

Flex CT0245J 2OU45 OCP JBOD Specification

A.1

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2 Scope

This document defines the technical specifications for the Flex CT0245J 2OU45 JBOD used in Open Compute Project

3 Overview

This document contains specifications for the CT0245J rack-mount 45-drive system, It is an Open Compute Project (OCP) compatible 2OU JBOD.

The CT0245J is a 2OU rack-mount 45-drive JBOD designed for high-density, high-reliability Telco cloud applications. The JBOD implements a tool-less drive sled design that allows installing or removing drives with the system running and simplifies maintenance and servicing. Each of the three drive sleds holds 15 drives and contains its own cable management arm (CMA). The CMA is a mechanical segmented arm that unfolds when you pull out the drive sled to access the drives and folds back up when you push the drive sled back in. Removable fans are housed at the rear of the JBOD chassis for easy serviceability. The chassis is powered from a shared 12 VDC power system. All data cables are accessible from the front of the chassis and power is provided from the rear by means of bus bars.

The CT0245J JBOD is shown in Figure 1 and Figure 2.

Figure 1 –CT0245J JBOD (front view)



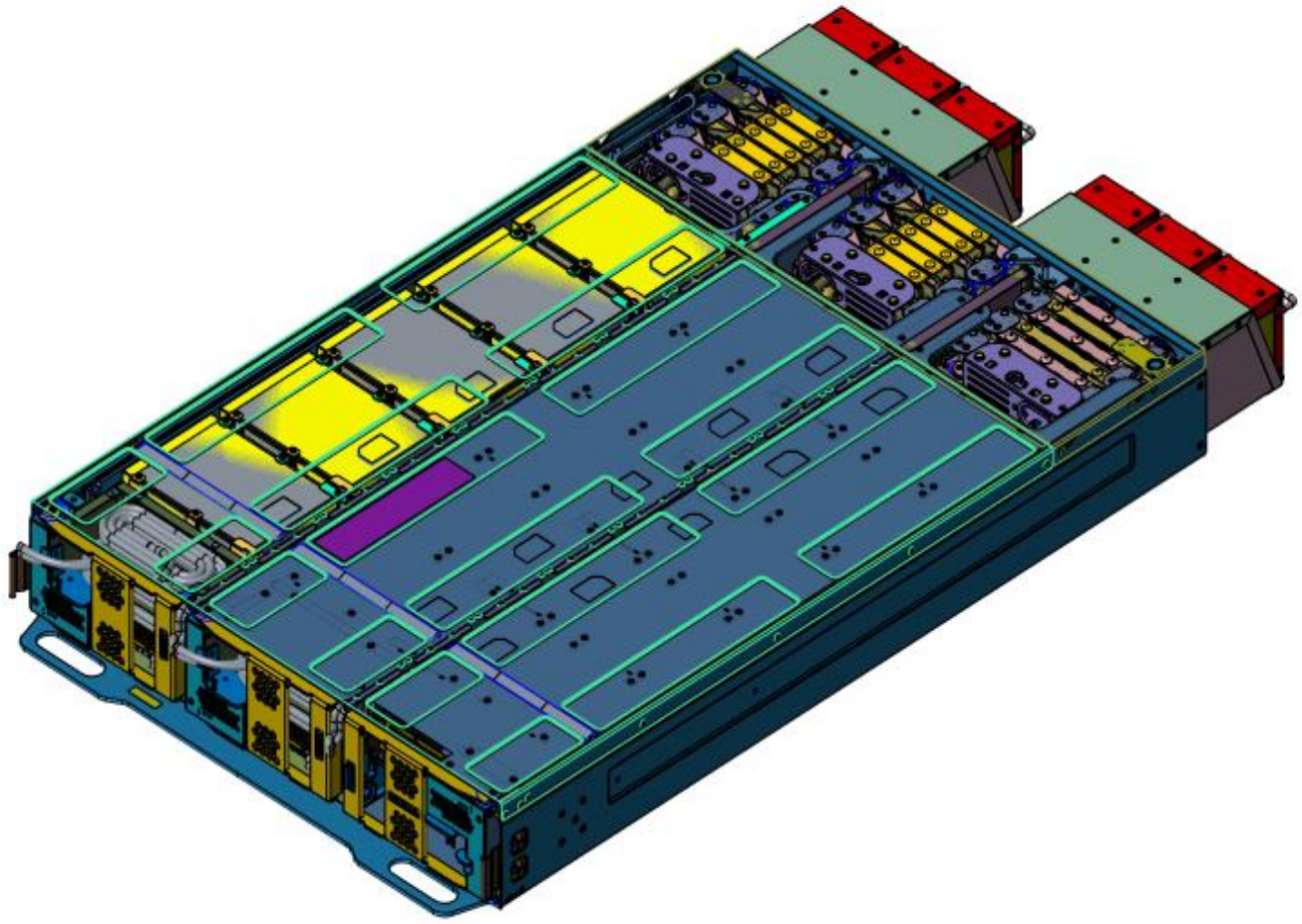
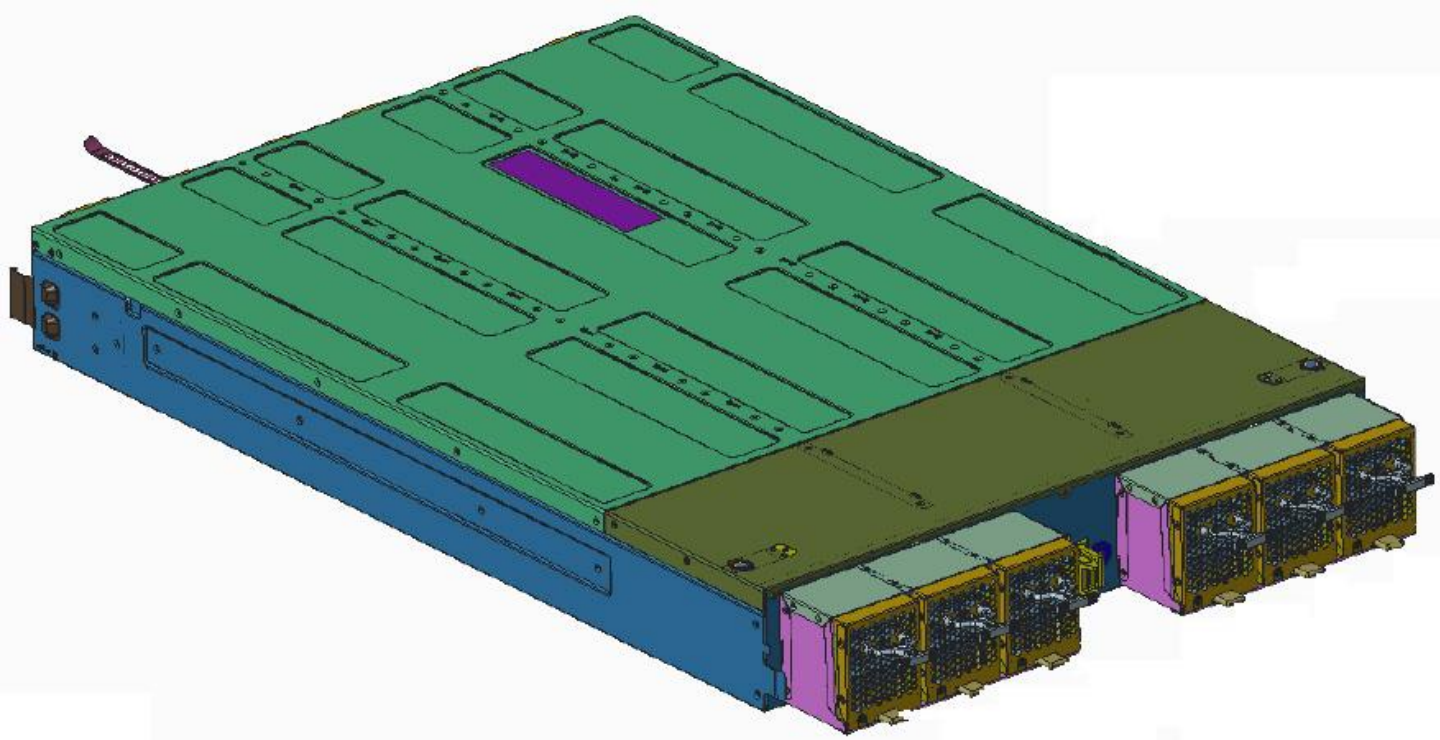


Figure 2 –CT0245J JBOD (rear view)





4 System Architecture

The architecture of the Flex CT0245J 2OU45 JBOD is intended to provide hard drive rotating storage with a flexible storage platform. The storage system is a 2OU system, with most of the components accessible and serviceable from the front of the chassis by means of slide-out storage sleds.

In its nominal configuration, the chassis supports up to 45 drives with three independent drive sleds, each holding up to 15 drives. Each drive sled has its own SAS Expander that can be connected to a host, or the left most SAS Expander can be connected to a host as the master with the other drive sleds operating as slaves with appropriate cabling interconnections. The only common component shared by the drive sleds is the incoming power (12V) delivered by the bus bar clip at the rear of the chassis. Drives are tool-less hot-swappable (a single drive can be replaced in a drive sled without affecting any of the other drives).

Several configurations of the chassis exist to satisfy various applications. The architecture is designed to maximize common components between configurations and modularize the components that differ.

5 Rack Compatibility

The Flex CT0245J 2OU45 JBOD is a 2OU (Open Rack Units) rack-mount chassis (compatible with ORv2). There are no mounting rails on the sides of the chassis. The chassis mounts in an OCP rack per standard practices.

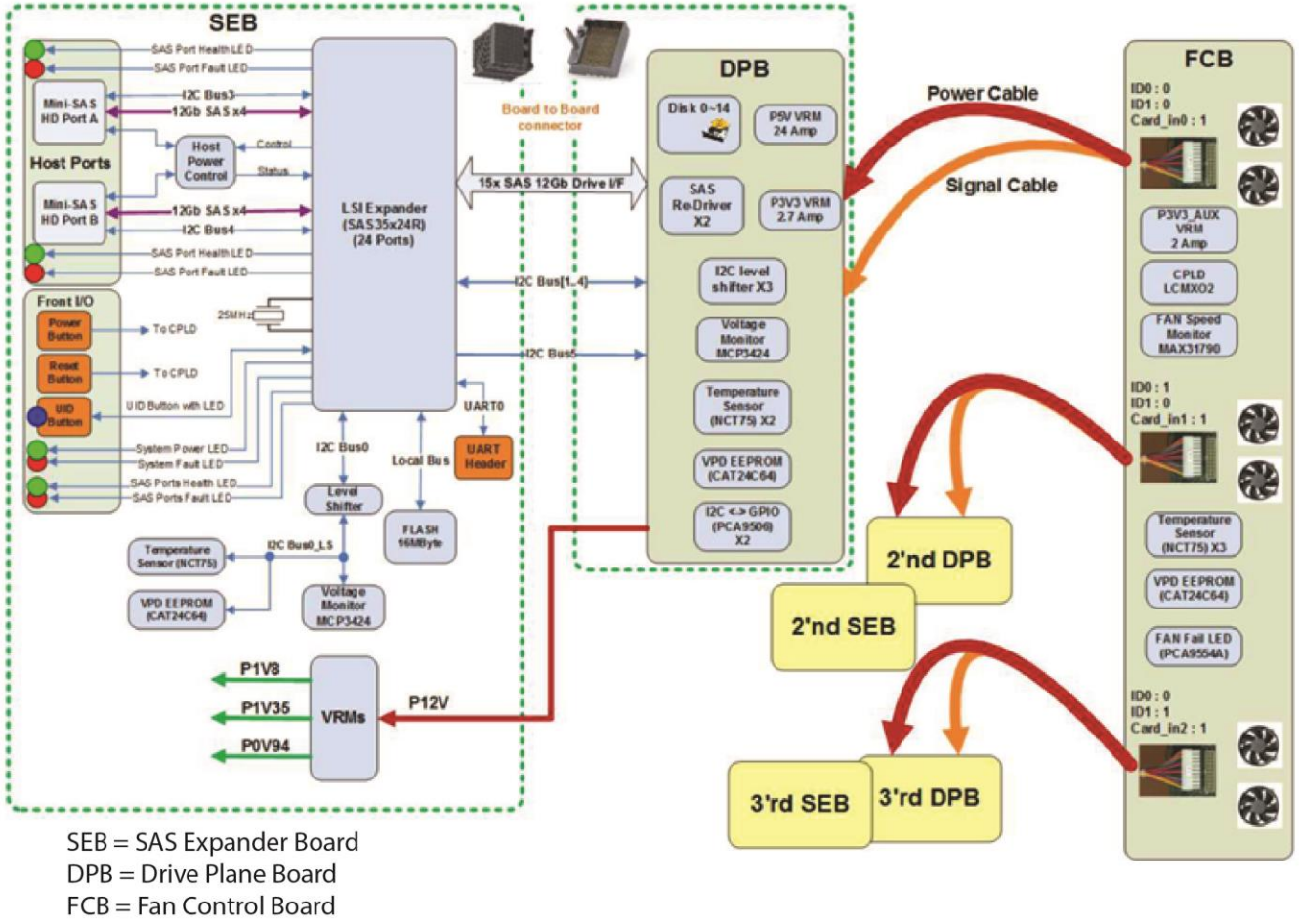
6 Physical Specifications

6.1 Block Diagrams of System Main Components

An overall block diagram of the CT0245J is shown in Figure 3. The product consists of the following main boards:

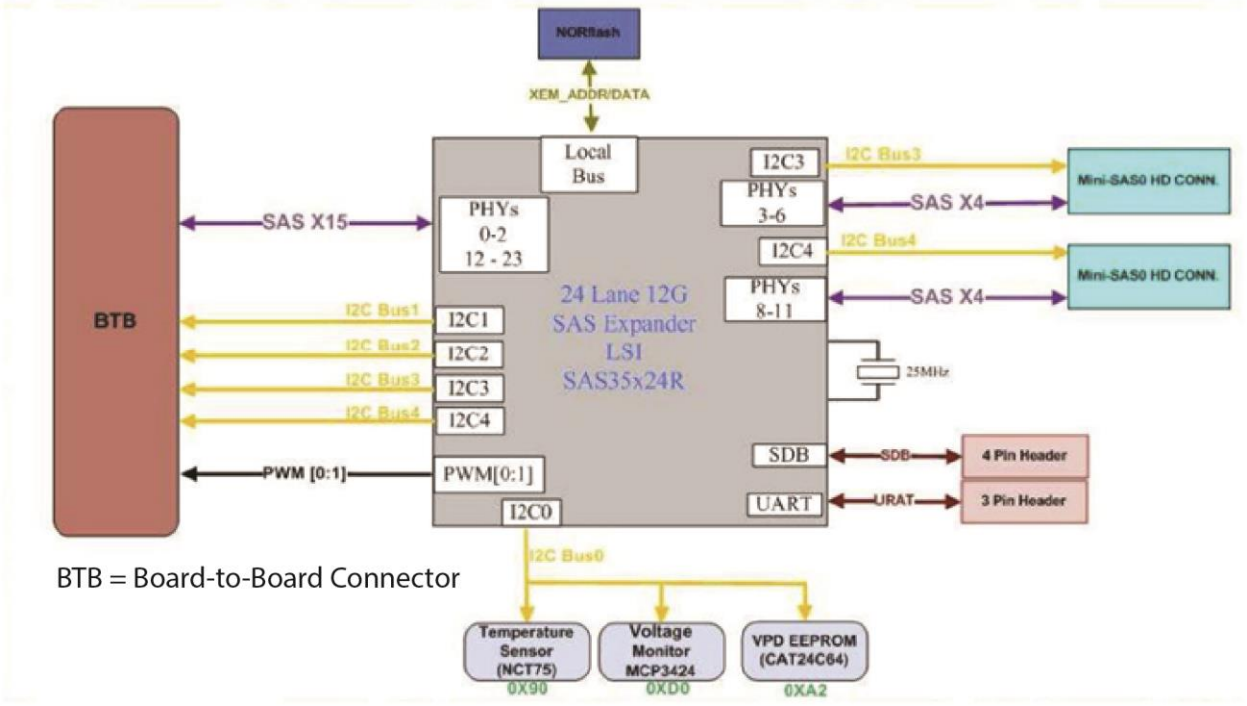
- SAS Expander Board (SEB) – one per drive sled
- Drive Plane Board (DPB) – one per sled
- Fan Control Board (FCB) – one per chassis

Figure 3 –CT0245J Block Diagram



A block diagram of the SAS Expander Board (SEB) is shown in Figure 4.

Figure 4 –SEB Block Diagram

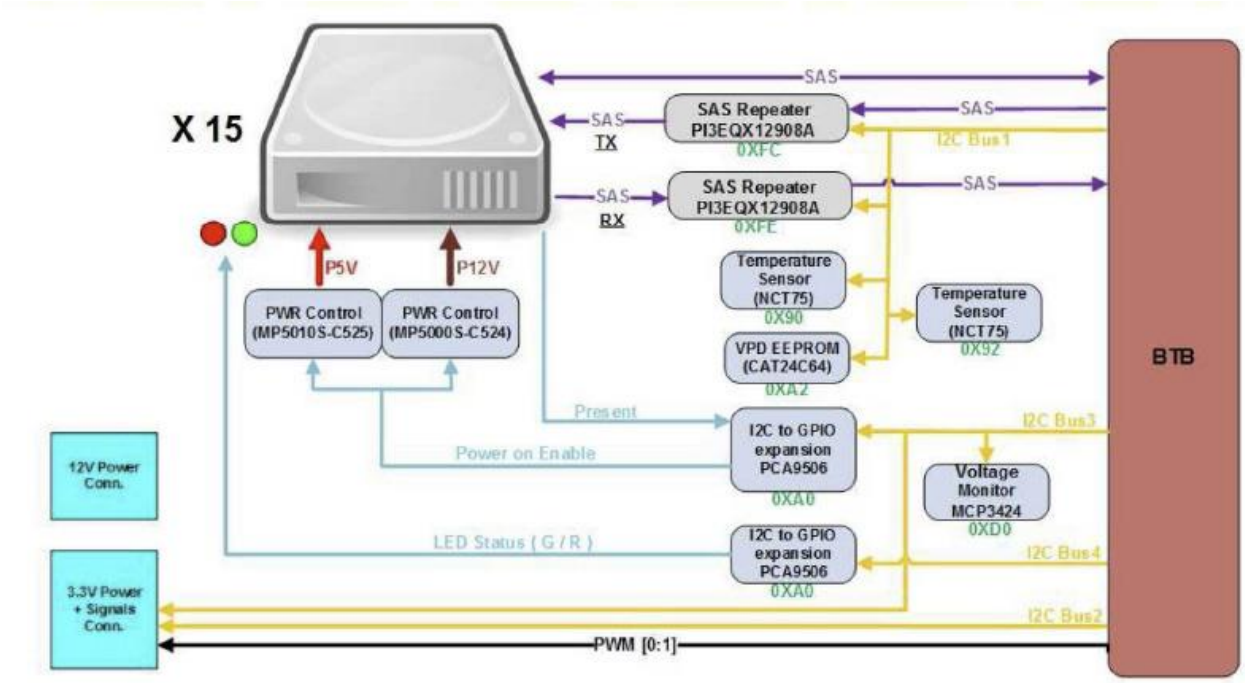


The SAS expander on each HDD drive sled performs the following key functions:

- Supports 15 drives
- Supports 2 external mini-SAS ports
- Supports a smart CLI interface via the serial port
- Controls bi-color enclosure status LED/ Mini-SAS ports Link indicator LED /Mini-SAS connectors status LED/ HDD Status LED.
- Supports in-band SAS firmware and CPLD updates
- Supports custom SES commands for host heartbeat/chassis reset
- Provides temperature sensor monitoring and fan control.
- Supports fan fail and thermal fail policy
- Controls functions of the UID button and LED

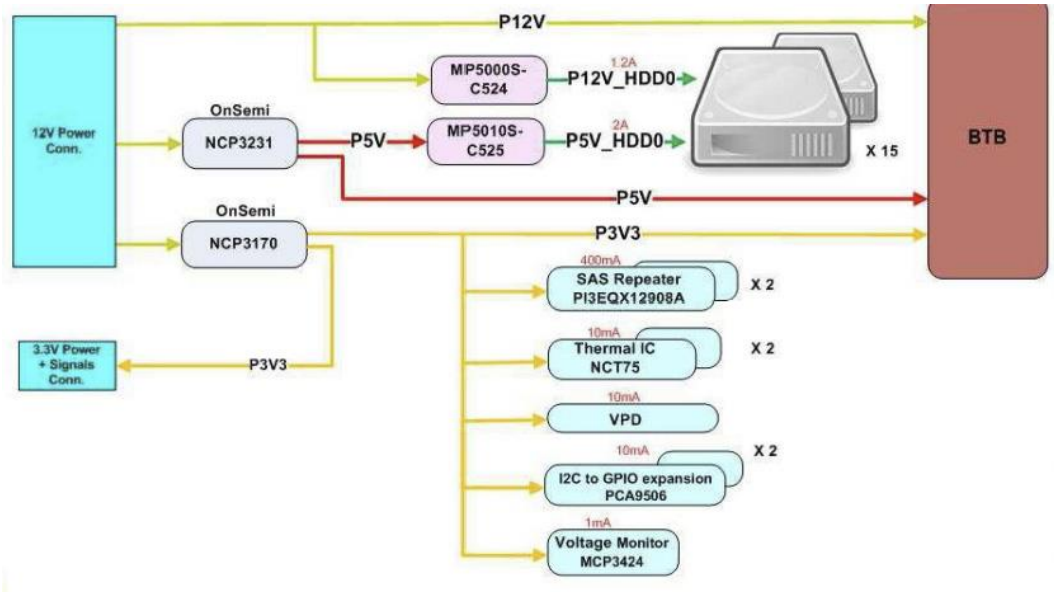
A block diagram of the Drive Plane Board (DPB) electronics is shown in Figure 5.

Figure 5 –DPB Block Diagram



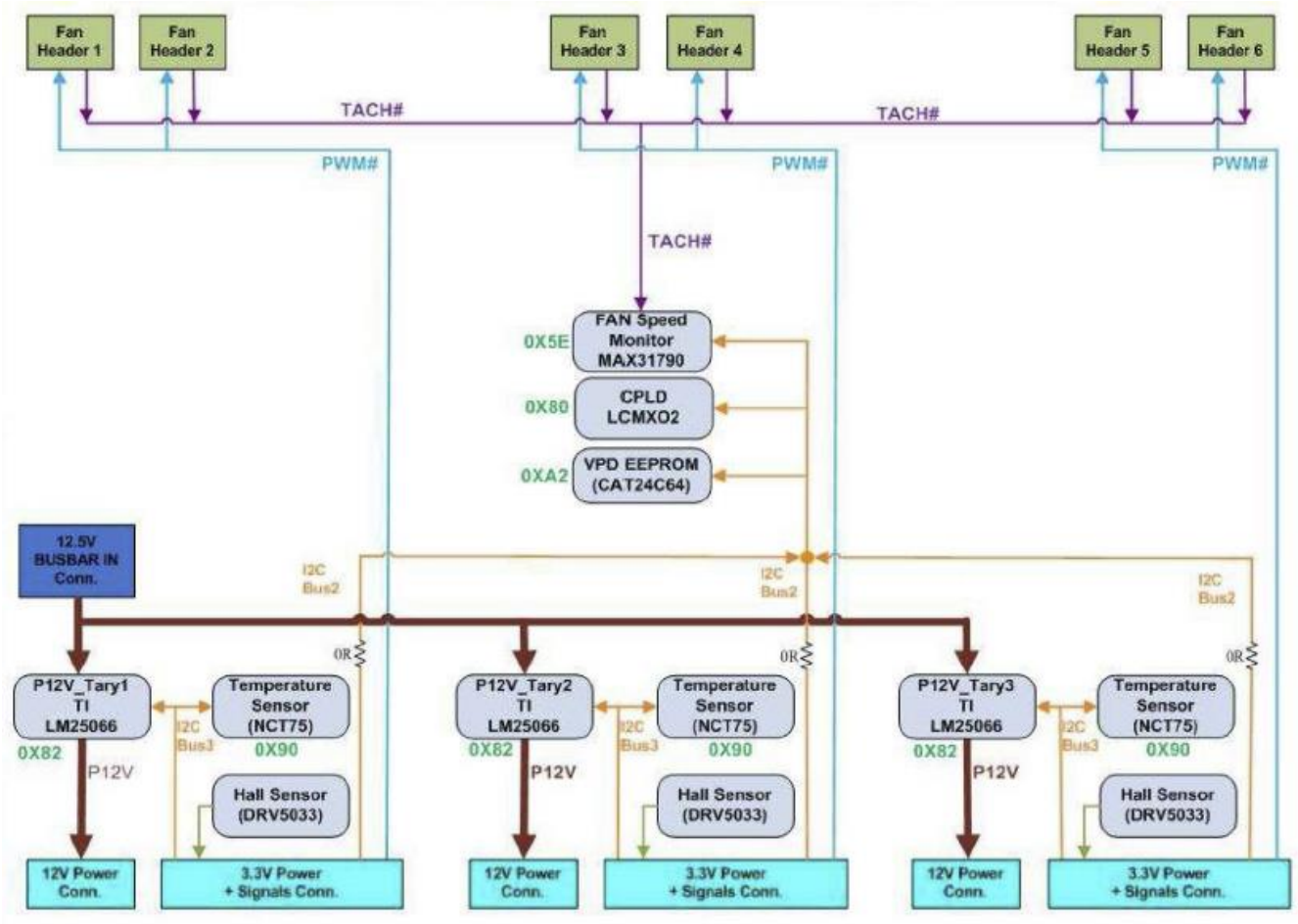
A block diagram of the DPB power distribution is shown in Figure 6**.**

Figure 6 –DPB Power Distribution Block Diagram



A block diagram of the Fan Control Board (FCB) electronics is shown in Figure 7.

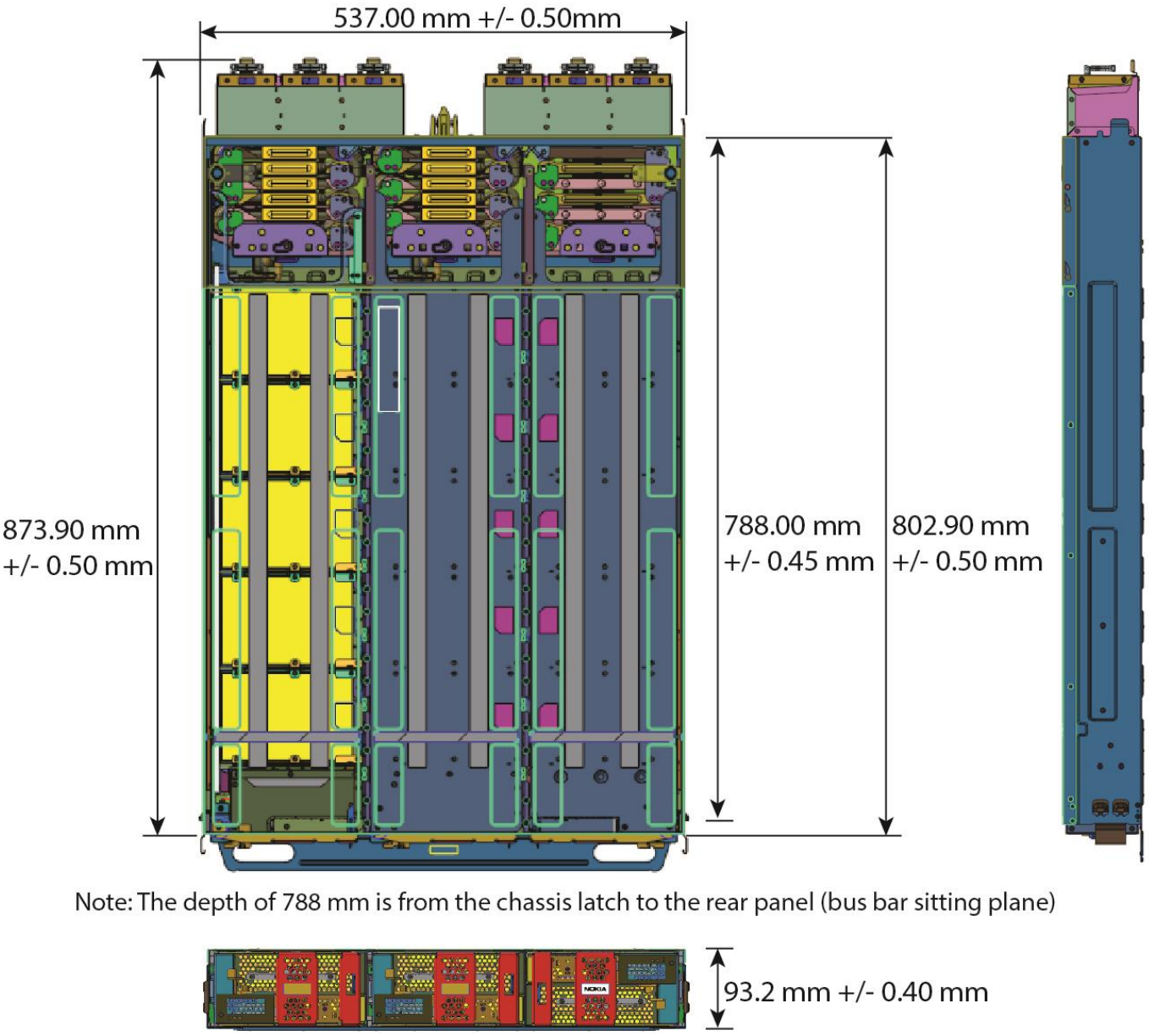
Figure 7 –FCB Block Diagram



6.2 Mechanical Form Factor

The CT0245J JBOD dimensions are shown in Figure 8

Figure 8 – CT0245J Dimensions



6.3 PCBs

The main boards in the system as shown in Figure 3 on page 10 are:

- SAS Expander Board (SEB) – one per drive sled
- Drive Plane Board (DPB) – one per sled
- Fan Control Board (FCB) – one per chassis

6.4 Figures & Illustrations

See Figure 3 through Figure 7 for the PCB block diagrams.

7 Thermal Design Requirements

7.1 Data Center Environmental Conditions

The inlet air temperature will vary. The cooling system covers inlet temperatures of 20° C, 25° C, 30° C, 35° C, 40° C and 45° C. Cooling above 40° C is beyond operating specifications.

7.2 JBOD Operational Condition

40° C maximum inlet temperature.

7.3 Thermal Kit Requirements

Thermal testing is performed up to a 45° C (113° F) inlet temperature to guarantee high temperature reliability.

8 SATA

The system supports the following:

- 45 3.5” and/or 2.5” SAS/SATA hot-pluggable HDDs/SSDs (you can mix SAS/SATA 2.5” drives with SAS/SATA 3.5” drives in the same sled)
- Three sleds with 15 drives per sled
- Drive types
    - 3.5” (LFF[1]) SAS/SATA HDD
    - 2.5” (SFF[2]) SAS/SATA HDD
    - 2.5” (SFF) SAS/SATA SSD
    - 2.5” support via drive sled is allowed
    - 2.5" drive sled supports 7mm, 10mm, and 15mm SSDs

[1] LFF = Large Form Factor

[2] SFF = Small Form Factor

The drive interface types are:

- 12G SAS (SAS-3)
- 6G SATA (SATA III)

There are no drive mixing restrictions. SAS and SATA drives, as well as 2.5” and 3.5” drives can be mixed within the same drive sled.

9 SAS Expander

The SAS Expander is controlled with a built-in ARM processor and firmware. The SAS Expander firmware may need to be periodically updated. This section explains how to update the firmware.

The four firmware regions that can be updated are listed in Table 1.

Table 1 – SAS Expander Firmware Regions

Region	Region Name	Size	Description
Region 0	Boot region	1536 kB	Boot loader
Region 1	Firmware_Copy_1	1536 kB	Firmware Copy_1 and Copy_2 are alternately used when firmware is updated. One is active, the other is backup
Region 2	Firmware_Copy_2	1536 kB	
Region 3	Manufacturer Configuration	1536 kB	Expander firmware setting

9.1 Use the g3Xflash and sg Tools

To update the SAS Expander firmware using the g3Xflash tool, follow these steps:

1 Get the SAS Expander address using the following g3Xflash command:

g3Xflash -i get avail

2 Update the SAS Expander firmware

a) Update the Boot region (Region 0) with the following command:

`g3Xflash -i [SAS ADDRESS] down fw [FW FILE] 0 -y -r` (After flashing, the SAS Expander will reset automatically)

a. Update the Backup region (Region 1 or 2) with either the g3Xflash command or Sg utility:

`g3Xflash -i [SAS ADDRESS] down fw [FW FILE] -y -r` (After flashing, the SAS Expander will reset automatically)

Example: g3Xflash -i 5140d4f0300069bf down fw HS0060.fw -y –r

sg_ses_microcode /dev/sg1 -m 7 -o 0 -i 0xe2 -I [FW FILE]

Example: sg_ses_microcode /dev/sg1 -m 7 -o 0 -i 0xe2 -I HS0060.fw

After flashing, you must reset the SAS Expander manually using one of the following methods:

- Use g3Xflash: g3Xflash -i <SAS address> reset exp

  Example: g3Xflash -i 5140d4f0300069bf reset exp

or

- Use the OEM SES command C7H: sg_ses /dev/sg1 -p4 -c --data=C7,38, or
- Press the Reset button on the SAS Expander

b) Update the Manufacturing region (Region 3) with either the g3Xflash command or Sg utility:

g3Xflash -i [SAS ADDRESS] down mfg [MFG FILE] 3 -r –y

Example: g3Xflash -i 5140d4f0300069bf down mfg HS0060.fw 3 -r –y

(After flashing, the SAS Expander will reset automatically)

sg_ses_microcode /dev/sg1 -m 7 -o 0 -i 0xe3 -I [MFG FILE]

Example: sg_ses_microcode /dev/sg1 -m 7 -o 0 -i 0xe3 -I HS0060.fw

(After flashing, you must reset the SAS Expander manually using one of the following methods:

- Use g3Xflash: g3Xflash -i <SAS address> reset exp, or
- Use the OEM SES command C7H: sg_ses /dev/sg1 -p4 -c --data=C7,38, or
- Press the Reset button on the SAS Expander

To get the SAS Expander firmware version, follow these steps:

1. Execute the following g3Xflash command:

   g3Xflash -i <SAS Address> get ver X, X: 1~3

   For example:

   g3Xflash -i 5140d4f0300069bf get ver <<< without X, current active FW.

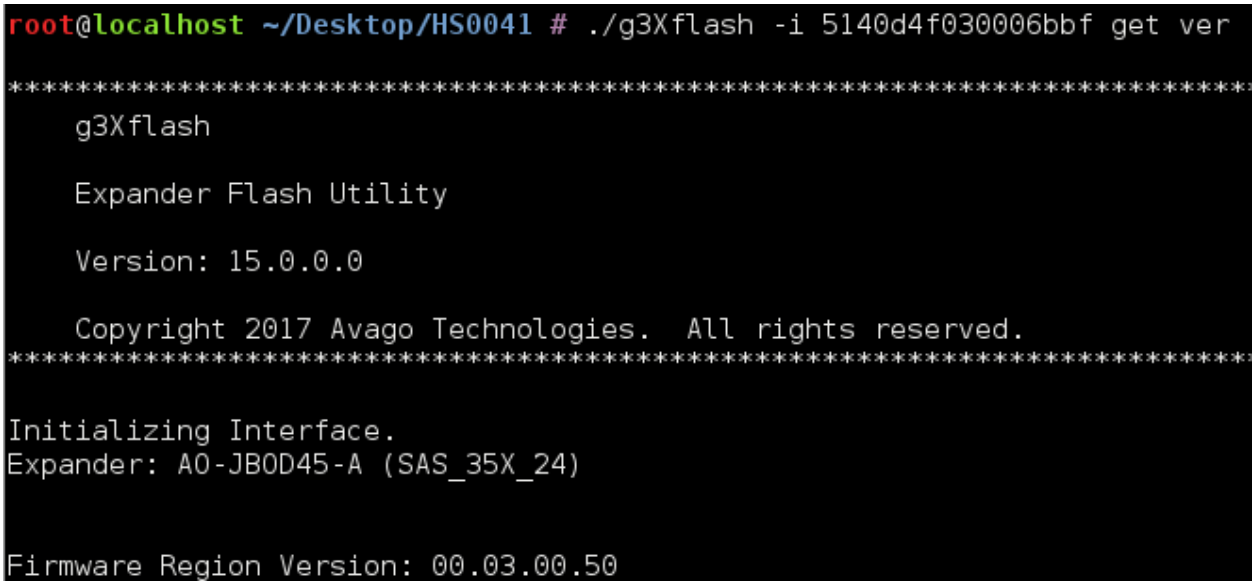
   g3Xflash -i 5140d4f0300069bf get ver 1 <<< FW region 1

   g3Xflash -i 5140d4f0300069bf get ver 2 <<< FW region 2

   g3Xflash -i 5140d4f0300069bf get ver 3 <<< MFG region 3

An example of this command and the resulting screen is shown in Figure 9.

Figure 9 – Getting the SAS Expander Firmware Version



9.2 Use the UART Port

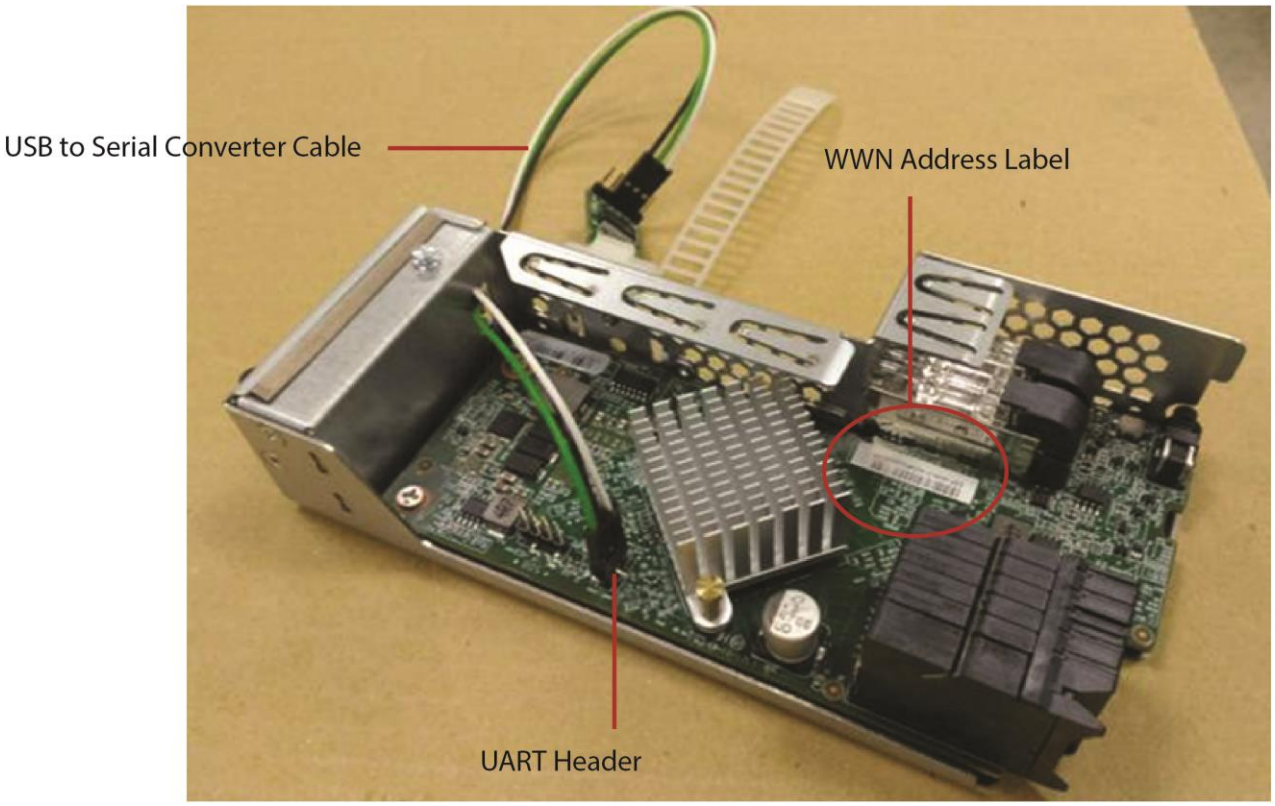
To update the SAS Expander firmware using the UART port, follow these steps:

1. Obtain the necessary firmware files from your Flex support portal.
2. Remove the SAS Expander from the CT0245J chassis (see section 22.2, “Replacing a SAS Expander”).

NOTE: The SAS Expander does not support hot-swap, so be sure to power off the drive sled before replacing the SAS Expander module.

3. Place the SAS Expander on a workbench (see Figure 10)

Figure 10 – SAS Expander



4. Locate the WWN address label and write down the address.
5. Use a USB to serial converter programming cable such as the one shown in the diagram to connect between your PC USB connector and the UART header on the SAS Expander.
6. Connect the green wire to pin 3, the white wire to pin 1, and the black wire to pin 2 of the header (see **Figure 11** and **Figure 12**).

Figure 11 – UART Header

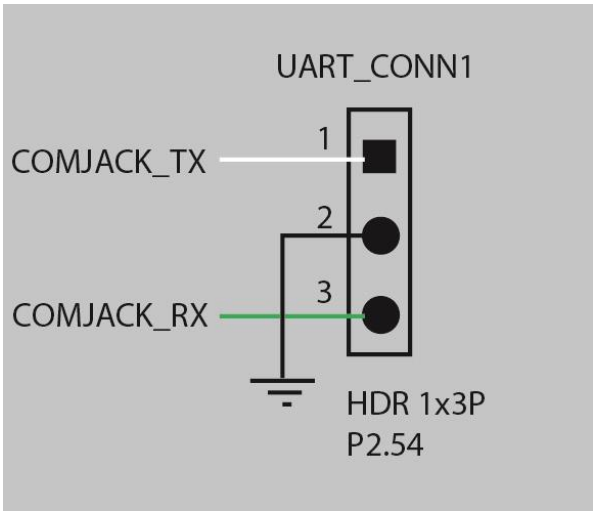
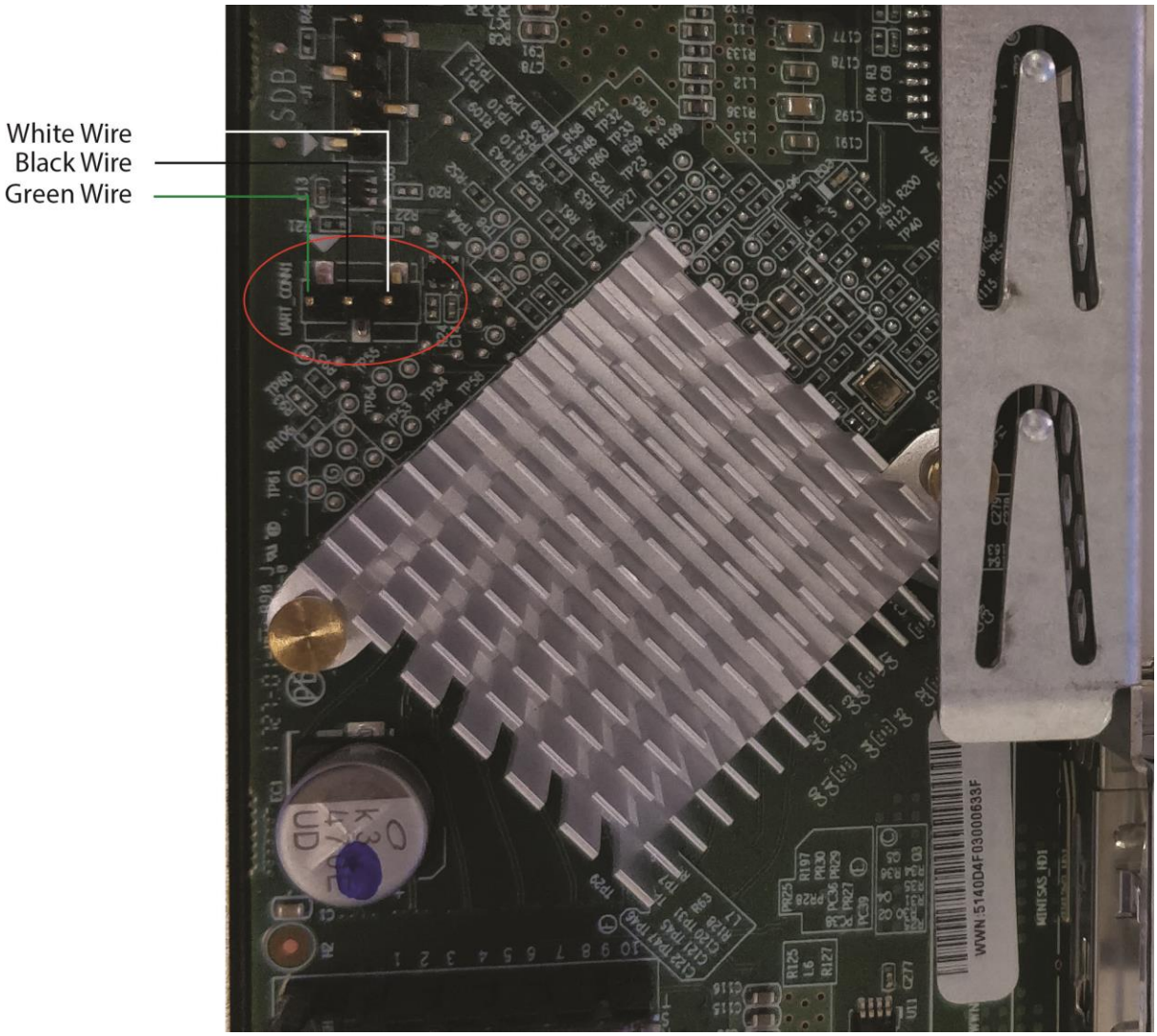


Figure 12 – UART Header Close view



7. Replace the SAS Expander in the chassis.
8. Connect the programming cable from the SAS Expander to a USB port on your PC.
9. Uncompress and copy all the necessary firmware files to a folder on your PC.
10. Use a root or admin account to log into your PCs Linux or Windows OS.
11. Copy the firmware and manufacturing .bin files into the flash tool folder.
12. For a Linux OS, execute "bash flash.sh <SAS address[3]>, “for example:

[3] The SAS address is the WWN address you wrote down previously.

bash flash.sh 5140D4F020000CFF

13. For a Windows OS, execute "flash.bat <SAS address>," for example:

    flash.bat 5140D4F020000CFF

14. Remove the SAS Expander and remove the cable from the UART header.

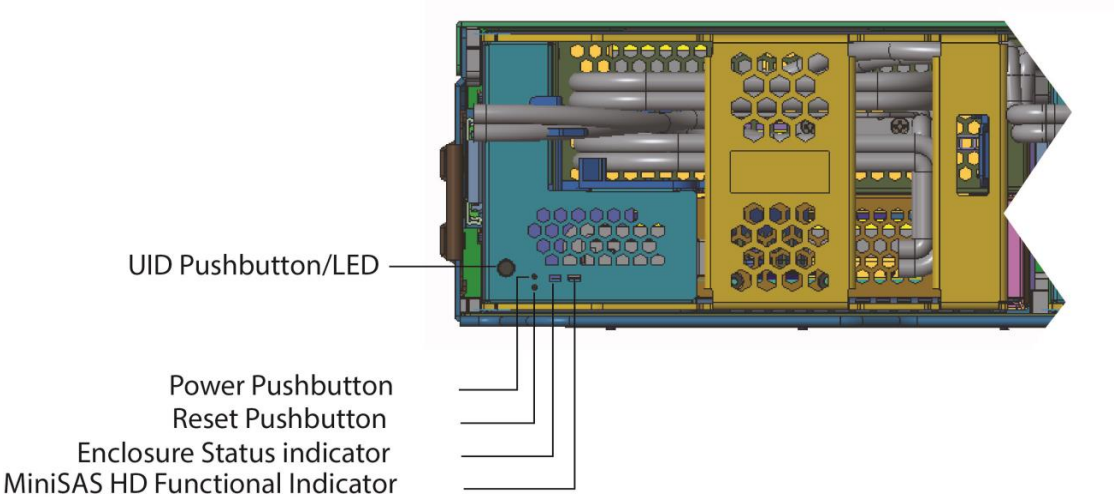
NOTE: The SAS Expander does not support hot-swap, so be sure to power off the drive sled before replacing the SAS Expander module.

15. Replace the SAS Expander module back into the drive sled.

10 Connecting the CT0245J to a Server

NOTE: When the system is fully inserted into the rack, it engages with the power connector on the power bus bar. Power is applied to each drive sled using the individual drive sled power buttons. Figure 13 shows the location of the power button for an individual drive sled.

Figure 13 – Sled Panel Buttons and LEDs (front of sled)



Before applying power to a drive sled, attach the appropriate mini SAS HD cables to the drive sleds. The drive sleds can operate in two modes, independent mode and cascade mode.

CAUTION: The minimum cable bend radius is as follows:

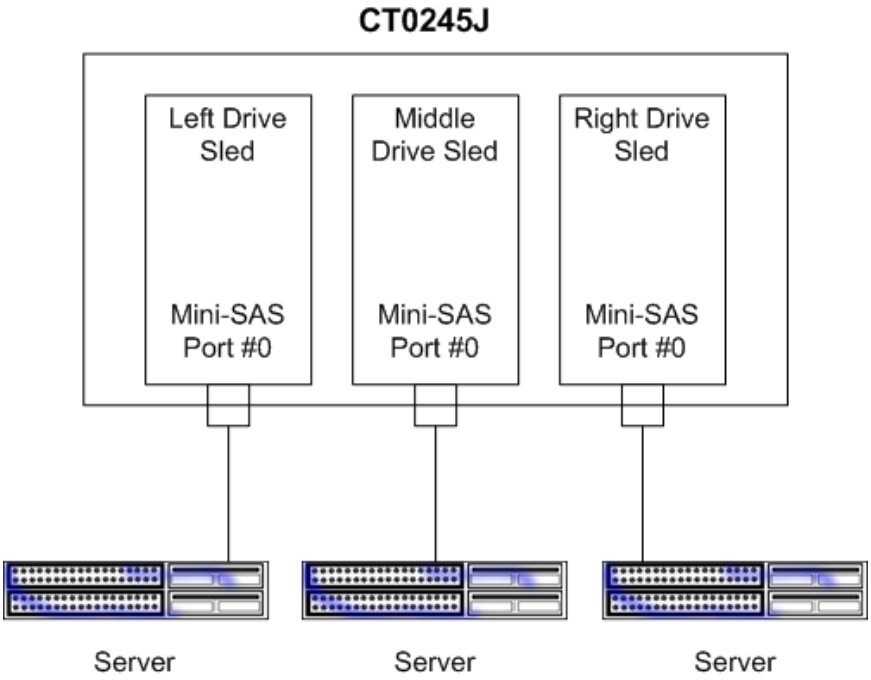
FCI Cables: 31.8 mm for 2-meter cables with a diameter less than or equal to 5.3 mm.

Molex Cables: 26 mm for 2-meter cables with a diameter less than or equal to 5.1 mm.

10.1 Attach Cables for Independent Mode

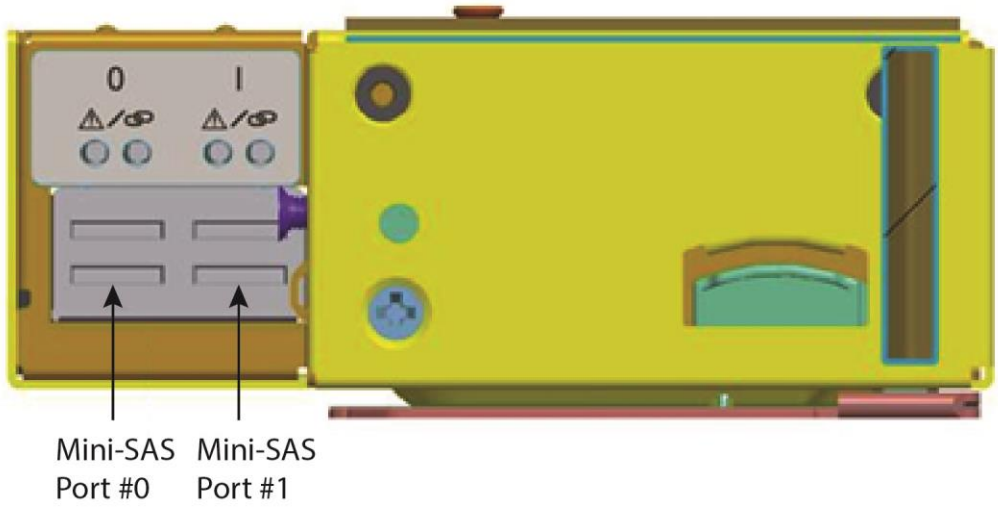
In independent mode, each drive sled is connected to its own host using a mini SAS HD cable. Simply connect the cable between mini SAS connector 0 on the drive sled to the corresponding host connector, as shown in the simplified drawing of Figure 14.

Figure 14 – Independent Mode



The location of mini SAS HD connector 0 is shown in Figure 15**Figure 33**. Connector 0 is the outer connector and is located on the SAS Expander. After the cable is connected, loop the excess cable and store it in the cavity of the drive sled.

Figure 15 – Mini SAS Port Connectors and LEDs



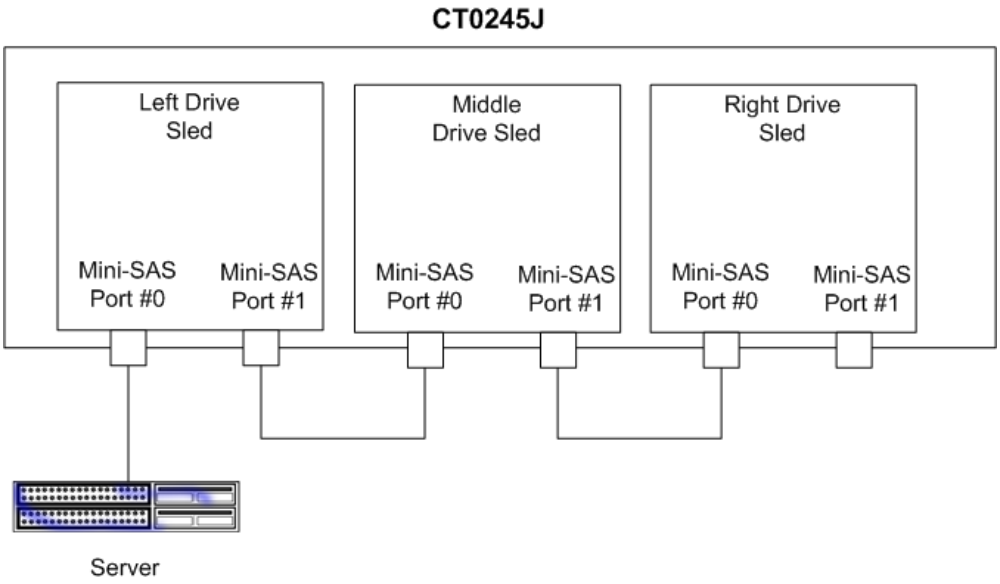
10.2 Attach Cables for Cascade Mode

Cascade mode is more involved than independent mode. In this mode, the drive sleds are interconnected with mini SAS HD cables. In a sample cascade mode scenario, the drive sleds are connected as follows:

1. The left drive sled is connected to the host with a cable connected to mini SAS HD connector 0.
2. The left drive sled is connected to the middle drive sled. This is done by connecting a cable from connector 1 of the left drive sled to connector 0 of the middle drive sled.
3. The middle drive sled is connected to the right drive sled. This is done by connecting a cable from connector 1 of the middle drive sled to connector 0 of the right drive sled.

A simplified diagram is shown in Figure 16.

Figure 16 – Cascade Mode



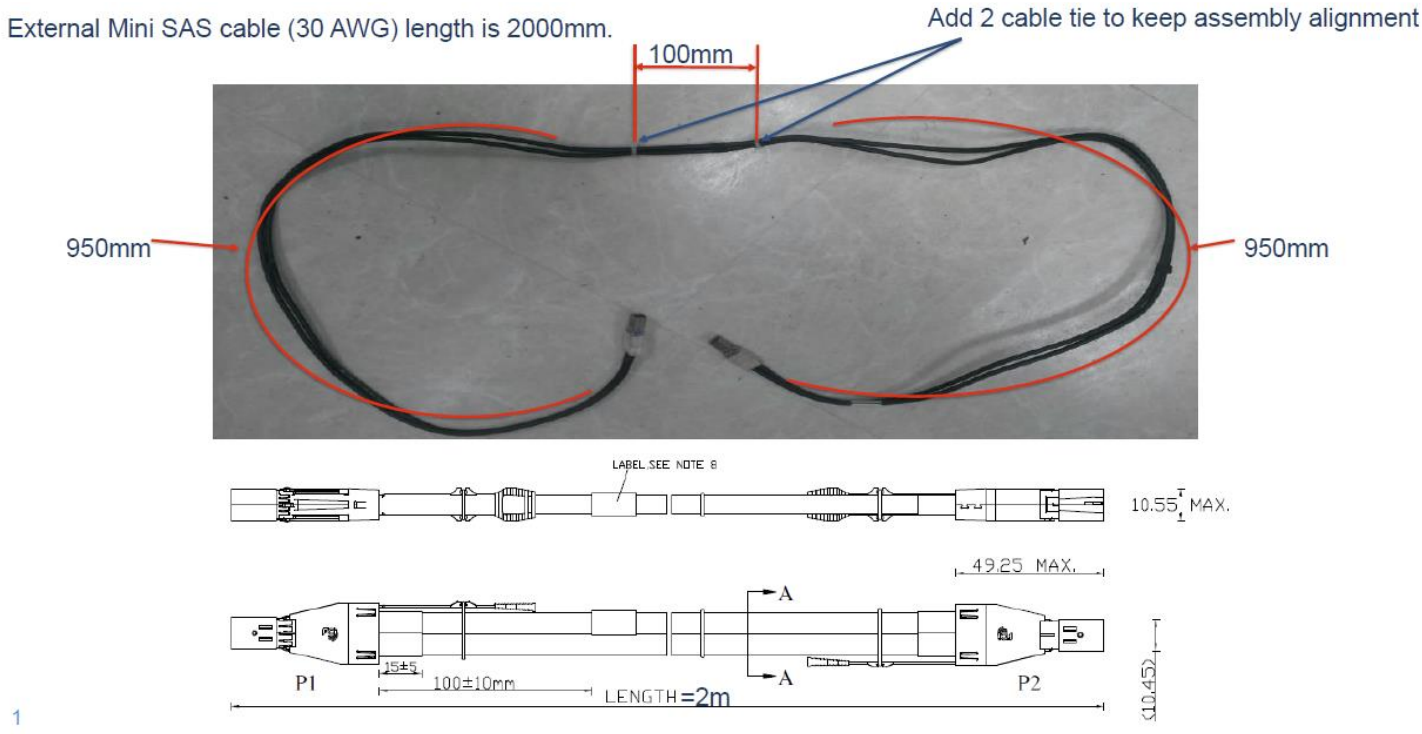
Because of the requirement to hot swap drives, each drive sled must have the ability to be fully extended from the chassis for servicing drives while maintaining the cable connection between drive sleds. In addition, the drive sled at the head of the cascade (typically the left drive sled) must maintain the cable connection between it and the host. This means that the cable from the left drive sled to the middle drive sled and the cable to the host must be able to extend to about two meters (6.5 feet). The same requirement must be met for the cable from the middle to the right drive sled. When the sleds are fully inserted into the chassis, the excess cable must be stored in the upper or lower slot of the drive sled.

The following cascade modes can be configured:

- Single Domain/Redundant Path
- Dual Domain/Single Path
- Dual Domain/Redundant Path

Each Mini SAS cable is 2 meters long, as shown in the following illustration:

Figure 17 – Mini SAS Cable

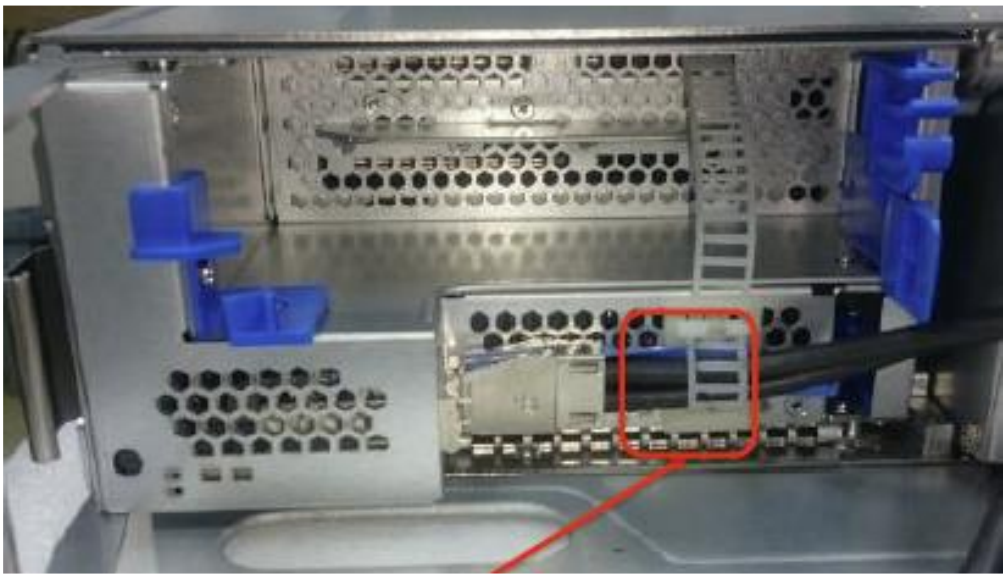


Note that actually there are two mini SAS cables in the cable assembly with one mini SAS HD connector at each end of the cable.

The following procedure must be followed for attaching cables to the drive sleds in the cascade mode (two cables are required):

1. Attach two cable ties to each of the mini SAS cables as shown in the illustration.
2. Insert one end of the first mini SAS cable into port #1 (inside slave connector) of the SAS Expander in the left drive sled and use a cable tie to secure the cable in place (see Figure 18).

Figure 18 – Insert Cable into Port 1 of Left Drive Sled



3. Snap the cable into the retainer at the top right of the left drive sled as shown in Figure 19.
4. Leave about one-half of the cable (1 meter) going toward the middle drive sled so that the other end of the cable can be connected to port #0 of the SAS Expander in the middle drive sled and the excess stored in the middle drive sled.

Figure 19 – Snap Cable into Retainer



5. Circle the excess length of the cable three times as shown in Figure 20 and place the excess in the top slot of the left drive sled.

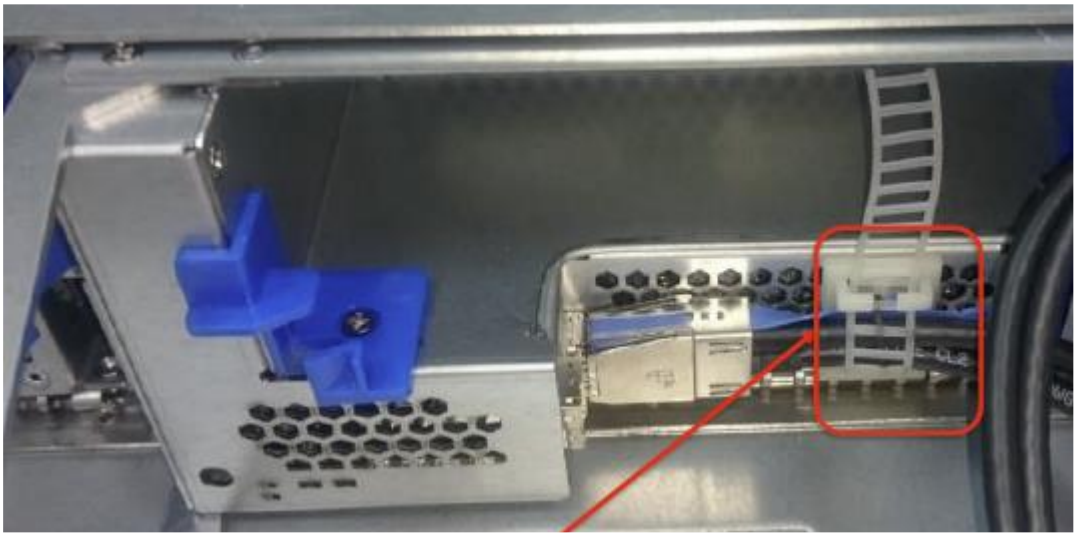
Figure 20 – Store Excess Cable in Top Slot





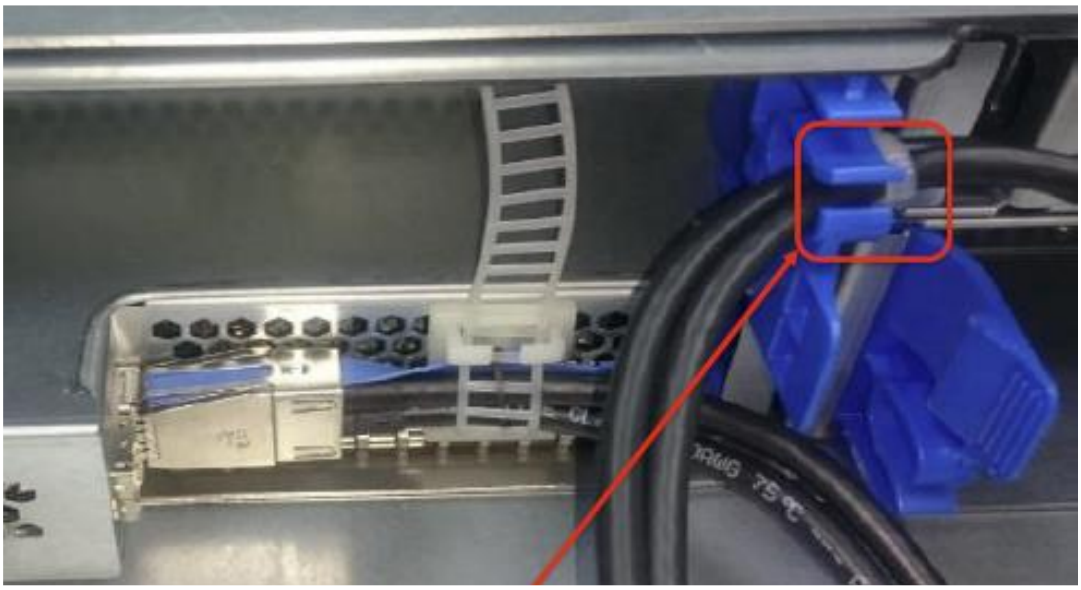
6. Insert one end of the second mini SAS cable into port #1 (inside slave connector) of the SAS Expander in the middle drive sled and use a cable tie to secure the cable in place (see Figure 21.

Figure 21 – Insert Cable into Port 1 of Middle Drive Sled



7. Snap the cable into the retainer at the top right of the middle drive sled as shown in Figure 22
8. Leave about one-half of the cable (1 meter) going toward the right drive sled so that the other end of the cable can be connected to port #1 of the SAS Expander in the right drive sled and the excess stored in the right drive sled.

Figure 22 – Snap Cable into Retainer



9. Circle the excess length of the cable three times as shown in Figure 23 and place the excess in the top slot of the middle drive sled.

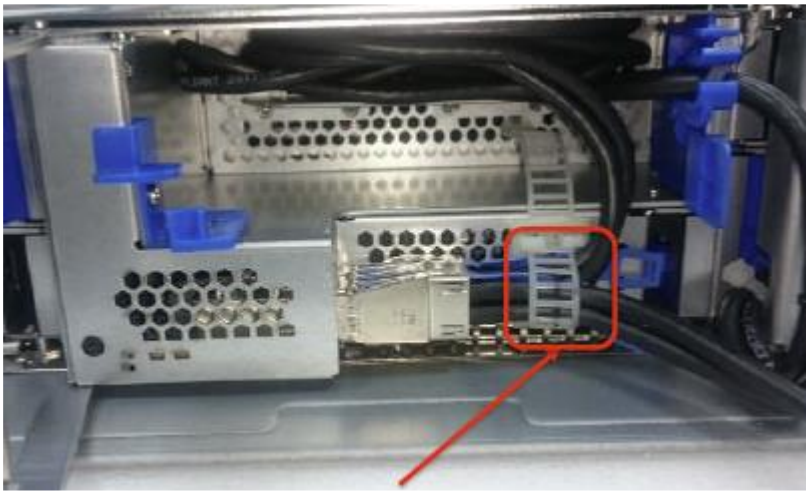
Figure 23 – Store Excess Cable in Top Slot





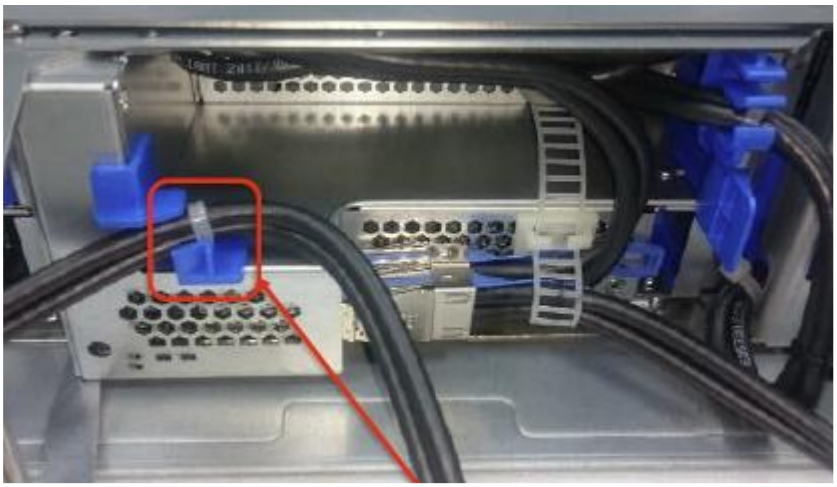
10. Insert the remaining end of the first mini SAS cable coming from the left drive sled into port #0 (outside master connector) of the middle drive sled as shown in Figure 24.

Figure 24 – Insert Cable from Left Drive Sled into Mini SAS Port #0 of Middle Drive Sled



11. Retain the cable in the bottom of the middle drive sled as shown in Figure 25

Figure 25 – Retain Cable in Bottom of Middle Drive Sled



12. Circle the excess cable three times as shown in Figure 26 and store the excess in the bottom slot of the middle drive sled.

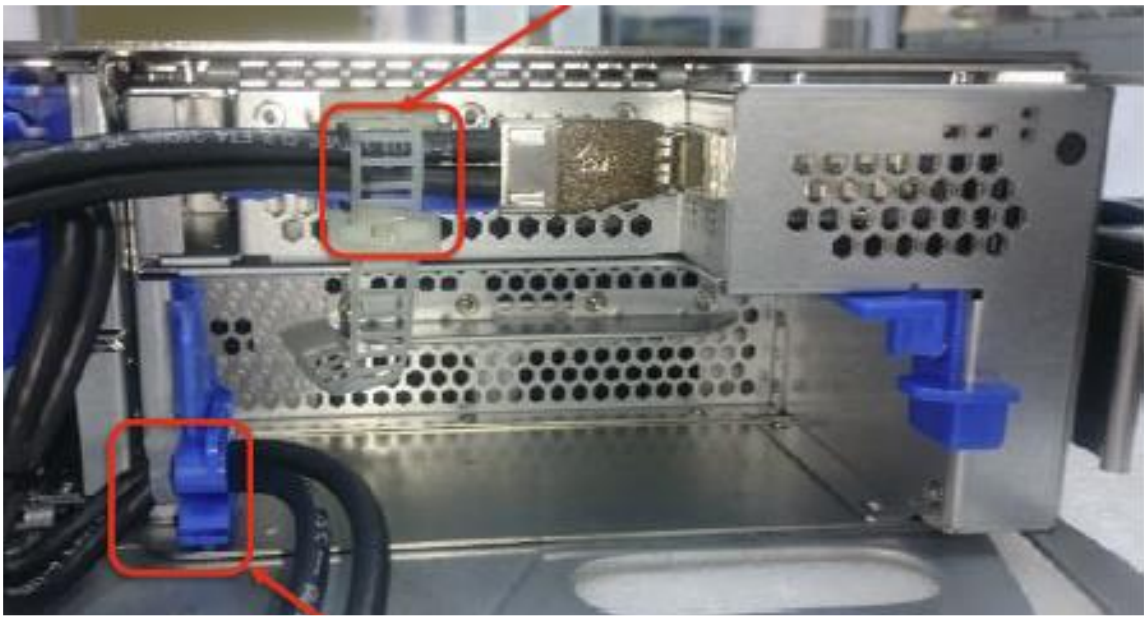
Figure 26 – Store Excess Cable in Bottom Slot Drive of Middle Drive Sled





13. Retain the cable coming from the middle drive sled and insert the remaining end of the second mini SAS cable coming from the middle drive sled into port #1 (inside slave connector) of the right drive sled as shown in Figure 27. Use a cable tie to keep it in place.

Figure 27 – Insert Mini SAS Cable into Port #1 of Right Drive Sled



14. Circle the excess cable three times as shown in Figure 28 and store the excess cable in the lower slot of right drive sled.

Figure 28 – Store Excess Cable in Lower Slot of Right Drive Sled



The final cable assembly appears as shown in Figure 29.

Figure 29 – Final Cable Assembly



11 Drive Information

11.1 Drive Identification Procedure

Use the following command to identify drives:

```
sg_ses /dev/sg2 -p2 --index=arr,14 --set=ident
```

Use the following command to clear drive identification:

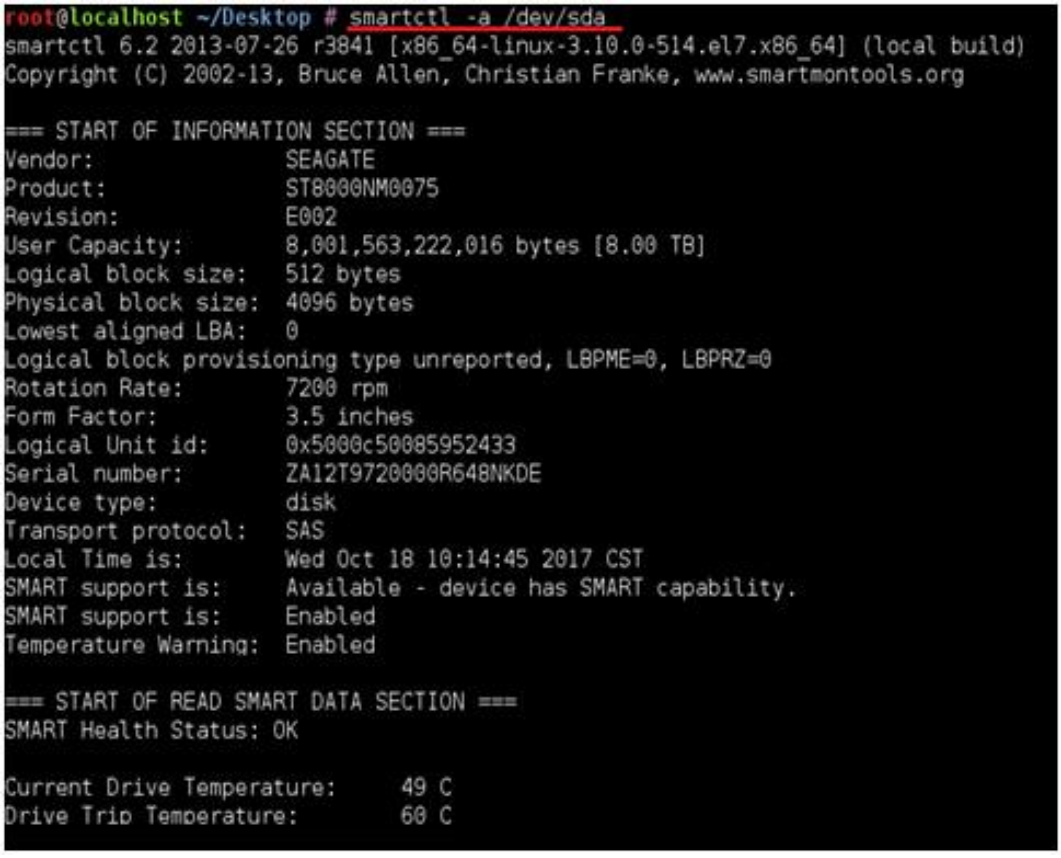
```
sg_ses /dev/sg2 -p2 --index=arr,14 --clear=ident
```

11.2 Drive Inventory Procedure

Use the following command to inventory drives, read drive health, and drive temperature (see Figure 30):

```
smartctl –a /dev/sda
```

Figure 30 – Drive Inventory



11.3 How to Map an OS Drive Letter with a Drive Hardware Address or Drive Slot

To map a drive letter to drive slot with a SAS3008 controller in the host, enter the following command:

```
ls -l /dev/disk/by-path
```

This command yields the following output lines for two of the drive sleds.

```
lrwxrwxrwx. 1 root root  9 Oct 24 16:54 pci-0000:65:00.0-sas-exp0x5140d4f03000567f-phy0-lun-0 ->
../../sdp

lrwxrwxrwx. 1 root root  9 Oct 24 16:54 pci-0000:65:00.0-sas-exp0x5140d4f03000567f-phy12-lun-0 ->
../../sds

lrwxrwxrwx. 1 root root  9 Oct 24 16:54 pci-0000:65:00.0-sas-exp0x5140d4f03000567f-phy13-lun-0 ->
../../sdt

lrwxrwxrwx. 1 root root  9 Oct 24 16:54 pci-0000:65:00.0-sas-exp0x5140d4f03000567f-phy14-lun-0 ->
../../sdu

lrwxrwxrwx. 1 root root  9 Oct 24 16:54 pci-0000:65:00.0-sas-exp0x5140d4f03000567f-phy15-lun-0 ->
../../sdv

lrwxrwxrwx. 1 root root  9 Oct 24 16:54 pci-0000:65:00.0-sas-exp0x5140d4f03000567f-phy16-lun-0 ->
../../sdw

lrwxrwxrwx. 1 root root  9 Oct 24 16:54 pci-0000:65:00.0-sas-exp0x5140d4f03000567f-phy17-lun-0 ->
../../sdx

lrwxrwxrwx. 1 root root  9 Oct 24 16:54 pci-0000:65:00.0-sas-exp0x5140d4f03000567f-phy18-lun-0 ->
../../sdy

lrwxrwxrwx. 1 root root  9 Oct 24 16:54 pci-0000:65:00.0-sas-exp0x5140d4f03000567f-phy19-lun-0 ->
../../sdz

lrwxrwxrwx. 1 root root  9 Oct 24 16:54 pci-0000:65:00.0-sas-exp0x5140d4f03000567f-phy1-lun-0 ->
../../sdq

lrwxrwxrwx. 1 root root 10 Oct 24 16:54 pci-0000:65:00.0-sas-exp0x5140d4f03000567f-phy20-lun-0 ->
../../sdaa

lrwxrwxrwx. 1 root root 10 Oct 24 16:54 pci-0000:65:00.0-sas-exp0x5140d4f03000567f-phy21-lun-0 ->
../../sdab

lrwxrwxrwx. 1 root root 10 Oct 24 16:54 pci-0000:65:00.0-sas-exp0x5140d4f03000567f-phy22-lun-0 ->
../../sdac

lrwxrwxrwx. 1 root root 10 Oct 24 16:54 pci-0000:65:00.0-sas-exp0x5140d4f03000567f-phy23-lun-0 ->
../../sdad

lrwxrwxrwx. 1 root root  9 Oct 24 16:54 pci-0000:65:00.0-sas-exp0x5140d4f03000567f-phy2-lun-0 ->
../../sdr
```

-
_____
_____

```
lrwxrwxrwx. 1 root root  9 Oct 24 16:54 pci-0000:65:00.0-sas-exp0x5140d4f030005c3f-phy0-lun-0 ->
../../sda

lrwxrwxrwx. 1 root root  9 Oct 24 16:54 pci-0000:65:00.0-sas-exp0x5140d4f030005c3f-phy12-lun-0 ->
../../sdd

lrwxrwxrwx. 1 root root  9 Oct 24 16:54 pci-0000:65:00.0-sas-exp0x5140d4f030005c3f-phy13-lun-0 ->
../../sde

lrwxrwxrwx. 1 root root  9 Oct 24 16:54 pci-0000:65:00.0-sas-exp0x5140d4f030005c3f-phy14-lun-0 ->
../../sdf

lrwxrwxrwx. 1 root root  9 Oct 24 16:54 pci-0000:65:00.0-sas-exp0x5140d4f030005c3f-phy15-lun-0 ->
../../sdg

lrwxrwxrwx. 1 root root  9 Oct 24 16:54 pci-0000:65:00.0-sas-exp0x5140d4f030005c3f-phy16-lun-0 ->
../../sdh

lrwxrwxrwx. 1 root root  9 Oct 24 16:54 pci-0000:65:00.0-sas-exp0x5140d4f030005c3f-phy17-lun-0 ->
../../sdi

lrwxrwxrwx. 1 root root  9 Oct 24 16:54 pci-0000:65:00.0-sas-exp0x5140d4f030005c3f-phy18-lun-0 ->
../../sdj

lrwxrwxrwx. 1 root root  9 Oct 24 16:54 pci-0000:65:00.0-sas-exp0x5140d4f030005c3f-phy19-lun-0 ->
../../sdk

lrwxrwxrwx. 1 root root  9 Oct 24 16:54 pci-0000:65:00.0-sas-exp0x5140d4f030005c3f-phy1-lun-0 ->
../../sdb

lrwxrwxrwx. 1 root root  9 Oct 24 16:54 pci-0000:65:00.0-sas-exp0x5140d4f030005c3f-phy20-lun-0 ->
../../sdl

lrwxrwxrwx. 1 root root  9 Oct 24 16:54 pci-0000:65:00.0-sas-exp0x5140d4f030005c3f-phy21-lun-0 ->
../../sdm

lrwxrwxrwx. 1 root root  9 Oct 24 16:54 pci-0000:65:00.0-sas-exp0x5140d4f030005c3f-phy22-lun-0 ->
../../sdn

lrwxrwxrwx. 1 root root  9 Oct 24 16:54 pci-0000:65:00.0-sas-exp0x5140d4f030005c3f-phy23-lun-0 ->
../../sdo

lrwxrwxrwx. 1 root root  9 Oct 24 16:54 pci-0000:65:00.0-sas-exp0x5140d4f030005c3f-phy2-lun-0 ->
../../sdc
```

The 15 lines of output above the separator line represent the 15 drives belonging to the drive sled with the SAS Expander address of 0x5140d4f03000567f.

The 15 lines of output below the separator line represent the 15 drives belonging to the drive sled with the SAS Expander address of 0x5140d4f030005c3f.

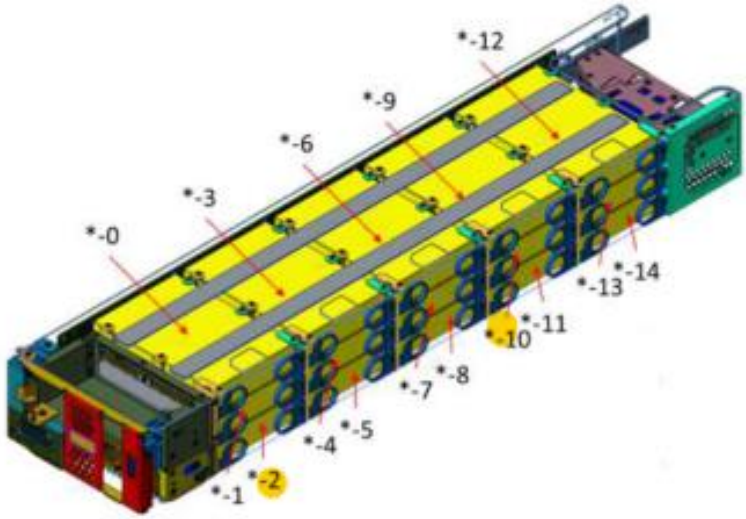
Each set of outputs represents the following PHY numbers, with corresponding drive letters and drive slots, as shown in Table 2

Table 2 – Correspondence of PHY Numbers, Drive Letters, and Drive slots

PHY Number	Drive Letter	Drive Slot
PHY 0	A	HDD 10
PHY 1	B	HDD 12
PHY 2	C	HDD 13
PHY 12	D	HDD 2
PHY 13	E	HDD 5
PHY 14	F	HDD 8
PHY 15	G	HDD 4
PHY 16	H	HDD 7
PHY 17	I	HDD 6
PHY 18	J	HDD 11
PHY 19	K	HDD 1
PHY 20	L	HDD 3
PHY 21	M	HDD 14
PHY 22	N	HDD 9
PHY 23	O	HDD 0

The drive slot physical locations are shown in Figure 31 .

Figure 31 – Drive Slot Physical Locations



Drive Slot Map

12 Command Line Interface

Each SAS Expander provides a Command Line interface (CLI) and a set commands for SAS expander debugging purposes. The CLI can be accessed through the UART console.

The below table lists the CLI commands.

Table 3 – CLI Command Set

CLI Command	Description
help	Display the current available commands and their syntax.
mr8	Memory read byte.
mw8	Memory write byte.
mr16	Memory read word.
mr32	Memory read Dword.
mw16	Memory write word.
mw32	Memory write Dword.
iicr	Read from an ISTWI slave device.
iicw	Write to an ISTWI slave device.
iicwr	Write and read data on a specified ISTWI channel.
thread	Display the thread information.
ful	Upload a file from a buffer.
fdl	Download a file to a buffer.
sspiing	Send an Inquiry command to an SSP target at a specified SAS address.
sspiw	Send a Write Buffer command to an SSP target at a specified SAS address.
sspir	Send a Read Buffer command to an SSP target at a specified SAS address.
rev	Display firmware revision information.
mdl	Download a file to memory.
mul	Upload a file from memory.
rreg	Read the processor and coprocessor registers.
rtr	Read and display all route table entries that are enabled. This command displays the route index, the SAS addresses, and the phy bitmap
rperm	Read the zone permissions RAM.
smpireq	Call an SMP initiator.
sasaddr	Display the SAS address of the expander.
ssptdebug	Print the SSP target module status.
mirror	Allow a PHY Tx and Rx to be echoed out of two unused phys and then to be monitored by an analyzer.
log	Store a string and write it to the log with the current timestamp.
showlogs	Return the current log buffer to the CLI.
clearlog	Clear the log buffer.
trace	Add a single trace entry with a number.
showtrace	Show the contents of the trace buffer.
tracesev	Display or change the current trace severity level.
tracemask	Modify the mask that determines which trace strings are added to the trace buffer.

tracetimestamp	Using the tracetimestamp command, you can enable or disable adding a timestamp to trace entries.
tracecap	Modify the state of trace capture and the trace buffer wrap or nowrap mode. Also registers and unregisters the callback functions for broadcasts' reserved primitives.
counters	Display or clear PHY counter register values.
fan	Control the PWM and tachometer blocks, which control the speed of the fan on the SAS/SATA expander board.
phyinfo	Display information about all phys (physical and virtual) of the expander.
memstat	Without any parameters, display run-time memory usage information about all thread stacks, byte pools, and NetX packets in the system.
rdcfg	Read the configuration page from the specified region and display it on the screen.
regerase	Erase the specified flash region ID.
cleartrrace	Clear the trace buffer.
buffsize	Print the buffer size of the specified buffer ID.
phyop	Perform the PHY operation.
reset	Reset the expander; the default reset is hard/cold reset.
showmfg	Display the manufacturing page information (0xFF0F).
sgxinfo	Display the SGX device information
edfbinfo	Display the DataBolt information
cableinfo	Display the cable management information for the specified PHY number
flashtblinfo	Display the Flash memory part information (Flash memory algorithm, mode, size, start address, sector count, and sector map) and Flash memory region information (region ID, type, offset, start sector, sector count, size, and validity status)
date	Display and set the current expander's system date or time
serdesinfo	Display the SerDes information, such as the SerDes configuration, the PHY capabilities, and the Tx and Rx parameters
sgpioinfo	Display the current state of the SGPIO, Pattern Generators, and Bit ReOrdering functions.

13 Standard SCSI and SES Commands

The SCSI Enclosure Services (SES) commands are described in this section.

13.1 Supported SCSI Commands

The supported commands for enclosure service management are shown in Table 4.

Table 4 – Supported SCSI Commands

Command Name	Operation Code
INQUIRY	12h
MODE SELECT (10)	55h
MODE SENSE (10)	5Ah
READ BUFFER	3Ch
READ DIAGNOSTIC RESULTS	1Ch
REPORT LUNS	A0h
REQUEST SENSE	03h
SEND DIAGNOSTIC	1Dh
TEST UNIT READY	00h
WRITE BUFFER	38h

13.2 Supported SES Pages

Table 8 summarizes supported SES pages. If the page code in an enclosure service request command does not appear in the list, the SAS Expander responds to the request with the sense code set to UNSUPPORTED ENCLOSURE FUNCTION.

Table 5 – Supported SES Pages

Page Code	Page Name	Control/Status
00h	Supported Diagnostic Pages diagnostic page	Status
01h	Configuration diagnostic page	Status
02h	Enclosure Control diagnostic page	Control
	Enclosure Status diagnostic page	Status
04h	String Out/in diagnostic page	Status
05h	Threshold Out diagnostic page	Control
	Threshold In diagnostic page	Status
07h	Element Descriptor diagnostic page	Status
0Ah	Additional Element Status diagnostic page	Status
0Dh	Supported SES Diagnostic Pages diagnostic page	Status
0Eh	Download Microcode Control diagnostic page	Control
	Download Microcode Status diagnostic page	Status
3Fh	See specific SCSI transport protocol for definition	

13.3 Supported SES Elements

Table 6 lists the element types and number of each type reported on the SES page.

Table 6 – Supported SES Elements

Element Type Code	Name
03h	Cooling
04h	Temperature Sensor
07h	Enclosure Services Controller Electronics
0Eh	Enclosure
12h	Voltage Sensor
17h	Array Device Slot
19h	SAS Connector

SES OEM commands are implemented by means of SES String-Out/String-In diagnostic page (SES Page 04h). The caller should place the requested command code and its parameters together in the form of consecutive data bytes (Data[0] ~ Data[N]) and sent it to the CT0245J SAS Expander firmware using the String-Out control page. If there is response data after the command operation, the response data is returned in the same way to the caller through the String-In status page.

13.4 SES Page Code 04h Command/Response Example

Any tools supporting read/write SES Pages can be used to send a command to and get a response from the CT0245J SAS Expander firmware. Here we use the sg_ses as an example.

NOTE: sg_ses is a free software utility and can be downloaded from the internet.

http://sg.danny.cz/sg/sg_ses.html

13.4.1 Issuing the Command

Issue the command using one of the following:

```
sg_ses /dev/sgN -p4 -c --data=[data0],[data1],[data2],…
```

or

```
sg_ses /dev/sgN -p4 -c --data=@FN
```

Note: 1. /dev/sgN -> N is 0, 1, 2…. The actual number will be assigned by the OS.

Note: 2. FN is a text file name that include the data string of ASCII hex bytes.

Example #1

To read the Product Asset Tag in FRU Vital Product Data (VPD) of the Fan Control Board (FCB), issue the following command:

```
sg_ses /dev/sg0 -p4 -c --data=c0, 2a
```

(refer to Table 7)

Example #2

To get the CPLD Revision, issue the following command:

```
sg_ses /dev/sg0 -p4 -c --data=c3
```

(refer to Table 12)

13.4.2 Getting the Response

To get the response to the command, issue the following:

```
sg_ses /dev/sg0 -p4
```

Note: This command applies to those commands that have response data returned.

13.5 SES Command List

See the following tables for the SES command and response details.

Table 7 – Read FRU Request

Field	Data	Data Size	Notes
Page	4	Byte	String Out diagnostic page
Data[0]	C0	Byte	Command code to read FRU EEPROM.
Data[1] Bit[7:4]	Board Type	4 bits	0: SEB 1: DPB 2: FCB Other: Reserved
Data[1] Bit[3:0]	String Type	4 bits	0: Board Manufacturer 1: Board Product Name 2: Board Serial Number 3: Board Part Number 4: Board FRU File ID 5: Product Manufacturer 6: Product Name 7: Product Part Number 8: Product Version 9: Product Serial Number

			A: Product Asset Tag B: Product FRU File ID Other: Reserved

Table 8 – Read FRU Response

Field	Data	Data Size	Notes
Page	4	Byte	String In diagnostic page
Data[0…N-1]	String data	N bytes	N is determined by string type.

Table 9 – Write FRU Request

Field	Data	Data Size	Notes
Page	4	Byte	String Out diagnostic page
Data[0]	C1	Byte	Command code to write FRU EEPROM.
Data[1] Bit[7:4]	Board Type	4 bits	0: SEB 1: DPB 2: FCB Other: Reserved
Data[1] Bit[3:0]	String Type	4 bits	5: Product Manufacturer 6: Product Name 7: Product Part Number 8: Product Version A: Product Asset Tag Other: Reserved
Data[2…N+1]	String Data	N bytes	If N is less than the length of the specified string type, the remaining data bytes will be filled with the “SPACE” character. If N is greater than the string length, the extra data byte(s) will be skipped

Table 10 – Get Write FRU Status Request

Field	Data	Data Size	Notes
Page	4	Byte	String Out diagnostic page
Data[0]	C2	Byte	Command code to get FRU

			write status.

Table 11 – Get Write FRU Status Response

Field	Data	Data Size	Notes
Page	4	Byte	String In diagnostic page

Table 12 – Get CPLD Revision Request

Field	Data	Data Size	Notes
Page	4	Byte	String Out diagnostic page
Data[0]	C3	Byte	Command code to get CPLD revision.

Table 13 – Get CPLD Revision Response

Field	Data	Data Size	Notes
Page	4	Byte	String In diagnostic page
Data[0] Bits [7:6]	Board Revision	2 bits	0 = EVT1 1 = EVT2 2 = DVT 3 = PVT
Data[0] Bit 5	Fan ID	1 bit	0 = Dual rotary 1 = Single rotary
Data [0] Bits [4:0]	Firmware Revision	5 bits	0x00 to 0x3F

Table 14 – I2C Write Request

Field	Data	Data Size	Notes
Page	4	Byte	String Out diagnostic page
Data[0]	C4	Byte	I2C Write Command
Data[1]	I2C Slave address	Byte	
Data[2]	I2C Bus number	Byte	
Data[3:M+2]	Number of data bytes to be written	M bytes	

Table 15 – I2C Read Request

Field	Data	Data Size	Notes
Page	4	Byte	String Out diagnostic page
Data[0]	C5	Byte	I2C Read Command

Data[1]	I2C Slave address	Byte	
Data[2]	I2C Bus number	Byte	
Data[3:M+2]	Number of data bytes to be read	N bytes	Must be between 1 and 32 bytes

Table 16 – I2C Read Request Response

Field	Data	Data Size	Notes
Page	4	Byte	String In diagnostic page
Data[0:N+1]	Number of data bytes read	N bytes	

Table 17 – I2C Write Read Request

Field	Data	Data Size	Notes
Page	4	Byte	String Out diagnostic page
Data[0]	C5	Byte	I2C Write Read Command
Data[1]	I2C Slave address	Byte	
Data[2]	I2C Bus number	Byte	
Data[3:M+2]	Number of data bytes to be read	N bytes	Must be between 1 and 32 bytes
Data[4:M+3]	Data bytes to be written	M bytes	

Table 18 – I2C Write Read Request Response

Field	Data	Data Size	Notes
Page	4	Byte	String In diagnostic page
Data[0:N-1]	Number of data bytes read	N bytes	

Table 19 – Reset Control

Field	Data	Data Size	Notes
Page	4	Byte	String Out diagnostic page
Data[0]	C7	Byte	Reset Control Command
Data[1]	38	Byte	Additional data byte with a pre-defined value to prevent an unexpected reset by a single byte command.

Table 20 – Host Heartbeat

Field	Data	Data Size	Notes
Page	4	Byte	String Out diagnostic page
Data[0]	D0	Byte	Host Heartbeat Command. The host should send this command to the Expander every 60 seconds to reload the watchdog timer.

			The watchdog timer for the Host heartbeat is disabled by default after the drive sled powers on or resets. When the SAS Expander receives the first heartbeat command, the watchdog timer starts counting down. If the next heartbeat command is not received within 60 seconds, the watchdog timer will time-out and the SAS Expander will reset.

14 Logging

The SAS Expander logs certain events. The types of events logged are implementation specific. The event logs are stored in two reserved regions of Flash memory. There are 2047 log entries stored in each region, for a maximum of 4094 entries. When both regions are full, the region with the oldest logs is erased to make room for new entries. This means When a 4095th entry is added; the oldest 2047 logs are erased to make room for the new log, leaving 2048 logs after the new log is added.

SCSI READ BUFFER and SCSI WRITE BUFFER commands can be used to retrieve the logs or clear them, respectively.

- The **`SCSI READ BUFFER`** command supports transferring the entire log in one buffer or using the offset field in the CDB. The buffer mode is 0x02, and the buffer ID is 0xE5. Read the entire buffer at once because the buffer is not locked, and therefore it might change between **`SCSI READ BUFFER`** commands.
- The **`SCSI WRITE BUFFER`** command clears the current log. The data in the data buffer is ignored. The buffer mode is 0x02, and the buffer ID is 0xE5.

Following are the logging formats.

14.1 Log Entry Format

The following table shows the log entry format, each log entry is 64 bytes in length and includes a header and log data. The fields are explained following the table.

Table 21 – Log Entry Format

31 24	23 16	15 8	7 0	Byte
Time Stamp				0x00
				0x04
RESERVED				0x08
Log Entry Qualifier		Log Sequence		0x0C
Log Data				0x10
				…..
				…..
				0x3C

- Time Stamp [8 bytes]: The Time Stamp field indicates the number of elapsed milliseconds since the expander was reset.
- Log Entry Qualifier [2 bytes]: The Log Entry Qualifier field specifies the type of event that occurred. The value in this field defines the contents of the 48-byte Log Data field. See Table 22.

Table 22 – Log Entry Qualifier

Log Entry Qualifier Value	Description
0x0000	The unused log entry
0x0001	The power-on/reset log entry
0x0002	The timestamp updated log entry
0x8100	LSI log entry
0x8101	OEM log entry

- Log Sequence [2 bytes]: This field specifies the chronological order for the particular log event. Greater Log Sequence values represent more recent error events. The host must interpret correctly the Log Sequence if this field rolls over.
- Log Data [48 bytes]: This field contains 48 bytes of additional data for the log entry.

14.2 Log Data Format

The Log Data format is shown in Table 23. The fields are explained following the table.

Table 23 – Log Data Format

<table>
<tr><th>31 24</th><th>23 16</th><th>15 8</th><th>7 0</th><th>Byte</th></tr>
<tr><td colspan="4">Log Code</td><td>0x00</td></tr>
<tr><td>Log Class</td><td>Argument Type</td><td colspan="2">Locale</td><td>0x04</td></tr>
<tr><td colspan="4" rowspan="3">Log Specific Data</td><td>0x08</td></tr>
<tr><td>…..</td></tr>
<tr><td>0x2C</td></tr>
</table>

- Log Code [4 bytes]. See the following table.

Table 24 – Log Code

Log Code Value	Description
0x00000001	Firmware initialization started
0x00000002	A string log
0x00000003	A SCSI Command Descriptor Block
0x00000004	Zoning information has been saved
0x00000005	Zoning module has reset a link to include it into the ZPDS
0x00000006	Zoning has timed out a configuration event
0x00000007	Zoning module cannot allocate space for Zoning table structures
0x00000008	Self-Discovery phy table is out of resources
0x00000009	Self-Discovery expander table is out of resources

0x0000000A	Self-Discovery has detected a subtractive to subtractive connection
0x0000000B	Self-Discovery has detected a table to table connection
0x0000000C	Self-Discovery has detected multiple subtractive ports
0x0000000D	Self-Discovery has detected the device table is full
0x0000000E	Self-Discovery has detected the route table is full
0x0000000F	Self-Discovery cannot allocate memory for resources
0x00000010	Self-Discovery has encountered an SMP related error event
0x00000011	Config Page region has posted information to log
0x00000012	Fault code and line number information
0x00000013	Callback Stack information related to fault event
0x00000014	Ethernet connection event
0x00000015	Ethernet disconnection event
0x00000016	FW download event has occurred
0x00000017	Self-Discovery has detected an expander attached to a direct route PHY
0x00000018	Self-Discovery has detected different route attributes for phys of a port
0x00000019	Zoning has detected an improperly configured wide port
0x0000001A	Memory allocation for ISTWI slave handle failed
0x0000001B	Zoning permission RAM parity error has been detected
0x80000001	Host Heartbeat Timeout Event
0x80000002	Thermal Critical Event.
0x80000003	Thermal Shut Down
0x80000004	Fan Fail Event
0x80000005	Fire Condition
0x80000006	Dual Rotary Fan Installed (On PVT or later chassis)
0x80000007	Dual Rotary Fan Fail (On DVT or earlier chassis)

- Log Class [1 byte]. See the following table.

Table 25 – Log Class

Log Class Value	Description
0x00 (Information)	Informational message
0x01 (Warning)	A component might be close to a failure point
0x02 (Critical)	A component failed, but the expander continued running
0x03 (Fatal)	A component failed, and the expander failed
0x04 (Dead)	A catastrophic error occurred, and the expander failed. This event is seen only after the expander has been restarted.

- Argument Type [1 byte]. See the following table.

Table 26 – Argument Type

Argument Type Value	Description
0x00	None
0x01	Boot operation
0x02	CDB Sense

Argument Type Value	Description
0x03	String
0x04	Zone state information
0x05	SCE discovery information
0x06	Configuration page information
0x07	Fault diagnostic
0x08	Ethernet information
0x09	Firmware download information
0xC0	OEM information

- Locale [2 bytes]. See the following table.

Table 27 – Locale

Locale Code	Description
0x0001 (SCSI)	SCSI command events.
0x0002 (SAS)	SAS event codes.
0x0003 (SMP)	SMP events.
0x0004 (EXP)	General expander events.
0x0005 (CONFIG)	Configuration changes.
0x0006 (SCE)	Self-configuration events.
0x0007 (ZONING)	Zoning events.
0x0008 (FAULT)	Fault events.
0x0009 (SES)	SES-related events.
0x000A (ISTWI)	ISTWI interface events.
0x000B (ENCLOSURE)	Alerts from enclosure-monitoring devices.
0x000C (PLATFORM)	Logs from the platform code.
0x000D (CLI)	Logs entered by the user from the CLI (CLI code logs use PLATFORM).
0x000E (ETHERNET)	Ethernet-related events.
0x000F (RWBUFFER)	Read/write buffer events connected to CLI, Telnet, and TFTP accesses to read/write flash buffer regions. 0x0010 (SXP) SxP Port events
0x0010 (SXP)	SxP Port events
0x8001 (OEM)	Logs from OEM porting

- Log-specific data [40 bytes]: This field contains 40 bytes of additional data for the specific log code.

14.3 Reading and Clearing the Log Using the sg Utility

14.3.1 Reading the Log

Following is an example of how to read the event log using the sg utility:

```
sg_read_buffer  /dev/sg0 -m 0x02 -I 0xe5 -l 0xYYYY -o 0xZZZZ
```

Where: YYYY = number of read bytes (multiples of 0x40, because each log entry consumes 64 bytes).

and: ZZZZ = read offset (multiples of 0x40)

For example:

Event Log 0, ZZZZ should be 0x0000.

Event Log 1, ZZZZ should be 0x0040.

Event Log 2, ZZZZ should be 0x0080.

…

For Log Sequence 1024, ZZZZ should be 0x10000.

….

For Log Sequence 2047, ZZZZ should be 0x1FFC0.

14.3.2 Clearing the Log

Following is an example of how to clear the log using the sg utility:

```
sg_write_buffer  /dev/sg0 -m 0x02 -I 0xe5 -l 0x1
```

15 SAS Zoning

SAS zoning implements SAS 2/2.1/3.0 specification compliant port-based zoning. The zoning capability restricts communication between devices in different zoned domains. In zoning mode, certain PHYs are marked as being in a zoned domain or not. Zones are based on an access permission table that determines the access permissions among different groups of devices. Groups that have access to each other constitute a zone. The CT0245J supports 256 zone groups and zone-aware address-based routing tables. The SMP commands necessary to program group IDs in-band and set up the access permission table are also supported.

Use the following SMP commands to set and check SAS zoning:

```
smp_zone_lock /dev/bsg/expander-2\:1

smp_zone_activate /dev/bsg/expander-2\:1

smp_rep_general /dev/bsg/expander-2\:1
```

The utility is smp_utils (see http://sg.danny.cz/sg/smp_utils.html)

- `smp_zone_lock and smp_zone_unlock`: lock and unlock the zone setting: If unlock, you can modify the zone setting. If lock, you can active the zone based on the setting.
- `smp_zone_activate`: Activate the zone.
- `smp_rep_general`: Get the general parameters of the zone.

The following example report shows the general parameters of the zone:

```
Report general response:
  expander change count: 48
  expander route indexes: 0
  long response: 1
  number of phys: 27
  table to table supported: 1
  zone configuring: 0
  self configuring: 0
  STP continue AWT: 0
  open reject retry supported: 1
  configures others: 1
  configuring: 0
  externally configurable route table: 0
  initiates SSP close: 0
  enclosure logical identifier (hex): 5140d4f0300069bf
  STP bus inactivity timer: 0 (unit: 100ms)
  STP maximum connect time: 0 (unit: 100ms)
  STP SMP I_T nexus loss time: 0 (unit: ms)
  number of zone groups: 1 (0->128, 1->256)
  zone locked: 0
  physical presence supported: 0
  physical presence asserted: 0
  zoning supported: 1
  zoning enabled: 0
```

saving: 0

saving zone manager password supported: 1

saving zone PHY information supported: 1

saving zone permission table supported: 1
saving zoning enabled supported: 1
maximum number of routed SAS addresses: 2048
active zone manager SAS address (hex): 0000000000000000
zone lock inactivity time limit: 0 (unit: 100ms)
power done timeout: 0 (unit: second)
first enclosure connector element index: 0
number of enclosure connector element indexes: 25
reduced functionality: 0
time to reduced functionality: 0 (unit: 100ms)
initial time to reduced functionality: 0 (unit: 100ms)
maximum reduced functionality time: 0 (unit: second)
last self-configuration status descriptor index: 0
maximum number of stored self-configuration status descriptors: 64
last PHY event list descriptor index: 108
maximum number of stored PHY event list descriptors: 108
STP reject to open limit: 0 (unit: 10us)

See Table 28 for the current SAS zoning configuration (for the current firmware).

Table 28 – Argument Type

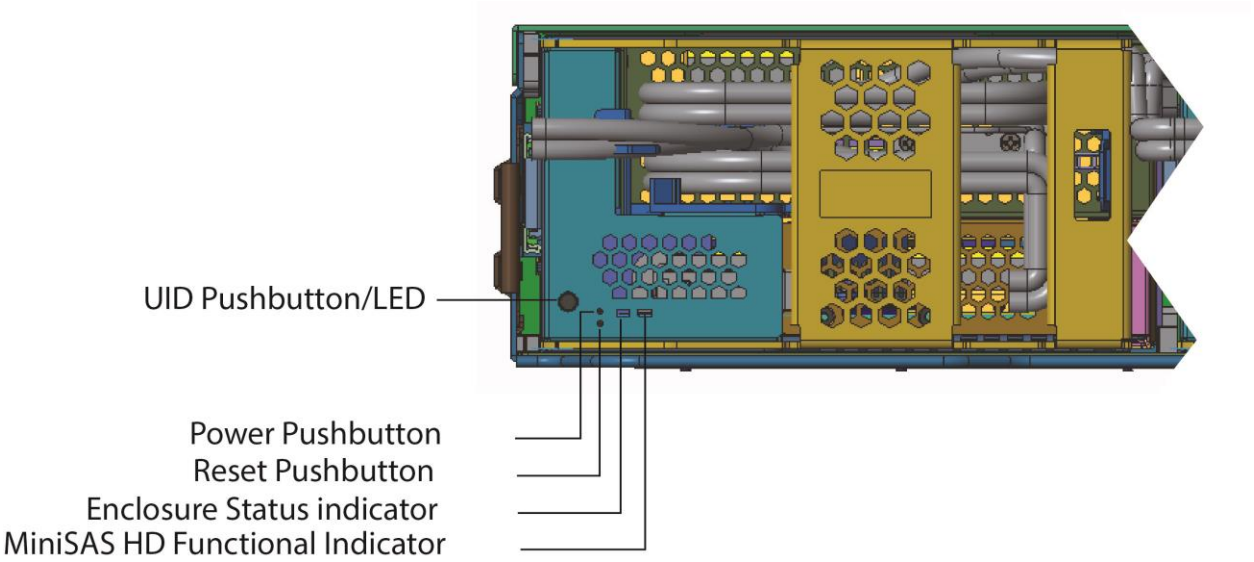
Zone	Function
81h	ENABLE DISABLE ZONING
85h	ZONED BROADCAST
86h	ZONE LOCK
87h	ZONE ACTIVATE
88h	ZONE UNLOCK
89h	CONFIGURE ZONE MANAGER PASSWORD
8Ah	CONFIGURE ZONE PHY
8Bh	CONFIGURE ZONE PERMISSION
PHY-based SMP output functions	
91h	PHY CONTROL

More utilities are included in the “smp_utils” package (see link above).

16 Switches and LEDs

This section provides a description of the pushbuttons and LEDS for the CT0245J JBOD (see Figure 32).

Figure 32 –Pushbuttons and LEDs



16.1 Unit Identifier (UID) LED/Pushbutton

The SAS Expander Board in each drive sled controls one blue Unit Identifier (UID) LED that is visible from the front of the sled. The LED is located in a pushbutton that, when depressed, alternately turns the LED on and off. The software can use this action to notify a remote host. In addition, a remote host can send a command to illuminate the UID LED on a drive sled.

16.2 Power Pushbutton

Each drive sled has a power pushbutton. Pushing the power pushbutton on a drive sled controls the power on the sled itself only.

16.3 Reset Pushbutton

Each drive sled has a reset pushbutton. Pushing the button reinitializes the drive sled operation.

16.4 Enclosure Status LED

The SAS Expander Board in each drive sled controls one bi-color system power/fault LED that is visible from the front of the sled.

The single bi-color (red/green) LED indications for the Enclosure Status LED are given in Table 29.

Table 29 – System States

Enclosure State	LED Color
System Booting	RED Blinking
System Normal	GREEN
Event Failure (thermal or fan failure)	RED blinking
System Fault (for dual rotary fans installed on DVT or earlier versions of the chassis)	RED

16.5 Mini SAS HD Functional Indicator LED

The SAS Expander Board in each drive sled controls one bi-color LED that is visible from the front of the sled. This LED indicates the overall status of the two mini SAS HD ports for the sled. The LED indications for various states are given in Table 30.

Table 30 – Mini SAS HD States (combined status of both mini SAS ports)

Mini SAS Port Link Status	LED Color
No SAS cable linked	OFF
SAS Links (x4) Health Good	GREEN
Loss of SAS Links (SAS cable present, but any signal on the four links (X0 – X3) has been lost or any link speed is less than 12G)	RED

16.6 Mini SAS Port Link Status LEDs

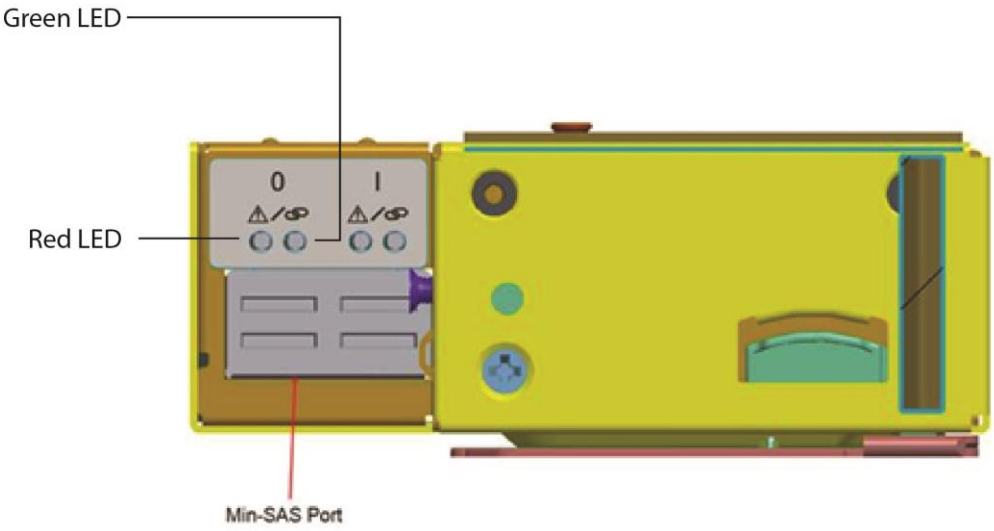
The SAS Expander Board in each drive sled controls two LEDs (one green, one red) for each of the two mini SAS HD connectors in a sled. These LEDs are built into the mini SAS HD connectors. The LEDs indicate the link status of the mini SAS ports. The LED indications are given in Table 31.

Table 31 – Mini SAS Port Link States (per connector)

Mini SAS Port Link Status	Green LED	Red LED	Description
No SAS Links	OFF	OFF	There is no SAS cable connected
SAS Links (x4) Health Good	ON	OFF	The PHYs for ports X0 –X3 are up and each PHY is operating at 12G
Loss of SAS Links X0 – X3	OFF	ON	One or more PHYs have lost link or one or more of the PHYs operates at a speed lower than 12G

The locations of the mini SAS connectors and LEDs are shown in Figure 33.

Figure 33 – Mini SAS Port Connectors and LEDs



16.7 Drive LEDs

There is one bi-color LED for each of the 15 drives in a sled. The LED for a drive is located in the top right area of the drive carrier and is visible when the drive sled is pulled out from the main chassis. The LED indications for various drive states are given in Table 32.

Table 32 – Drive Status

Drive State	LED Color
No drive inserted	OFF
Drive online and healthy	GREEN
Drive identify	Blinking GREEN
Drive failure	RED
Drive power OFF	Blinking RED/GREEN

17 Fans

There are two models for the fan. See Table 33 and Table 34.

The specifications for the single phase, 4-pole brushless DC motor fan are listed in Table 33. It is a single-rotor fan with dimensions 60 mm x 60 mm x 38 mm.

Table 33 – Single Phase, 4-Pole Brushless DC Motor Fan Specifications

Mechanical Characteristics	
Motor Design	Single phase, 4-poles Brushless DC motor
Bearing System	Precision ball bearing system
Dimensions	60X60X38 mm
Materials of Frame	Thermoplastic PBT of UL 94V-0
Materials of Fan Blade	Thermoplastic PPE of UL 94V-0
Direction of Rotation	Counter-clockwise viewed from front of fan blade
Mounting Holes	Diameter 4.5 mm in 8 holes
Weight	120 g
Electrical Characteristics	
Rated Voltage	12 VDC
Rated Current	1900 mA / MAX. 2185 mA
Rated Power Consumption	22.80 WATTS / MAX. 26.22 WATTS
Operating Voltage Range	10.2~13.2 Vdc
Starting Voltage	10.2 Vdc (25 deg. C POWER ON/OFF)
Operating Temperature Range	-10 to + 70 deg. C
Storage Temperature Range	-40 to + 70 deg. C

Performance Characteristics	
Rated Speed	19,800 RPM (nominal) 22,800 RPM ± 10% (maximum) at rated voltage 17,820 RPM minimum
Air Flow	67.8 CFM / MIN. 60.3 CFM
Static Pressure	4.84 Inch-H 2 O / MIN. 3.68 Inch-H 2 O
Acoustic Noise	64.1 dB(A) / MAX. 69.9 dB(A)

The specifications for the DC brushless vane axial fan are listed in Table 34
Its dimensions are 60 mm x 60 mm x 38 mm.

Table 34 – DC Brushless Vane Axial Fan Specifications

Mechanical Characteristics	
External Dimensions	60X60X38 mm
Housing Material	Plastic (UL V-0)
Impeller Material	Plastic (UL V-0)
Bearings	Two ball bearings
Weight	135 g
Electrical Characteristics	
Rated Voltage	12 Vdc
Rated Current	3000 mA / MAX 3300 mA
Rated Power Consumption	36.0 WATTS / MAX. 39.6 WATTS
Operating Voltage Range	10.8~13.2 Vdc
Operating Temperature Range	-10 to + 70 deg. C
Storage Temperature Range	-40 to + 70 deg. C
Insulation Resistance	10 mega OHM minimum
Dielectric Strength	Must withstand 500 Vac minimum
Protection – current limit	If power is turned on and a rotor is locked, the fan attempts to restart at a typical repetition rate (a temperature rise will be prevented). The fan will automatically restart with the locked rotor is released
Protection – reverse polarity	The power supply voltage must not be applied between the signal output line and any other line directly. Reverse polarity protection is effective to just switch the positive and negative power lines.

Performance Characteristics	
Rated Speed	19,800 RPM nominal 17,820 RPM minimum 21,780 RPM maximum
Air Flow	76.6 CFM / MIN. 65.3 CFM
Static Pressure	5.05 Inch-H 2 O / MIN. 3.88 Inch-H 2 O
Acoustic Noise	67.5 dB(A) / MAX. 72.0 dB(A)
Direction of Rotation	Clockwise (from label side)
Direction of Airflow	Clockwise (from label side)

18 Rear Side Power, I/O and Midplane

18.1 Rear Side Power

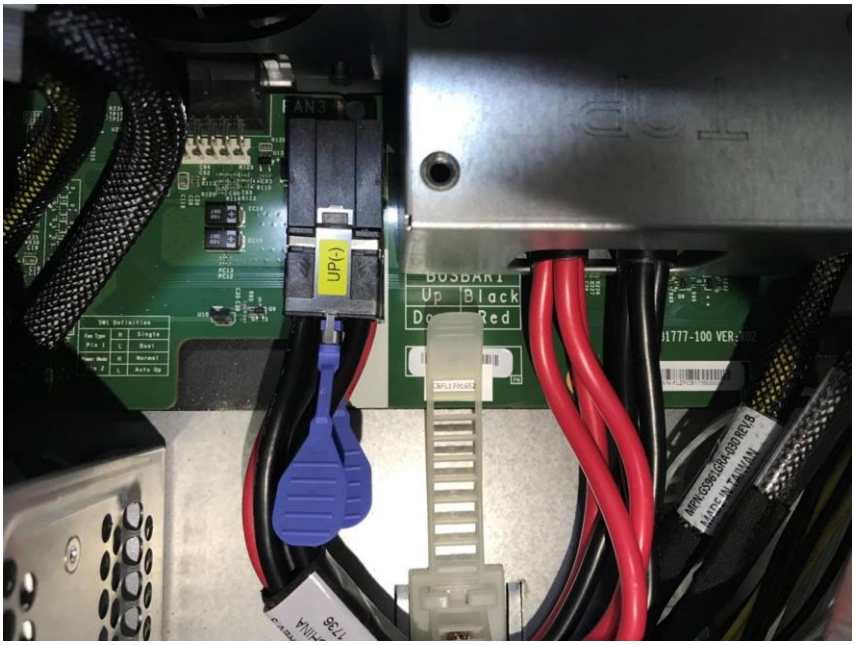
The CT0245J has a standard OCP power connector at the back of the chassis.

CAUTION: You MUST check the power cables inside the CT0245J chassis for proper polarity connections before installing the chassis in a rack. Failure to do this may result in major damage to the chassis.

Follow these steps to check the polarity of the power cables:

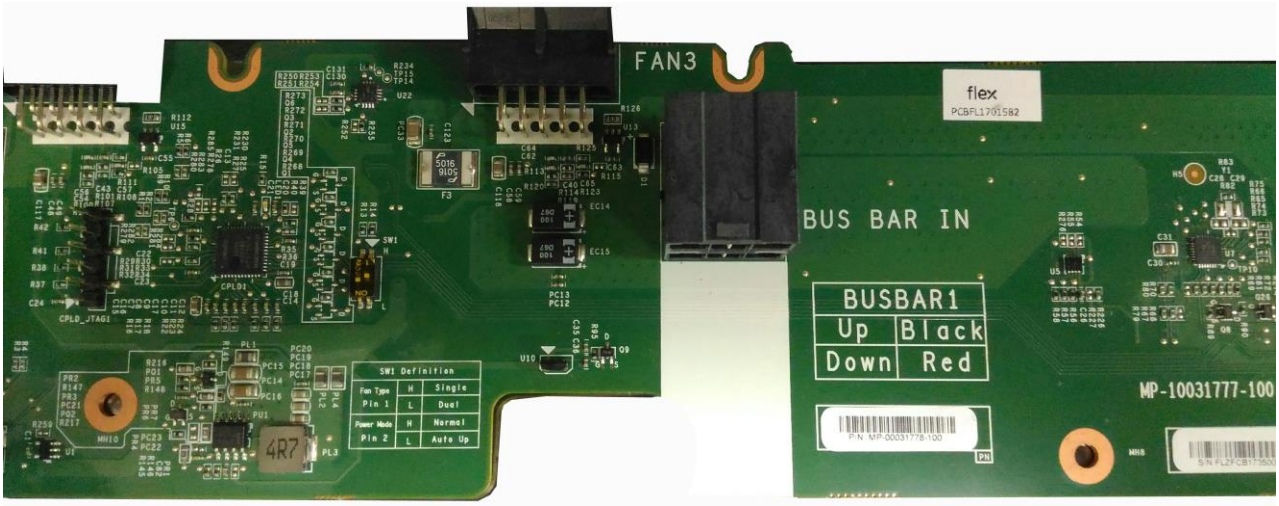
1. Remove the rear cover (see “CPLD Programming” on page 41).
2. Locate the power cables at the back of the chassis (see **Figure 34**).

Figure 34 – Mini SAS Port Connectors and LEDs



3. Ensure that the connector for the black power cable is connected to the top connector and the red power cable is connected to the bottom power connector (see silkscreen markings on Figure 35). If this is not the case, use the blue pull tabs to release the cables and reconnect the cables in the proper locations.

Figure 35 – Silkscreen Marking for Cable Colors



4. Check the polarity markings on the rear of the chassis to make sure the chassis will mate correctly to the rear bus bar in the rack (see Figure 36).

Figure 36 – Chassis Polarity Marking



CAUTION: Double check the power cable connections at the rear of the chassis per Figure 26 before installing the chassis in the rack. Failure to do this may result in major damage to the chassis.

18.2 I/O

There is one 12G LSI SAS35x24R drive expander per drive sled and there are two external mini SAS HD I/O connectors per sled for connecting to the host.

18.3 Midplanes

Drive mid-planes in each drive sled connect to a dedicated expander module for the sled.

18.4 Overview of Footprint and Population Options

Some customers may choose to receive a system without purchasing the full complement of 45 drives. If this is the case, any drives in the chassis will have been populated in increments of 15, installed in first sled, then the second sled, and then the third sled.

If additional drives are ordered, they must be installed in increments of 15.

This method of drive population has thermal and operational implications. Drives should not be installed in any other manner.

18.5 Rear Side Connectors

There are no rear side connectors except for the power connector.

19 ORv2

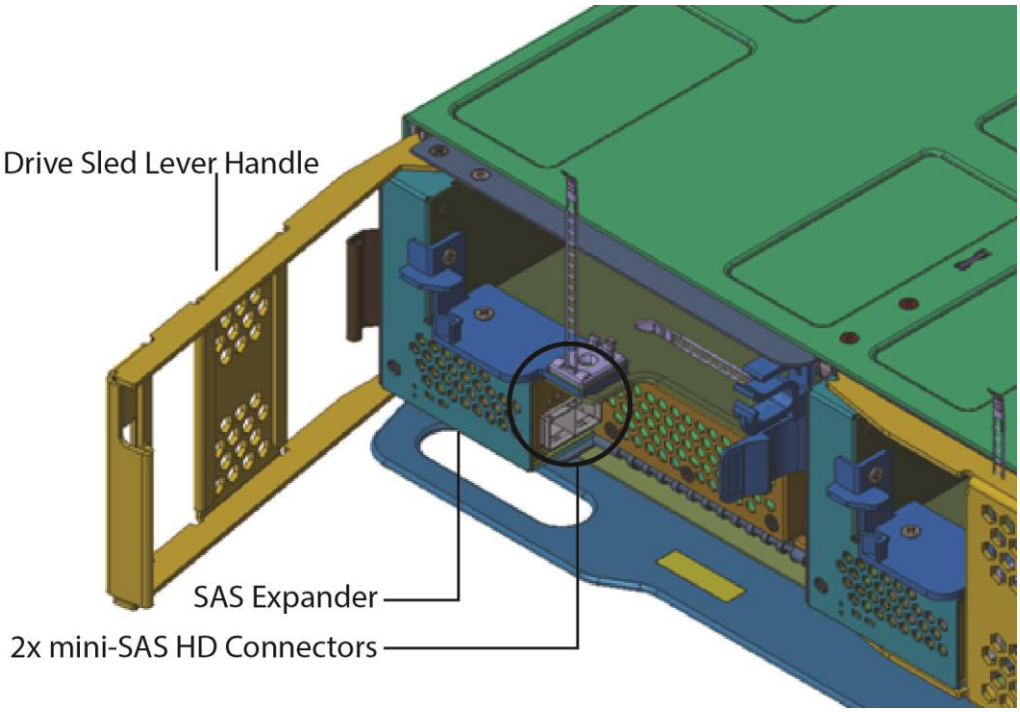
The CT0245J is compatible with Orv2 racks supporting a single power supply connector for the single-rack center bus bar.

20 Mechanical

20.1 Drive Sled Front Connectors

Each sled contains two mini-SAS HD connectors, as shown in Figure 37. They are part of the SAS Expander Module and are accessible when you open the drive sled lever handle.

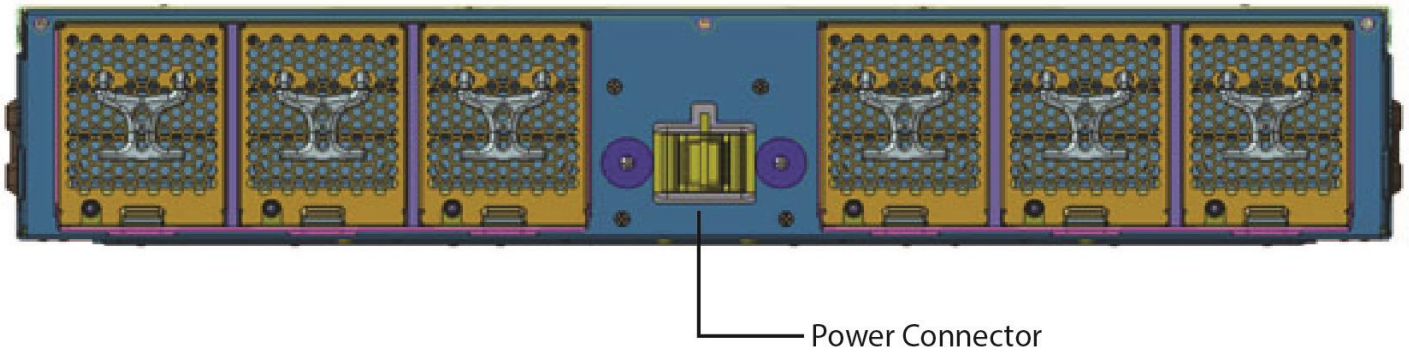
Figure 37 – Sled SAS HD Connectors (front of sled)



20.2 Chassis Rear Connector

The CT0245J chassis contains a single main power connector at the rear of the chassis, shown in Figure 38 .

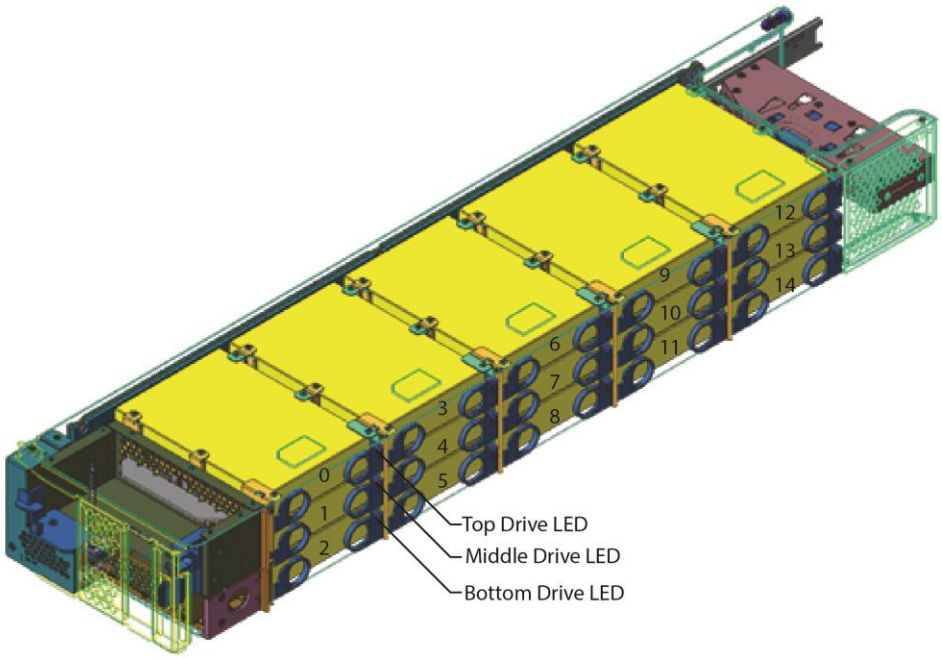
Figure 38 – Power Connector (rear of chassis)



20.3 Drive Sled LEDs

Each sled contains up to 15 drives and there is one LED per drive. The LEDs are visible when the drive sled is fully extended. Figure 39 shows the locations of the first three drive LEDs. The leftmost top drive is HDD 0, the leftmost middle drive is HDD 1, and the leftmost bottom drive is HDD2. The rightmost top drive is HDD 12, the rightmost middle drive is HDD 13, and the rightmost bottom drive is HDD 14.

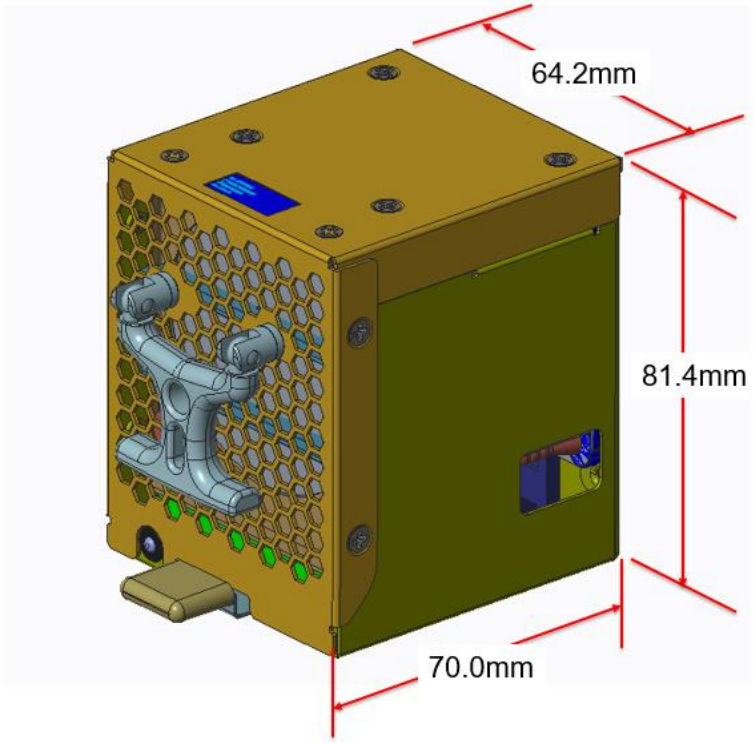
Figure 39 – Sled Drive LEDs (sled extended)



20.4 Fan Assembly

The image below shows the fan module assembly. The fan itself has dimensions of 60 mm x 60 mm x 38 mm.

Figure 40 – Fan Assembly



20.5 PCB Color

The PCB color is green.

21 Power System

There is a power distribution board that distributes +12 VDC from the rear power connector to the system.

21.1 Input Voltage

Input voltage is +12 VDC

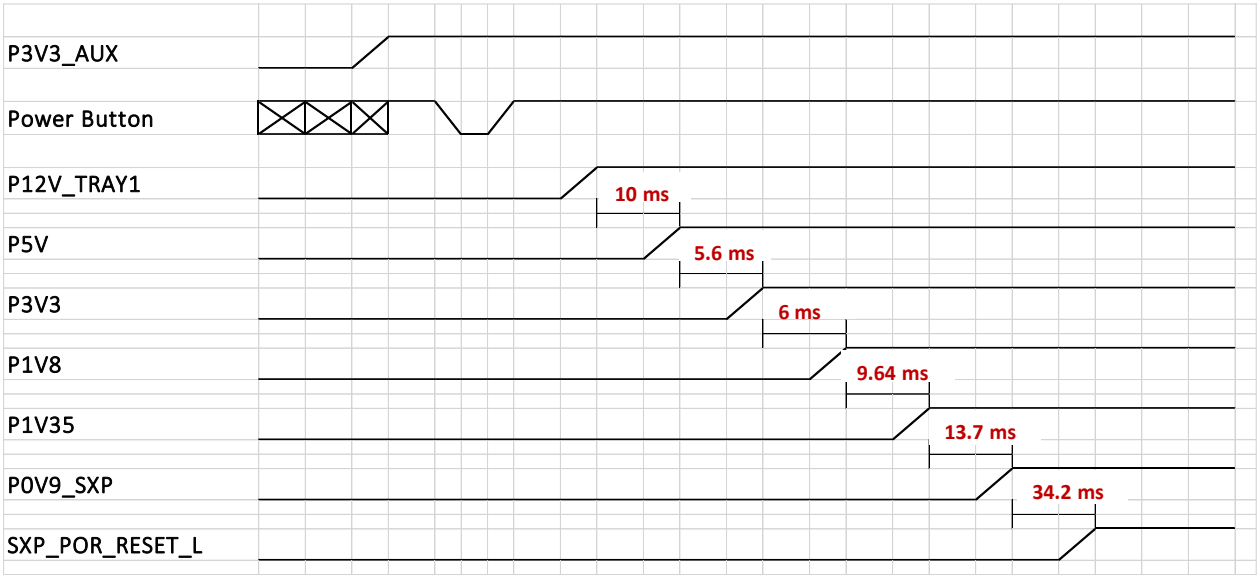
21.2 Hard Drive Power

The 15 drives in each drive sled receive +12 VDC and +5 VDC from the Drive Plane Board (DPB)

21.3 Power On

The power sequence for the CT0245J is shown in Figure 41.

Figure 41 – Power Sequence



22 Service Operations

22.1 Replacing a Drive

Follow these steps to replace a drive:

1. Extend the drive sled.
2. Remove the old drive:
    a. Squeeze the drive carrier latch toward the center to release it as shown in Figure 42.

Figure 42 – Release the Drive Carrier Latch

- 

    b. Pull out the drive as shown in Figure 43

Figure 43 – Pull Out the Drive

- 

3. If necessary, mount the new drive on a drive carrier.
4. Insert the new drive into the drive sled until it securely mates with the drive backplane connector and the latch secures it in place.

5. Push the drive sled back into the chassis.

22.2 Replacing a SAS Expander

NOTE: The SAS Expander does not support hot-swap, so be sure to power off the drive sled before replacing the SAS Expander module.

Follow these steps to replace a SAS Expander:

1. Push the drive sled latch button to open the lever handle as shown in Figure 44.

Figure 44 – Push Drive Sled Latch Button



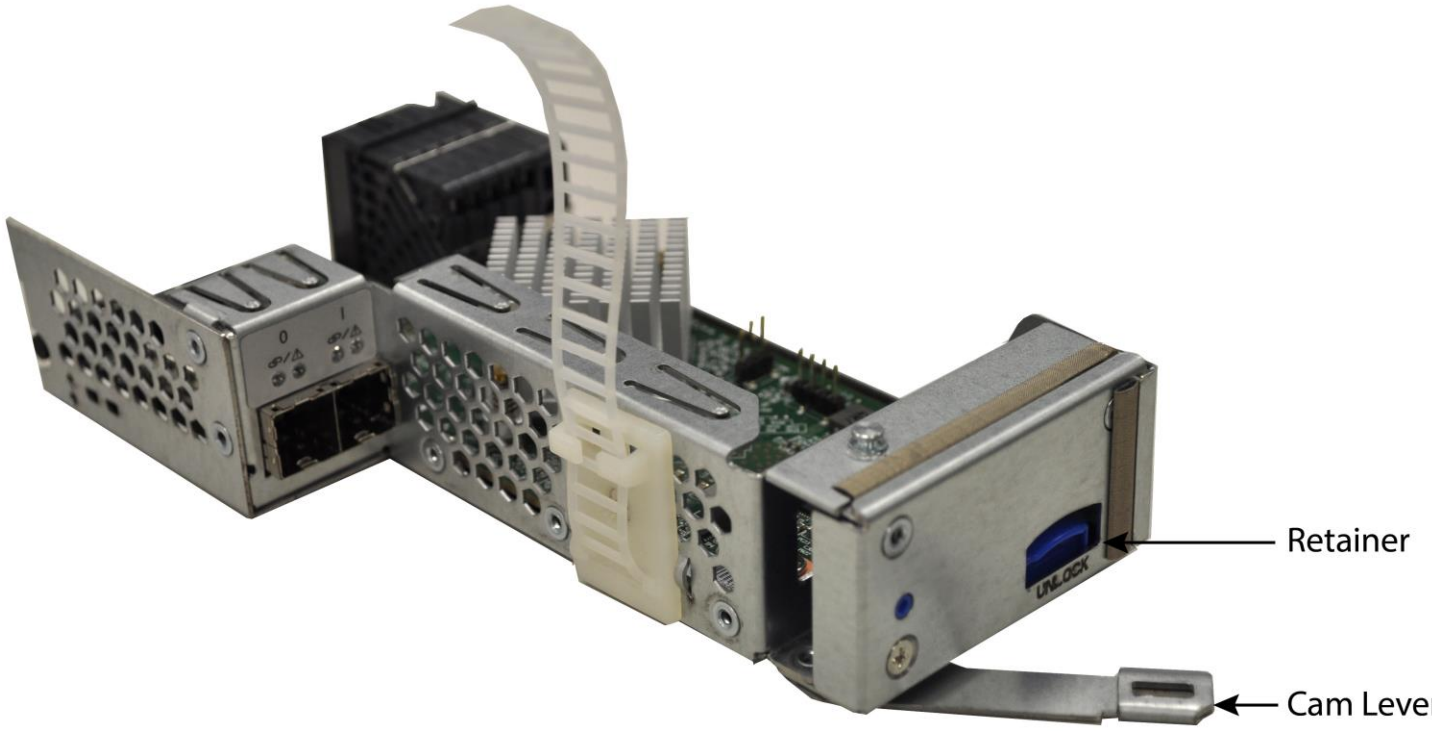
2. Rotate the lever handle fully as shown in Figure 45.

Figure 45 – Rotate Lever Handle



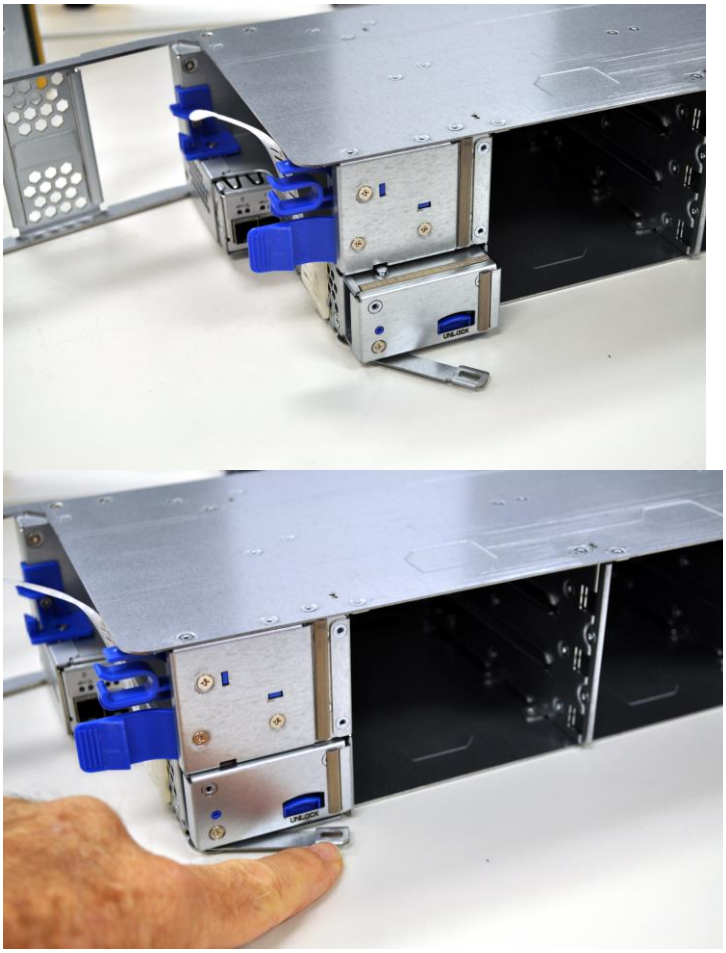
3. Lift up the plastic retainer to unlock the cam lever and rotate the cam lever to release the SAS Expander from the HDD backplane as shown in Figure 46.

Figure 46 – Remove SAS Expander



4. Repeat the steps in reverse to install the replacement SAS Expander as shown in Figure 47.

Figure 47 – Replace SAS Expander



22.3 Replacing a Fan

To replace a fan, follow these steps:

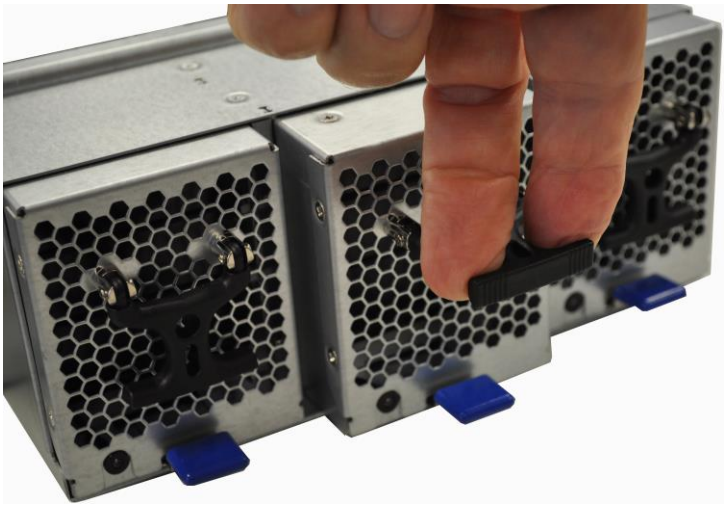
1. Lift up the fan latch as shown in Figure 48Figure 51.

Figure 48 – Lift Fan Latch



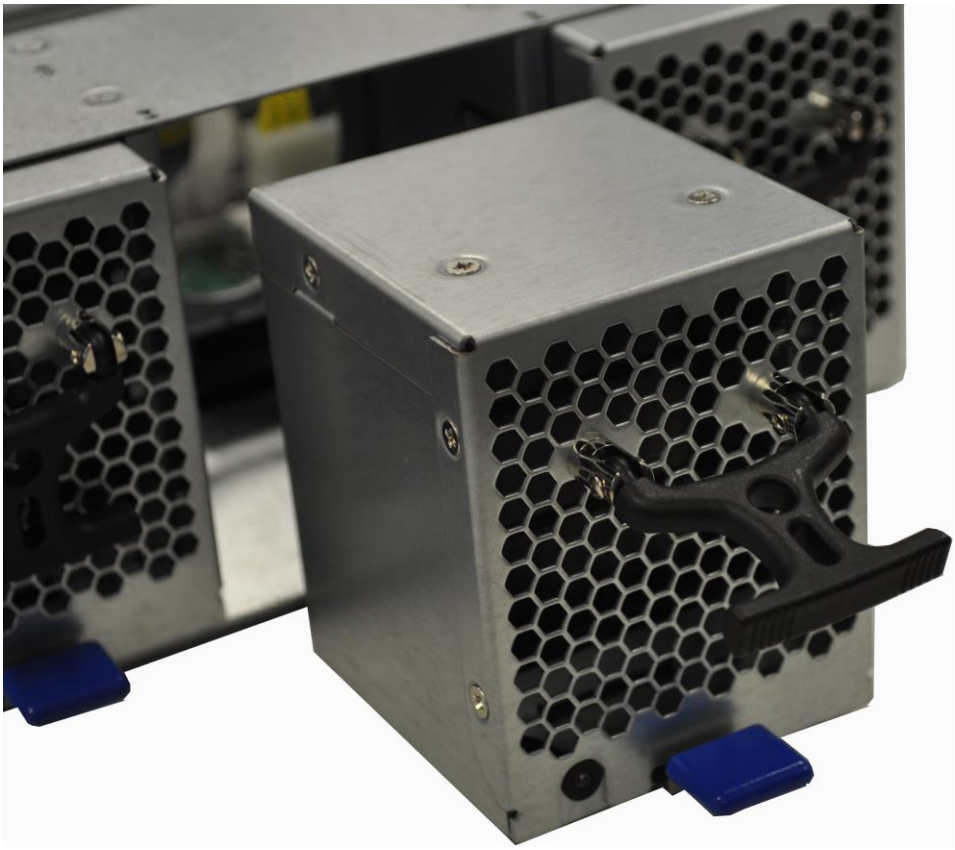
2. While lifting the fan latch, pull on the fan handle as shown in
3. Figure 49.

Figure 49 – Pull Fan Handle



4. Remove the fan completely as shown in Figure 50.

Figure 50 – Remove Fan



5. Insert the new fan until it is securely seated and the latch clicks, securing the fan in place.

23 Environmental Requirements

The CT0245J supports a temperature range of 0 to 40° C and complies with ETSI EN300 019-1-3 Class 3.1 thermal and humidity climatogram and seismic conditions.

A fully equipped CT0245J JBOD has an allowed ambient temperature of at least 400° C.

23.1 Vibration & Shock

The CT0245J meets the shock and vibration requirements according to the following IEC specifications: IEC78-2-(*) & IEC721-3-(*) Standard & Levels.

23.2 Regulations

The CT0245J meets the fire spread criteria specified in GR-63-CORE chapter 4.2.2.2 Shelf-Level Fire-Resistance Criteria.

The CT0245J meets EMC compliance EN300386, V1.6.1 requirements as specified for the telecommunication centers installation environment.

The CT0245J meets Safety Compliance EN60950-1: 2006 + A2:2013 and IEC 60950-1 including national deviations of Australia, Denmark, Germany, Great Britain (BSI), Finland, Japan, Sweden, Norway, USA and Canada.

The CT0245J is compliant to CFR 47, FCC 15, class A emission criteria.

The CT0245J is compliant to CISPR 22 Class A and CISPR 24.

The CT0245J is compliant to TEC/EMI/TEL-001/01/FEB-09 and TEC/IR/SWN-2MB/07/MAR-10

24 Labels and Markings

24.1 PCBA Labels and Markings

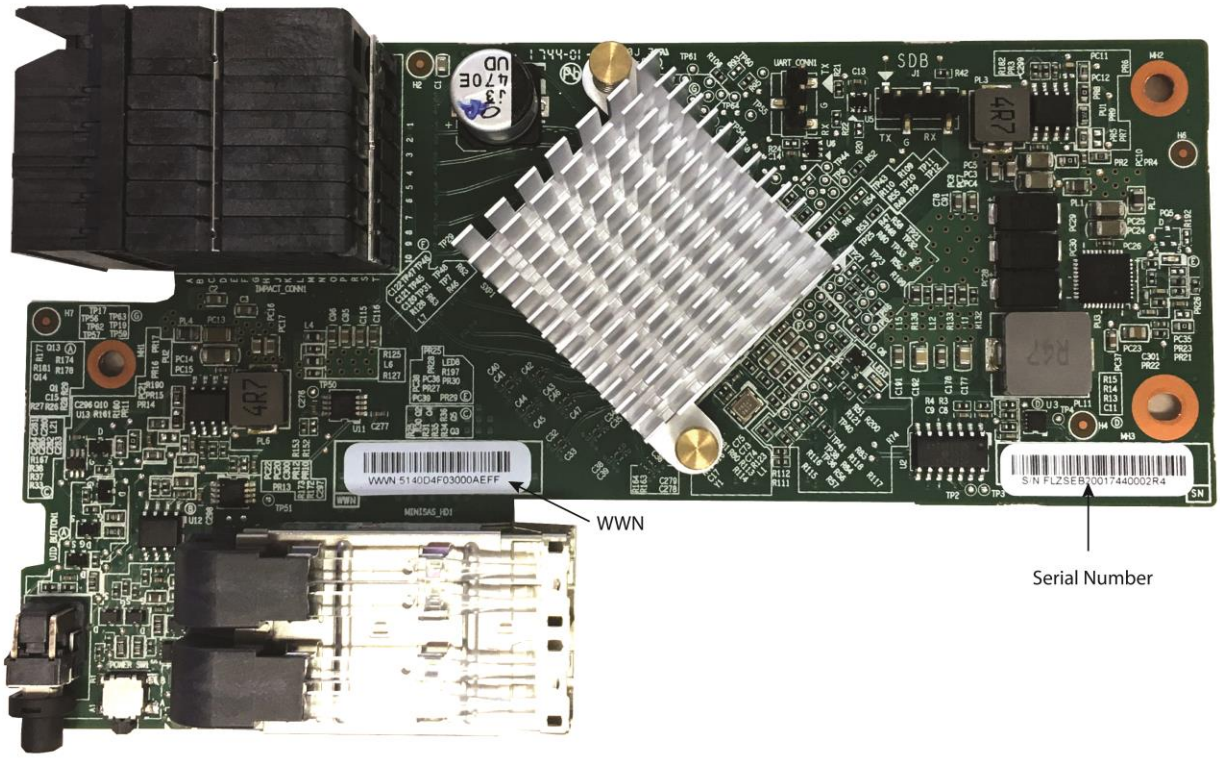
All PCBAs include the following labels, summarized in Table 35. The labels are not placed in such a way that disrupts the functionality or airflow to the system.

Table 35 – Labels and Markings

Description	Type	Barcode Required?
Vendor P/N, S/N, REV (revision would increment for any approved changes)	Adhesive label	Yes
PCB vendor logo, name	Silkscreen	No
Date code (industry standard: WEEK/YEAR)	Adhesive label	Yes
RoHS compliance	Silkscreen	No

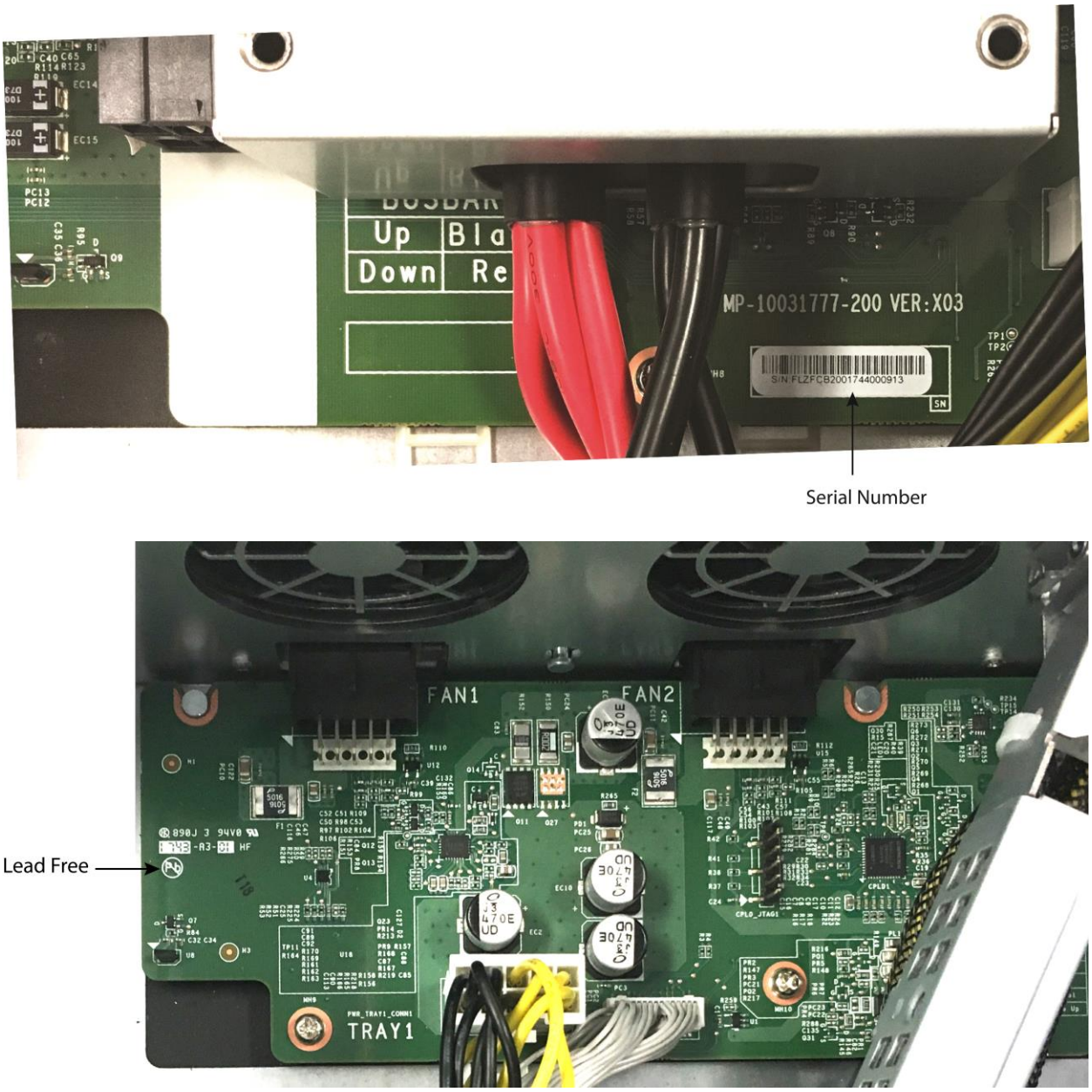
The Expander board has two labels, one showing the WWN number and the other showing the serial number (see Figure 51).

Figure 51 – Expander Board Labels



The Fan and Power board has the labels shown in Figure 52, one showing the serial number and the other showing the lead-free marking.

Figure 52 – Fan and Power Board Labels



24.2 Chassis Labels and Markings

The chassis carries the following adhesive barcoded labels in locations that can easily be scanned during integration:

- Vendor P/N, S/N, REV (revision would increment for any approved changes)
- Date code (industry standard: WEEK/YEAR)
- The assembly is marked “THIS SIDE UP,” TOP SIDE UP,” or other approved markings in bright, large characters in a color to be defined by the customer. This printing is on the PCB itself, or on an installed component such as an air baffle. The label is clear and easy to read in low light conditions, when viewed from above or below from two feet away, and at an angle of approximately 60 degrees off horizontal.

The exact label location will be agreed upon between the vendor and the customer.

The chassis has two labels on top. One label has all the safety logos, such as CE, WEEE, and so on. The other label is a power warning label (see Figure 53).

Figure 53 – Chassis Labels



25 Prescribed Materials

All materials, components, and interconnect wire and cable used within the CT0245J equipment assemblies meet the requirements of ANSI T1.307-2007 and the requirements specified in GR-63-CORE chapter 4.2.3.

25.1 Disallowed Components

The CT0245J components fulfill the EU RoHS directive 2011/65/EU Article 7b (EN 50581 (2012)).

26 Reliability and Quality

26.1 Warranty

Flex provides a 3-year warranty on the manufacturing and labor of the product. Advanced replacement of the product under warranty is offered to keep the customer's operation ongoing while the failure is investigated and resolved.

26.2 MTBF Requirements

The product has a minimum calculated MTBF of 200K hours at 90% confidence level up to 400° C without HDDs and a calculated MTBF of 36K hours at 90% confidence up to 400° C with HDDs populated.

The JBOD has a minimum Service Life of 5 years (24 hours per day, full load, at 400° C ambient temperature).

APPENDIX

This section acknowledges the following people, who contributed to this specification.

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