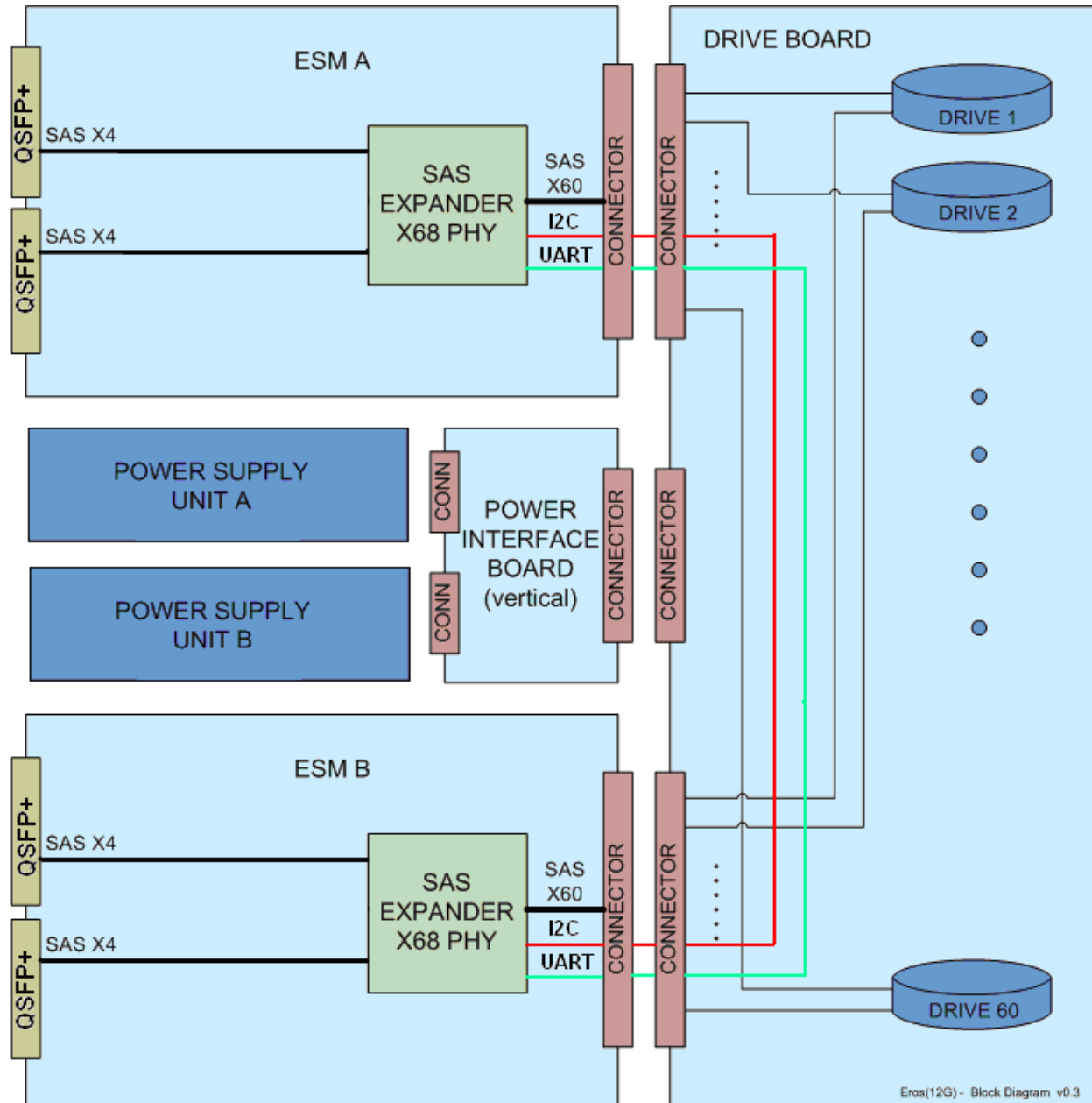
The 60 hard drives are connected to a single PMC 8056 SAS 3.0 exapander located in the ESM.

The system is powered by two 1650 watt power supply units (PSU) connected together in an N+1 redundant configuration. The PSUs plug into the PIB. The PIB distributes power to the Drive Board, which further distributes power throughout the system. The status of the PSUs is monitored by the ESM canisters.

The ESM, PSU, and drives are all field replaceable units (FRU) and may be replaced while the system is running. The PIB, Drive Board and front display module are field replaceable units which can only be replaced while the system is powered off.

The two ESM canisters communicate via I2C and UART connections routed between them over the Drive Board.

3.4 Mechanical Concept

The mechanical design of the 4U60 Storage Enclosure system is cost-effective, highly reliable, and supports hot-swapping of components (such as, power supplies and IOMs). All other components, interface drive boards, are not hot-swappable. System maintenance should be scheduled when the entire enclosure can be taken offline to replace non-redundant, failed components.

The following is a list of the Minimum component revisions:

Minimum Component Revisions	
Chassis	1EX0082
I/O Module (ESM)	1EX0080
Power Supply Unit	1EX0081
HDD With carrier	1EX0083
Rail Kit	1EX0106
Cable Management Assembly	1EX0107

Table 10: Minimum Component Revisions

4 4U60 Storage Enclosure Platform Design

Topics:

- Chassis
- SAS Expander Module
- Power Interface Board
- Drive Board
- Power Supply Unit
- Hard Disk Drive Carrier

The following section will provide a product overview of the 4U60 Storage Enclosure platform design.

4.1 Chassis

The 4U chassis of the 4U60 Storage Enclosure is designed to house all the components of the 4U60 Storage Enclosure within a standard 19 inch NEMA rack.

The following figure is a trimetric front view of the front of the 4U60 Storage Enclosure:

Figure 2: 4U60 Storage Enclosure Trimetric View (Front)
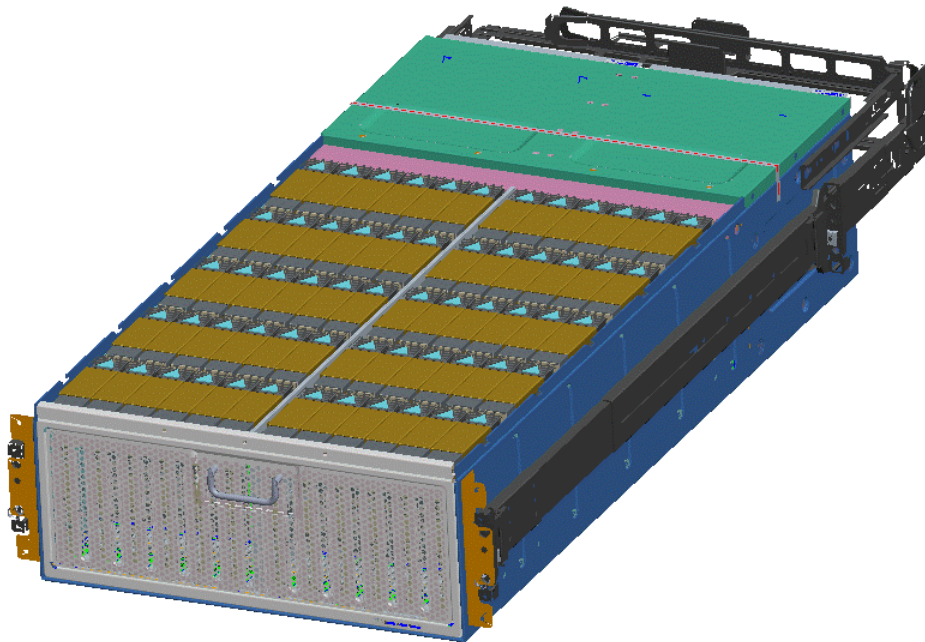
The following figure is a trimetric rear view of the front of the 4U60 Storage Enclosure:

Figure 3: 4U60 Storage Enclosure Trimetric View (Rear)
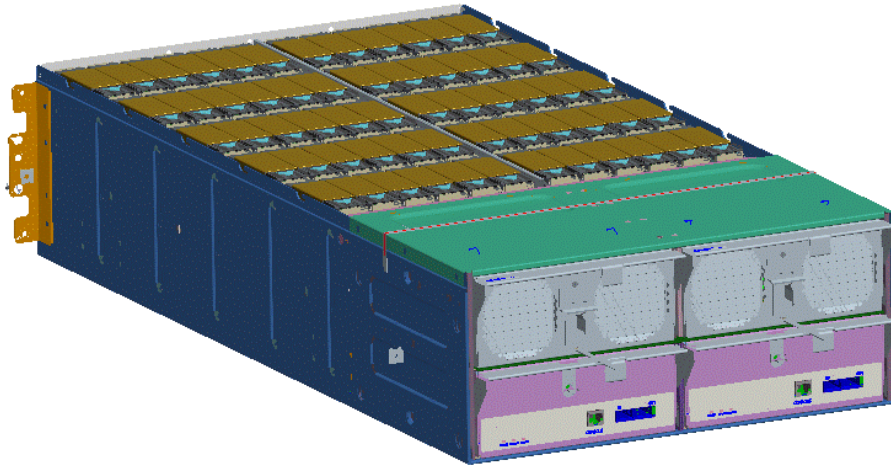
The following features are available in the 4U60 Storage Enclosure sub-assemblies:

- Supports up to 60 LFF hard drives
- Supports two 2U half-width ESM
- Supports two 2U half-width power supply units with integrated cooling fans
- Three front LEDs for enclosure status
- Contains all necessary EMI containment to ensure compliance
- 4U rack-mount with slide rail and CMA

The following figure displays the major sub-assemblies of the 4U60 Storage Enclosure:

Figure 4: 4U60 Storage Enclosure Sub-assemblies
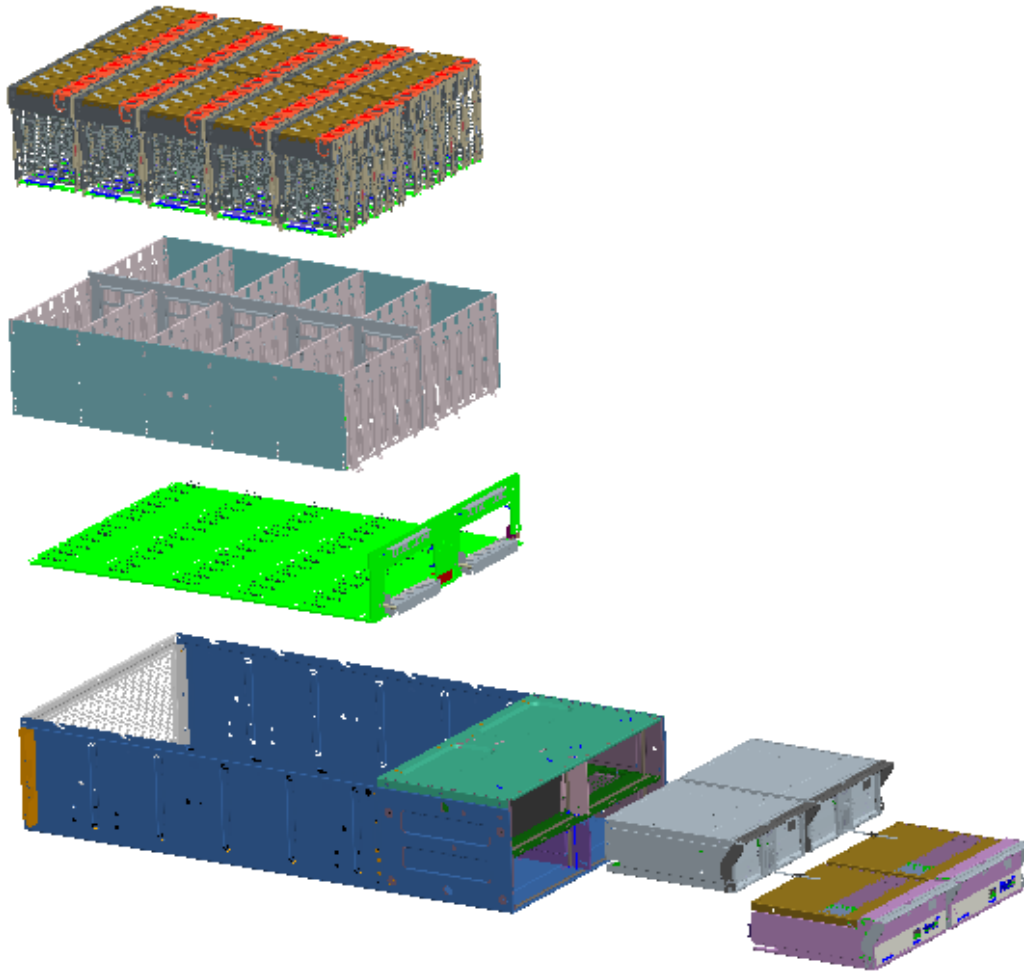
The following features are available in the 4U60 Storage Enclosure base structure:

- Main outer enclosure is 1.5mm SGCC sheet metal
- Designed to reduce sag and vibration

The following figure displays the base structure of the 4U60 Storage Enclosure:

Figure 5: 4U60 Storage Enclosure Base Structure
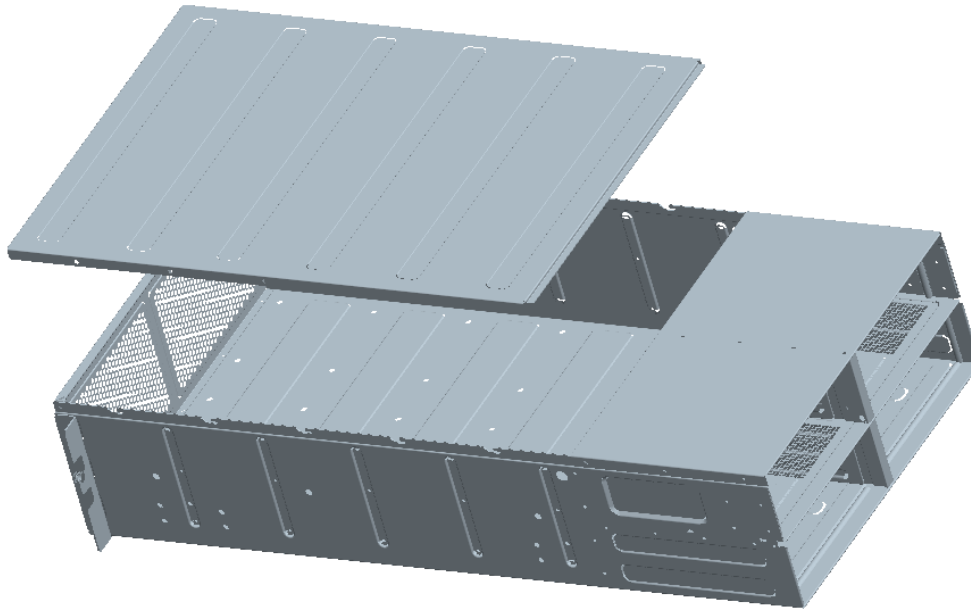
The following features are available in the 4U60 Storage Enclosure inner structure:

- Die casting walls with external sheet metal
- Includes locking feature to retain the HDD drives
- Robust honeycomb structure design to reduce sag and improve rotational vibration performance
- Inner structure attaches to the base and side walls of the main chassis
- Extensive FE analysis has been done to move from SGCC to casting

The following figure displays the inner structure of the 4U60 Storage Enclosure:

Figure 6: 4U60 Storage Enclosure Inner Structure
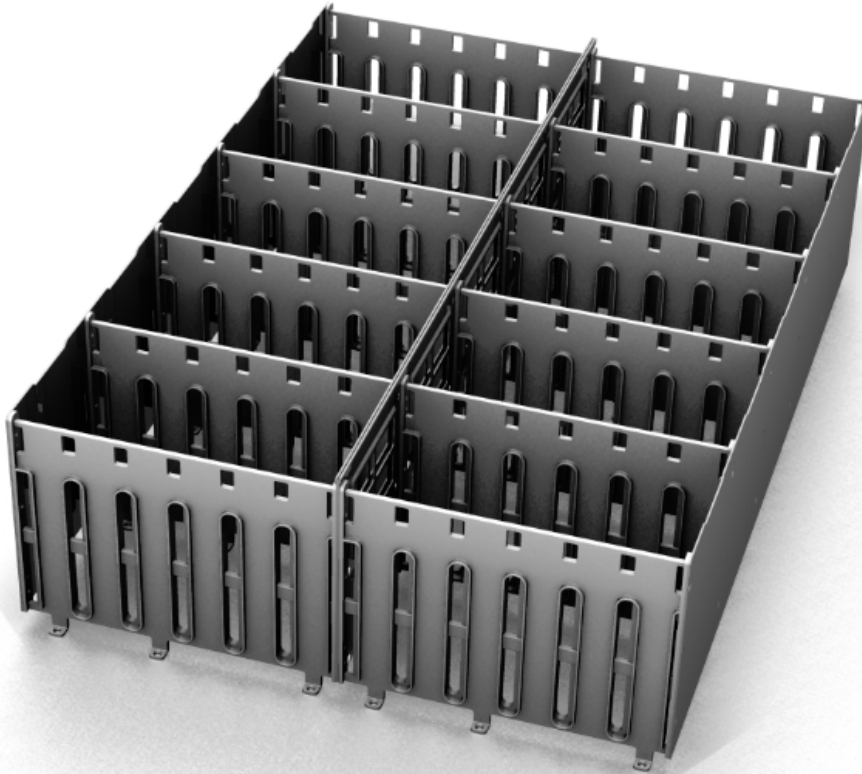
4.2 SAS Expander Module

The SAS Expander Canister Module provides SAS connectivity and enclosure management within the 4U60 Storage Enclosure. The SAS Expander Canister is not SBB 2.0 compliant and is a custom form factor designed to support an overall length of 860mm for the 4U60 Storage Enclosure chassis.

Each SAS Expander Canister Module provides two (2) external SAS 4x QSFP+ (SFF-8436) connectors (one "upstream" and one "downstream" for expansion), a RS-232 serial port, and three status LEDs. Firmware in the canister provides SAS topology configuration, enclosure management, and canister-canister synchronization. 4U60 Storage Enclosure supports up to two SAS Expander Canisters in a single system.

The following features are available in the 4U60 Storage Enclosure SAS Expander Canister:

- Supports native 12G connections for supporting of SAS 12G HDD and SSD
- Dimension: 80.5x196.4x228.3mm (Height x Width x Depth)
- PMC SAS 3.0 12G x 68-port SAS expander

  - 60x SAS 3.0 connections to disks
  - Two SAS 4x to external QSFP+ connectors
  - Integrated SCSI Enclosure Service firmware
- Two SFF-8436 compliant QSFP ports , one for upstream link and one for downsream cascading
- SCSI Enclosure Service (SES) firmware for SAS topology configuration, enclosure management, and canister-canister synchronization

- Support PSU output power monitor
- All target ports support spin-up control for SAS drives
- One RS232 port, through RJ45 connector, on a faceplate for product configuration and support

The following figure displays the SAS Expander Canister 4U60 Storage Enclosure isometric view:

Figure 7: 4U60 Storage Enclosure SAS Expander Canister
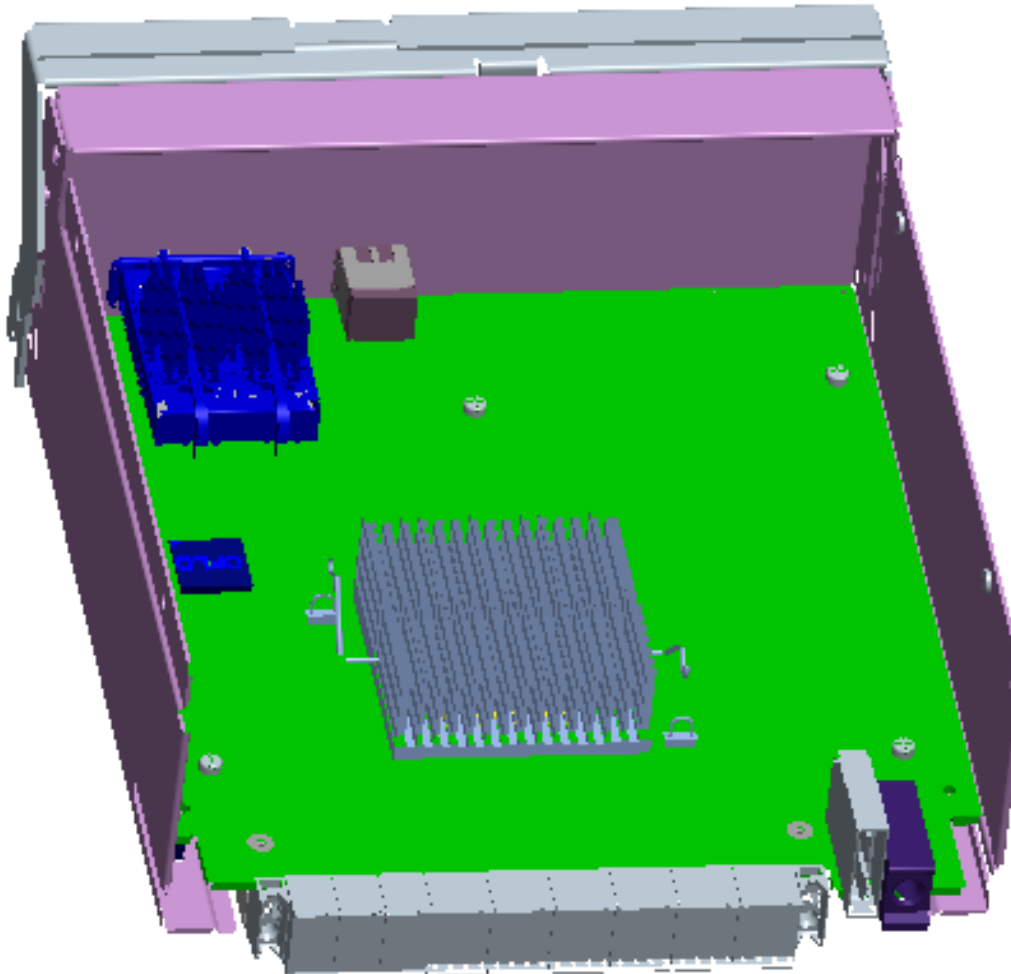
The following figure displays the high-level block diagram of the 4U60 Storage Enclosure SAS expander module:

Figure 8: 4U60 Storage Enclosure SAS Expander Module

Eros Canister Block Diagram v0.2
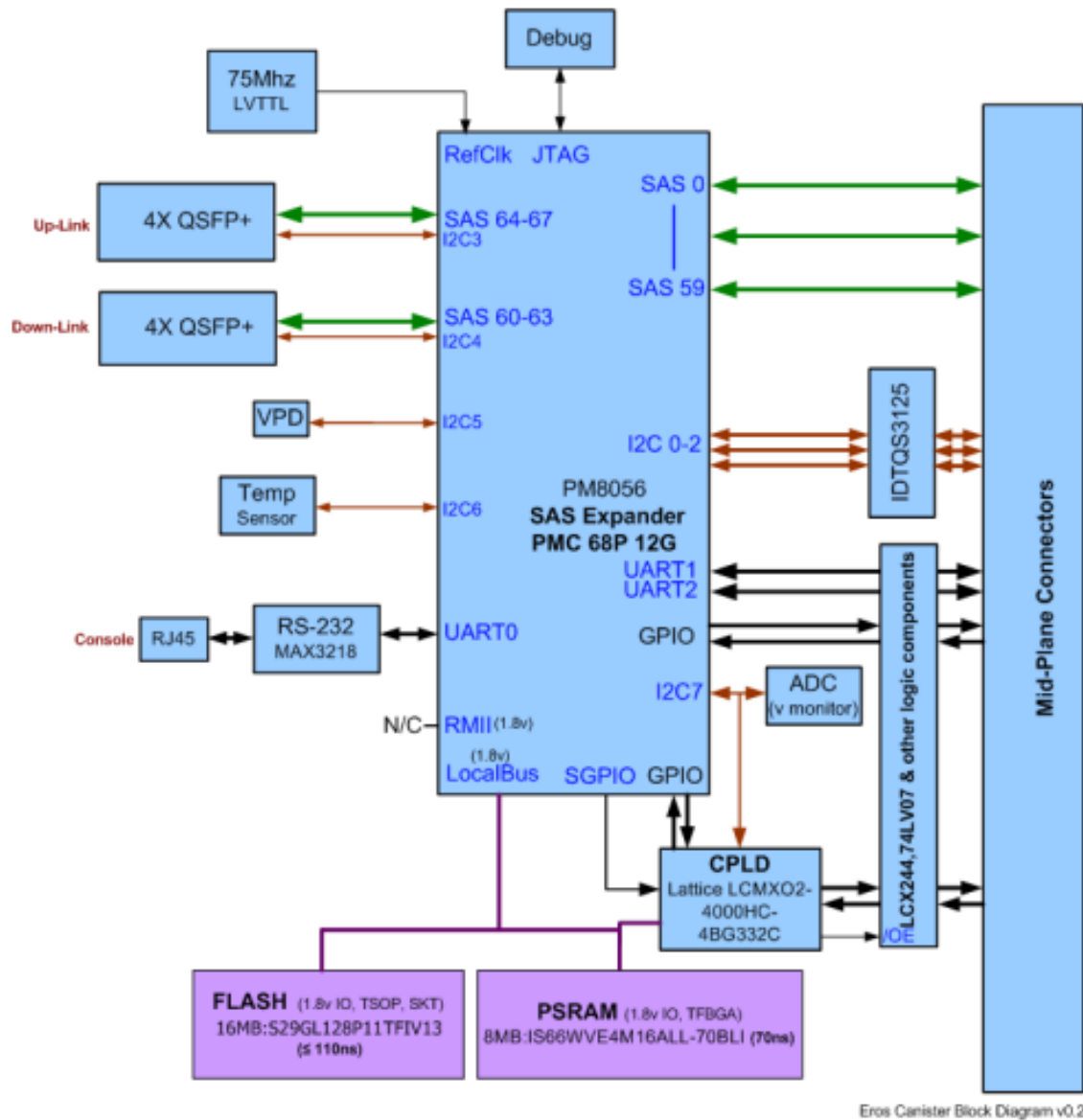
4.3 Power Interface Board

The 4U60 Storage Enclosure Power Interface Board connects the power supplies to the **drive board**. It is a pure passive design which only contains connector on the board. The Power Interface Board is field replaceable after the system has been powered off.

The following figure displays the top layer of the power interface board of the 4U60 Storage Enclosure:

Figure 9: 4U60 Storage Enclosure Power Interface Board (Top Layer)
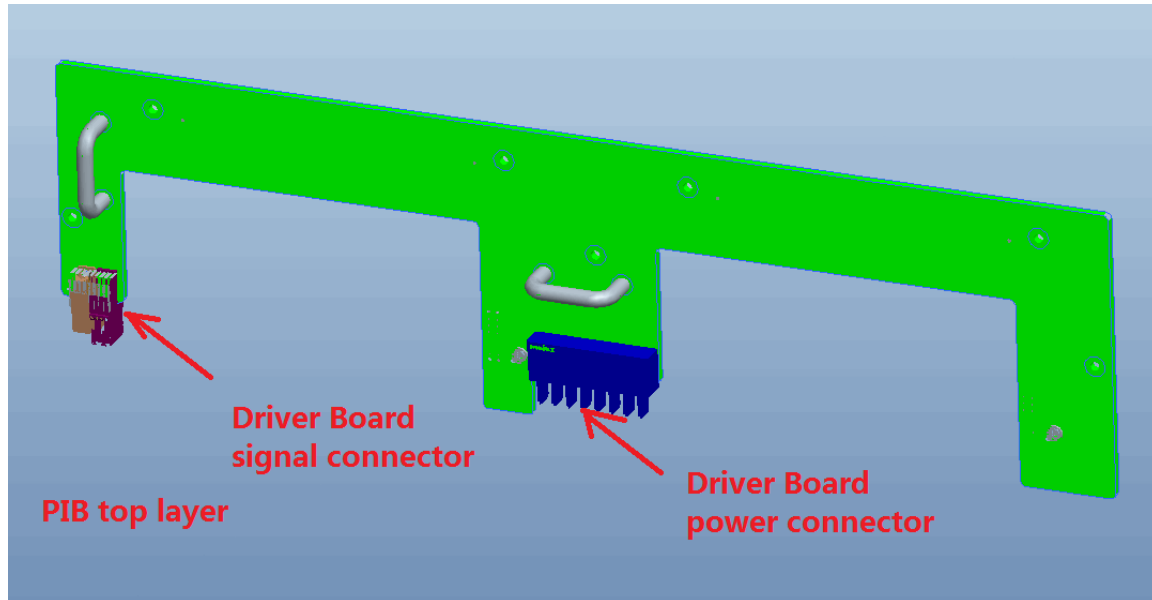
The following figure displays the bottom layer of the power interface board of the 4U60 Storage Enclosure:

Figure 10: 4U60 Storage Enclosure Power Interface Board (Bottom Layer)
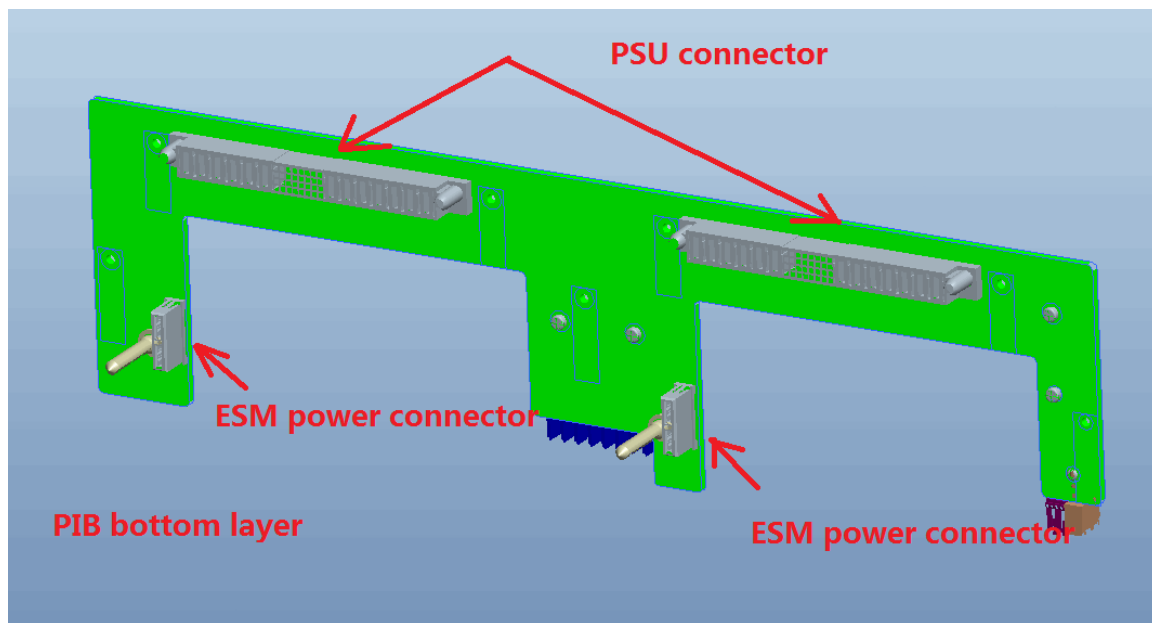
4.4 Drive Board

The 4U60 Storage Enclosure drive board interconnects the drives, ESM, and power supplies. The Drive Board is designed to operate up to 12Gbps and meet all the signal integrity requirements of the SAS 3.0 specification. Direct plug SAS drives are supported without the use of an interposer in the drive carrier.

The following figure displays the Drive Board of the 4U60 Storage Enclosure:

Figure 11: 4U60 Storage Enclosure Drive Board
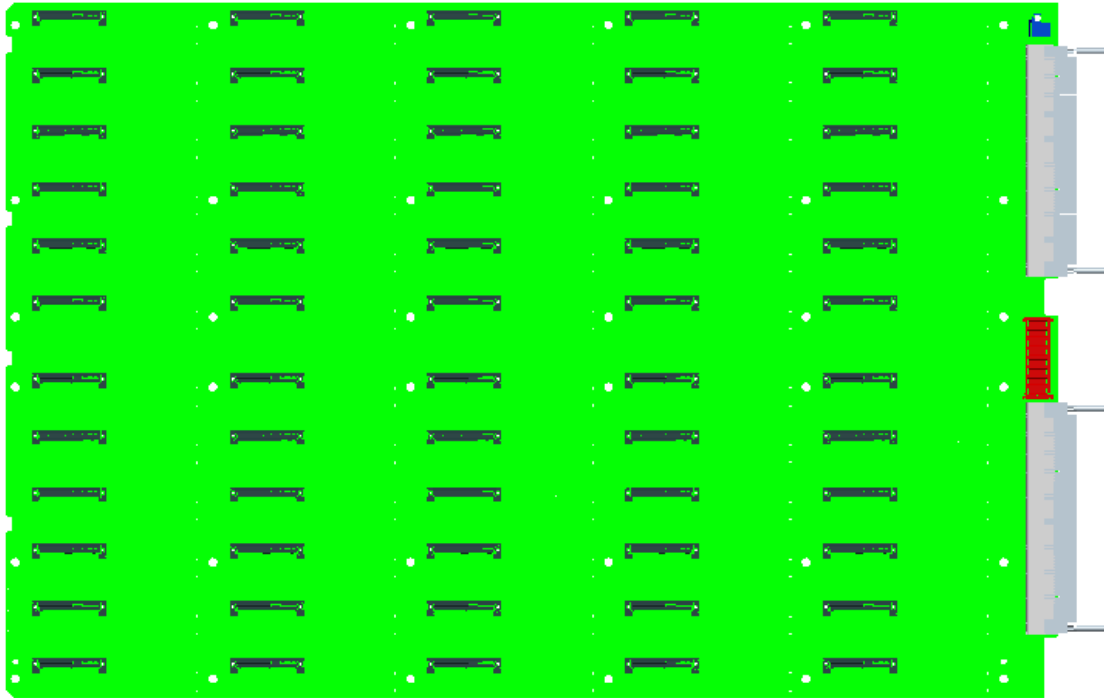
4.5 Power Supply Unit

Each PSU contains two fan assemblies. In the event of a fan failure, the PSU and SES firmware will adjust the speed of the remaining fans to maintain sufficient cooling. During normal operation, the SAS Expander Canister communicates with the PSU using I2C to control the speeds of these fans. The 4U60 Storage Enclosure is powered by two 1650 watt redundant PSUs.

The following features are available in the 4U60 Storage Enclosure 1650W PSU:

- 200-240 VAC input, 47Hz – 63Hz
- +12V and +5V outputs, +5V standby power
- Hot pluggable, 1+1 redundancy with active current sharing
- Compliant with 80 Plus effciency Gold level
- I2C VPD and controller interface for system communication
- +/- 5% Voltage margin control on 5V and 12V rails
- Trouble history implementation

The following figure displays the PSUs contained within the 4U60 Storage Enclosure:

Figure 12: 4U60 Storage Enclosure 1650W PSU
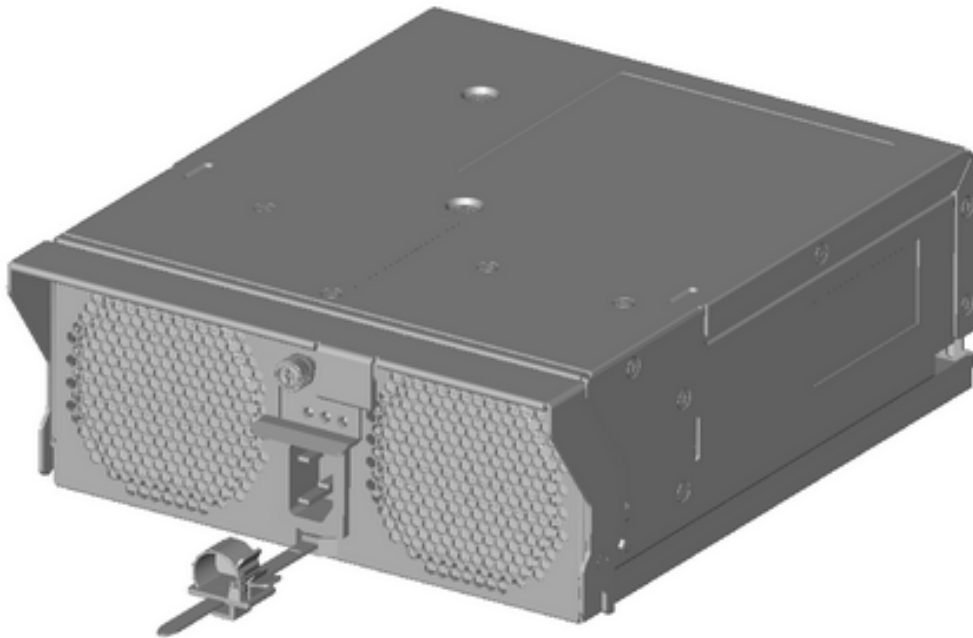
4.6 Hard Disk Drive Carrier

The 4U60 Storage Enclosure utilizes a custom HDD carrier design to support hot insertion and removal of LFF HDDs.

The following features are available in the 4U60 Storage Enclosure LFF HDD Carrier:

- Drive carriers shall eliminate or reduce RVI (Rotational-Vibration Isolation) to acceptable levels
- ESD protection shall be included
- The carrier over docking and locking mechanism shall keep the drive installed during normal operation and transportation
- The carrier shall provide for easy installation and removal of the drives
- The carrier shall prevent backwards or upside-down installation
- The carrier shall support 3.5 inch drives
- Dummy carrier to support less than 60 drive population.

    Note: The 4U60 Storage Enclosure HDD carrier has been designed to allow for two drive mounting positions to support either direct-plug SAS drives or the use of an optional interposer card mounted to the carrier.

The following figure displays the LFF HDD Carrier of the 4U60 Storage Enclosure:

Figure 13: 4U60 Storage Enclosure LFF HDD Carrier
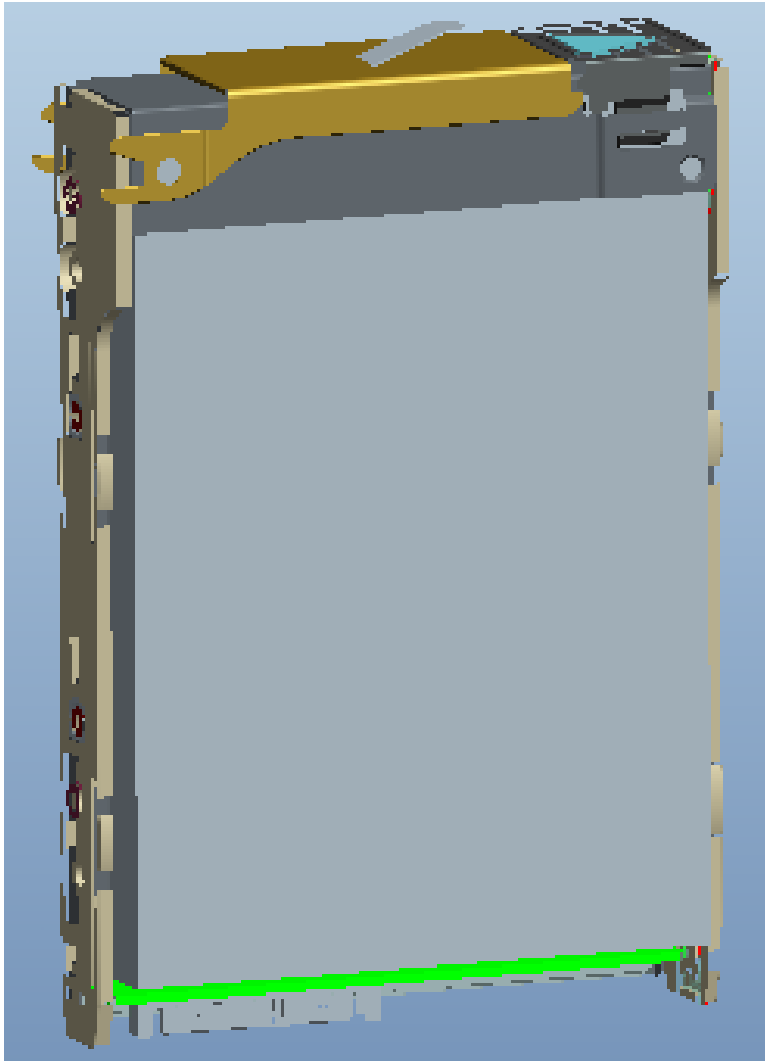
5 Software and Firmware

Topics:

- Overall Firmware Philosophy
- SCSI Enclosure Services

The following chapter will provide an overview of the software utilized with the 4U60 Storage Enclosure. The sections in the following chapter will introduce the *overall firmware philosophy*, *Serial Attached SCSI (SAS) Expander Firmware Architecture*, and *bootstrap* involved with the 4U60 Storage Enclosure.

5.1 Overall Firmware Philosophy

The embedded firmware philosophy is, to reuse as much code as possible, from one project to another. Not only from one platform to another, but from one generation of product to another. This will, in time, include different hardware architectures and vendors for the embedded processors. The 4U60 Storage Enclosure platform will design the embedded firmware hierarchy to be as portable as possible, while considering changes in vendors and hardware architecture. This will allow for the accommodation of multiple simultaneous and future products to alter code with minimal effort.

This style of creating and designing the code allows for better support of all products, both initially and with bug fixes in the field. For example, when a bug is fixed in one project, the intention is to have those fixes implemented across all other projects and platforms.

5.2 SCSI Enclosure Services

The following section provides detailed definition of diagnostics pages and SES elements supported for the 4U60 Storage Enclosure.

5.2.1 SES Overview

SCSI Enclosure Service (SES) is the service that establishes the mechanical environment, electrical environment, and external indicators and controls for the proper operation and maintenance of devices within an enclosure. The SES data is transported 'in-band' to and from the application client.

The SES pages are accessed via the SCSI commands SEND DIAGNOSTICS (control pages) and RECEIVE DIAGNOSTIC RESULTS (status pages).

4U60 Storage Enclosure system applies "Standalone Enclosure Services Process" model that can be accessed by external host directly via the data channel. In shared mode when two SAS Canisters work in one enclosure, both Canisters manage the enclosure services in "Active-Active" mode that provide a redundant service model to external host.

It is recommended for management application software running at host side to use "Polling" as the reporting method with Venus canisters when managing Venus system. Asynchronous event notification is NOT supported.

5.2.2 Canister Features

The following section displays the canister features for the 4U60 Storage Enclosure:

- Management interfaces
  - Host side management via SES pages
  - Command line interface
  - System and Canister LED indicators
  - Redundant Midplane VPD
  - Canister to Enclosure compatibility check
  - Dual Canisters pairing and Inter Canister communication
- General enclosure management features

- ◆ System power management
- ◆ System cooling management
- ◆ System inventory management
- ◆ System event log
- ◆ Firmware upgrade
- Port management and configurations

  - ◆ PHY attributes

6 Rotational Vibration Isolation Specification

Topics:

- RVI Specification

6.1 RVI Specification

Rotational Vibration (RV) Isolation is a key performance index for a disk array enclosure. Considering different class HDD disk drives, the RV specification for 4U60 Storage Enclosure is displayed in the following table. The testing procedure follows the manufacturers standard.

The following RV test will be conducted for a performance index:

- RV Test Part 1: HDD - HDD Interaction
- RV Test Part 2: Cooling System – HDD Interaction

Disk Types	Performance Degradation
Enterprise-class drives	Average Slot <5%; Worst Slot <10%
Nearline-class drives	<10%

Table 11: RVI Specification for Part 1 and Part 2

7 Environmental Requirements

Topics:

- Enclosure Environmental Requirements
- Acoustic Noise Requirement

The following chapter will provide an overview of the environmental requirements utilized in the 4U60 Storage Enclosure. The sections in the following chapter will introduce the *Enclosure Environmental Requirements* involved with the 4U60 Storage Enclosure.

7.1 Enclosure Environmental Requirements

The enclosure based upon the drive maximum environmental specifications will be designed around the following environmental requirements:

Non-operating	4U60 Storage Enclosure
Temperature	-40°C to 70°C
Temperature Gradient	30°C per hour
Temperature De-rating	1°C per 300m above 3000m
Relative Humidity	8% to 90% non-condensing
Relative Humidity Gradient	30% per hour maximum
Altitude	-300m to 12,000m de-rated 300m per 1°C above 40°C
Altitude Gradient	22860m per hour maximum

Table 12: Non-operating Environmental Requirements

Operational	4U60 Storage Enclosure
Temperature	5°C to 40°C
Temperature Gradient	20°C per hour
Temperature De-rating	1°C per 125m above 950m
Relative Humidity	8% to 90% non-condensing
Relative Humidity Gradient	30% per hour maximum
Altitude	-300m to 3048m

Table 13: Operational Environmental Requirements

7.2 Acoustic Noise Requirement

A single enclosure shall not exceed 65 dB sound pressures (almost equal to 7.5db sound power) at 23+/-2 degree C with typical system loading.

Acoustic Noise Emissions, Declared Sound Power Level measured in accordance with ISO 7779 and results reported per ISO 9296.

For maintenance purpose (rack door open, top cover off, and so on), the A-weighted sound pressure will not exceed 85 dB sound pressures.

8 Thermal Requirement

Topics:

The following provides the thermal requirements for 4U60 Storage Enclosure.

8.1 Cooling Requirement

The following section displays the cooling requirements for the 4U60 Storage Enclosure:

- The cooling system provides adequate airflow to ensure all components are properly cooled and ensure the drives operate at or below 55C drive case temp across the operating temperature range. During fan failure and servicing, a maximum of 60C drive case is allowed. The thermal solution supports drive up to 15W maximum power dissipation coupled with 1W interposer card (optional) for a total of 16W per drive slot.
- The thermal solution supports N+1 redundancy. Any one system fan can fail without affecting normal system operation.
- The thermal solution is designed to ensure that the system can operate during a PSU replacement service interval (two fans removed) of 10 minutes without experiencing an over temperature condition.
- The cooling system will ensure that the system continues while the top cover is removed for drive servicing. User should replace drive FRU one by one, not recommend to pull out multiple drive FRUs at the same time without putting new HDD or dummy carrier in place. A maximum time interval of 10 minutes is recommended to make sure the user does leave the unit unattended with the cover removed for longer durations.
- An air flap system for the PSU fans is required to prevent hot air recirculation when a fan fails.
- Canister/drive blank with similar airflow impedance to a fully populated drive FRU is required to reduce bypass airflow.
- The power supply cavity will have a gravity air flap to limit airflow bypass when a power supply is removed for service.

8.2 Airflow Management

Each cooling module houses two 80mm x 38mm fans. Ambient air enters from front of chassis, travels through the HDD array, and then is distributed into two parallel airflow paths. One path is for the PSUs and the other is for the canisters. The required airflow is based on the power consumption of the canisters, power supplies based on the associated component cooling requirements. Each power supply module provides power to the internal cooling module as well as the cooling module that resides on the peer power supply, to ensure uninterrupted and continuous operation of the cooling module when any one power supply is removed. The fans in both power supplies are powered by the external redundant 12V power rail, such that, if a power supply ceases to function, its internal fans continue to operate.

An independent cooling module resides in each PSU and provides the front-to-rear airflow displayed in the following figure:

Figure 14: System Airflow Diagram
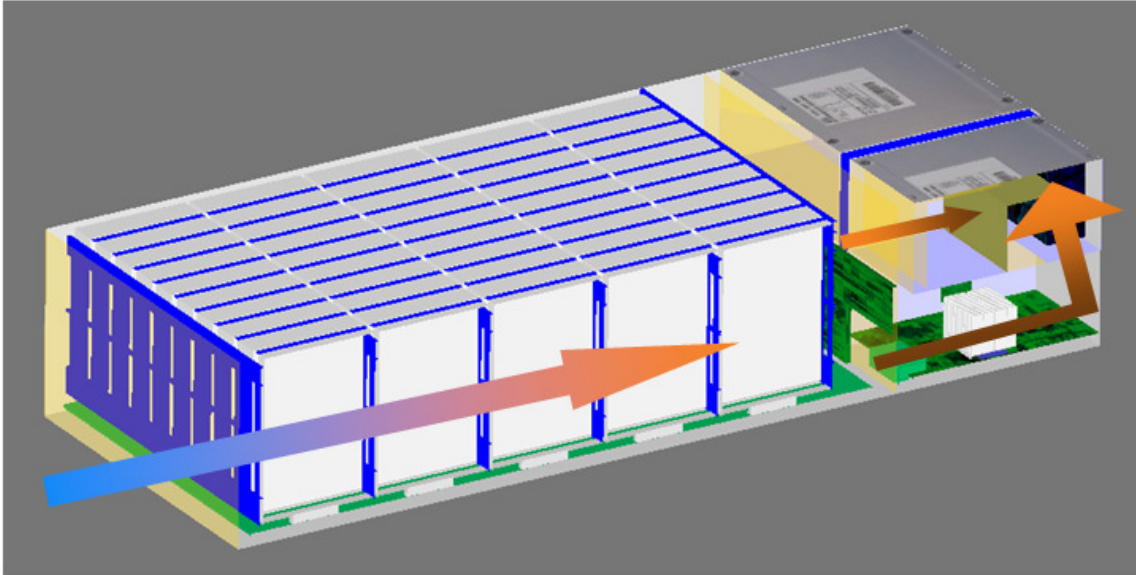
8.3 Fan Speed Control Strategy

The fan control strategy implementation ensures that the appropriate fan speed is dynamically adjusted and monitored to properly cool the system. The fan control algorithm is designed to minimize cooling power consumption and acoustic noise emission. The fan speed control algorithm utilizes thermal sensor inputs from various locations within the 4U60 Storage Enclosure to determine the appropriate fan speed to ensure sufficient airflow is delivered to the system.

9 Agency

Topics:

- Electromagnetic Compatibility Agency Requirements
- Safety Compliance

The following chapter will provide an overview of the agency utilized in the 4U60 Storage Enclosure. The sections in the following chapter will introduce the *EMC Agency Requirements* and *Safety Requirements* involved with the 4U60 Storage Enclosure.

9.1 Electromagnetic Compatibility Agency Requirements

The following table outlines how the 4U60 Storage Enclosure is being designed to comply with the Electromagnetic Compatibility agency requirements:

Country/Region	Authority or Mark	Standard	Status
Australia/New Zealand	C-tick or A-tick	AS/NZS CISPR22	In Progress
Canada/North America	Industry Canada	ICES-003	In Progress
Customs Union/Russia, Kazakhstan, Belarus, Armenia	EAC	TR CU 020/2011	In Progress
European Union	CE	EN55022, EN55024 including EN61000-3-2, EN61000-3-3	In Progress
International		CISPR22, CISPR24	In Progress
Japan	VCCI	V-3:2014	In Progress
United States/North America	FCC	FCC Part 15	In Progress
Taiwan	BSMI	CNS13438	In Progress
Korea	MSIP	KN22, KN24	In Progress
Ukraine	UKrTEST or equivalent	4467-1:2005	In Progress
Serbia	KVALITET	CISPR22	In Progress
Brazil	INMETRO		In Progress

Table 14: Product Electromagnetic Compatibility/Immunity Compliance

9.2 Safety Compliance

The following table outlines how the 4U60 Storage Enclosure is designed to pass the product safety requirements:

Country/Region	Authority or Mark	Standard	Status
Australia/New Zealand	CB report, CB certificate	AS/NZS 60950.1	TBD
Canada/North America	NRTL	CSA C22.22 No. 60950-1-07	In Progress

Country/Region	Authority or Mark	Standard	Status
Customs Union/Russia, Kazakhstan, Belarus, Armenia	EAC	TR CU 004/2011	TBD
European Union	CE	EN 60950-1	In Progress
International		IEC60950, CB report and Certificate to include all country national deviations	In Progress
United States/North America	NRTL	UL 60950-1	TBD
Mexico	NYCE or NOM	NOM-019-SCFI-1998	TBD
Brazil	INMETRO	IEC 60950-1	TBD
Taiwan	BSMI	CNS14336	TBD
Ukraine	UKrTEST or equivalent	4467-1:2005	TBD
Moldova	INSM	SM SR EN60950-1	TBD
Serbia	KVALITET	SRPS EN60950:2010	TBD
India	BIS	IS 13252 (Part 1):2010	TBD

Table 15: Product Safety Compliance

4U60 Storage Enclosure Glossary

A

AC	**Alternating Current**
ACMA	**Australian Communications and Media Authority**

B

BIOS	**Basic Input/Output System**
BIS	**Business Information System**
BIST	**Built-In Self-Test**
BMC	**Baseboard Management Controller**
BOM	**Bill of Materials**
BSMI	**Bureau of Standards, Metrology and Inspection**

C

CDB	**Computer Data Bus**
CLI	**Command Line Interface**
CS	**Climate Saver**

D

DC	**Direct Current**
DL	**Device Server or Device**

4U60 Storage Enclosure controller serving the virtual disk LUNs. It is not referring to the HDD however the HDD may perform some of the functions on its behalf.

E

EC	**Engineering Change**
EEPROM	**Electrically Erasable Programmable Read-Only Memory**

EMC	Electromagnetic Compatibility
EMI	**Electromagnetic Interference**
ESD	**Electrostatic Discharge**
EVPD	**Enable Vital Product Data**

F

FCC	**Federal Communications Commission**
FRU	**Field Replaceable Unit**
FW	**Firmware**

G

GBE	**Gigabit Ethernet**
GPIO	**General-Purpose Input/Output**
GUI	**Graphical User Interface**

H

HD	**Hard Drive**
HDD	**Hard Disk Drive**

I

ICT	**In-circuit Test**
IEC	**International Electrotechnical Commission**
I/O	**Input/Output**
IOC	**Input/Output Controller**
IOM	**I/O Module**
IPMI	**Intelligent Platform Management Interface**

J

JBOD	**Just a Bunch of Disks**

L

LED	**Light-Emitting Diode**
LPC	**Low Pin Count**
LPH	**Low Profile Hybrid**
LUN	**Logical Unit Number**

M

MAC	**Media Access Control**
miniSAS	**Mini Statistical Analysis System**

O

OS	**Operating System**
OUI	**Organizationally Unique Identifier**

P

PCB	**Printed Circuit Boards**
PCI	**Peripheral Component Interconnect**
PDB	**Power Distribution Board**
PDU	**Power Distribution Unit**
PMBus	**Power Management Bus**
POST	**Power On Self Test**
PSU	**Power Supply Unit**
PHY	**Physical Layer**
PWM	**Pulse-Width Modulation**
PWR	**Power**

R

ROC	**Recovery Oriented Computing**
RTC	**Real Time Clock**

S

SAS	**Serial Attached SCSI**
SATA	**Serial Advanced Technology Attachment**
SBB	**Storage Bridge Bay**
SCSI	**Small Computer System Interface**
SDK	**Software Development Kit**
SEP	**SCSI Enclosure Processor**
SES	**SCSI Enclosure Services**
SMART	**Self-Monitoring, Analysis and Reporting Technology**
SMP	**Server Message Block**
SMB	**Server Message Block**
SPI	**Serial Peripheral Interface**
SSP	**Serial SCSI Protocol**

T

TCA	**Telecommunications Computing Architecture**

U

UART	**Universal Asynchronous Receiver/Transmitter**

V

VBOD	**Virtualized Bunch of Disks**
VD	**Virtual Disk**

A Virtual Disk is utilized for storing user data. There is a 1-to-1 relationship between the Virtual Disk and the Physical Disk presented by the 4U60 Storage Enclosure controller

VPD	**Vital Product Data**

The serial number and identification that is stored persistently by the controller.

W

WOL							**Wake On LAN**

WOS							**Wake On SAS**

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X

XDP							**XML Data Package**

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