



Exos AP 5U84

GEM 5 SES-3 Addenda

205135500-00-A
March 2023

© 2023 Seagate Technology LLC. All rights reserved.

Seagate, Seagate Technology, and the Spiral logo are registered trademarks of Seagate Technology LLC in the United States and/or other countries. Exos is either a trademark or registered trademark of Seagate Technology LLC or one of its affiliated companies in the United States and/or other countries. All other trademarks or registered trademarks are the property of their respective owners. When referring to drive capacity, one gigabyte, or GB, equals one billion bytes and one terabyte, or TB, equals one trillion bytes. Your computer's operating system may use a different standard of measurement and report a lower capacity. In addition, some of the listed capacity is used for formatting and other functions, and thus will not be available for data storage. Actual data rates may vary depending on operating environment and other factors, such as chosen interface and disk capacity. Seagate reserves the right to change, without notice, product offerings or specifications.

Revision History

Revision	Date	Change Description
00-A	2023-03-30	Initial release

Table of Contents

1	Introduction.....	5
1.1	Scope	5
1.2	Terms and Abbreviations	5
1.3	Notation Conventions	6
1.4	References	6
2	Supported ANSI SES-3 Pages and Elements.....	7
3	Element to Device Mapping	8
3.1	Enclosure FRU Layout	8
3.1.1	Enclosure Front View	8
3.1.2	Enclosure Top View	8
3.1.3	Enclosure Rear View.....	9
3.2	SES Element Mapping	10
3.3	GEMNet Addresses.....	12
4	Diagnostic Page Layouts	13
4.1	Diagnostic Page 00h	13
4.2	SES Page 01h.....	13
4.3	SES Page 02h and Page 05h Layout	16
4.3.1	SES Page 05h Threshold Support.....	18
4.4	SES Page 07h Layout.....	19
4.4.1	Page 07h Descriptor Strings	21
4.5	SES Page 0Ah Layout.....	22
4.5.1	SES Page 0Ah Layout for SBB IOM A.....	22
4.5.2	SES Page 0Ah Layout for SBB IOM B.....	28
4.6	Vendor Unique Page 91h Layout	34
4.7	Vendor Unique Page 92h Layout	39
5	Zone Modes.....	41
5.1	Zone Mode Configurations	41
5.2	Zone Configuration Layouts	42
5.2.1	Zone mode 1 - HA Performance Mode	42
5.2.2	Zone mode 2 - HA Expansion Mode.....	43
5.2.3	Zone Mode 3 - HA Hybrid	44
5.2.4	Zone Mode 4 - HA Single Core Mode.....	45
5.2.5	Zone Mode 5 - SCSN Performance Mode.....	46
5.2.6	Zone Mode 6 - SCSN expansion	47
Appendix A	Detailed Zone Configuration.....	49
A-1	Zone mode 1 configuration	49
A-1.1	Zone mode 1 IOM phy settings.....	49
A-1.2	Zone mode 1 sideplane phy settings	50
A-1.3	Zone mode 1 permissions table	52
A-2	Zone mode 2 configuration	53
A-2.1	Zone mode 2 IOM phy settings.....	53
A-2.2	Zone mode 2 sideplane phy settings	54
A-2.3	Zone mode 2 permissions table.....	56
A-3	Zone mode 3 configuration	57
A-3.1	Zone mode 3 IOM phy settings.....	57
A-3.2	Zone mode 3 sideplane phy settings	58
A-3.3	Zone mode 3 permissions table	60
A-4	Zone mode 4 configuration	61
A-4.1	Zone mode 4 IOM phy settings.....	61
A-4.2	Zone mode 4 sideplane phy settings	62
A-4.3	Zone mode 4 permissions table	64
A-5	Zone mode 5 configuration	65
A-5.1	Zone mode 5 IOM phy settings.....	65
A-5.2	Zone mode 5 sideplane phy settings	66
A-5.3	Zone mode 5 permissions table.....	68
A-6	Zone mode 6 configuration	69
A-6.1	Zone mode 6 IOM phy settings.....	69

A-6.2 Zone mode 6 sideplane phy settings 70
A-6.3 Zone mode 6 permissions table 72

1 Introduction

1.1 Scope

This document is provided as an extension to the GEM 5 SES-3 Specification to detail exact SES page layouts and specification deviations implemented by the Exos AP 5U84 12G SAS storage server product. It is a guide to inform both customers and product testers of the intended SES page structure a product variant provides.

This document is not intended to cover all specifics of SES implementation for the Seagate storage enclosure platform. For details on element/descriptor formats and behavior, the GEM 5 SES-3 Specification [3] and ANSI T-10 SES Specification [1] should be referenced.

This document applies to the following enclosure product IDs.

- SP-3584-AP-BV-1

1.2 Terms and Abbreviations

ANSI	American National Standards Institute
CDB	Command Descriptor Block
CLI	Command Line Interface
EEPROM	Electrically Erasable Programmable Read-Only Memory
EIIOE	Element Index Includes Overall Element
EIP	Element Index Present
EM	Enclosure Management
ESI	Enclosure Services Interface Processor
ESP	Enclosure Services Process
FRU	Field Replaceable Unit
GEM	Generic Enclosure Management
IOC	I/O Controller
IOM	I/O Module
LED	Light-Emitting Diode
LSB	Least Significant Bit
MSB	Most Significant Bit
NAA	Network Address Authority
PCM	Power Cooling Module
PSU	Power Supply Unit
RQST	Request
RSVD	Reserved
SAS	Serial Attached SCSI
SBB	Storage Bridge Bay
SBBMI	SBB Midplane Interconnect
SCSI	Small Computer System Interface
SCSN	Single Controller Shared Nothing
SEP	Storage Enclosure Processor
SES	SCSI Enclosure Services
SGPIO	Serial General Purpose I/O
TWI	Two Wire Interface
VPD	Vital Product Data
ZG	Zone Group
ZPSDS	Zoned Portion of the Service Delivery Subsystem
ZPT	Zone Permissions Table

Application client	An object that is the source of SCSI commands.
Attached ESP	An ESP that is attached to another device server.
Critical condition	An enclosure condition established when one or more elements inside the enclosure have failed or are operating outside of their specification. The failure of the element makes continued normal operation of at least some elements in the enclosure impossible. Some elements within the enclosure may be able to continue normal operation.
Information condition	An enclosure condition that should be made known to the application client. The condition is not an error and does not reduce the capabilities of the devices in the enclosure.
Non-critical condition	An enclosure condition established when one or more elements inside the enclosure have failed or are operating outside of their specifications. The failure of the elements does not affect continued normal operation of the enclosure. All SCSI devices in the enclosure continue to operate according to their specifications. The ability of the devices to operate correctly if additional failures occur may be reduced by a noncritical condition.
Standalone ESP	An ESP that is also the device server.
Subenclosure	An enclosure accessed through a primary subenclosure's ESP.
Unrecoverable condition	An enclosure condition established when one or more elements inside the enclosure have failed and have disabled some functions of the enclosure. The enclosure may be incapable of recovering or bypassing the failure and requires repairs to correct the condition.

1.3 Notation Conventions

<value>h	Indicates a hexadecimal number, e.g., <i>23h</i>
<value>	A value without leading zeroes and no suffix indicates a decimal number, e.g., <i>34</i> .
[option0, option1]	Indicates possible options for this field.
[valueX..valueY]	Indicates options range from valueX to valueY.
[defaultX: valueX..valueY]	Indicates the default value "defaultX", with possible alternatives.
[XX]	Indicates variable values.

1.4 References

- [1] T10 SES-3r10
- [2] SCSI Primary Commands - 4 (SPC-4) Revision 36n
- [3] GEM 5 ANSI SES-3 Specification
- [4] GEM Command Line Interface Specification
- [5] SAS Protocol Layer - 3 (SPL-3) Revision 7

2 Supported ANSI SES-3 Pages and Elements

Table 1 lists the ANSI SES pages and Vendor Unique SES pages supported by the enclosure. Table 2 lists the ANSI and Vendor Specific SES elements supported by the enclosure.

Table 1 - Supported SES Pages

Page Code	Description	Control/Status
ANSI SES Pages		
00h	Supported Diagnostics Pages Diagnostic Page	Status
01h	Configuration Diagnostic Page	Status
02h	Enclosure Diagnostic Page	Control and Status
05h	Threshold Out Diagnostic Page	Control and Status
07h	Element Descriptor Diagnostic Page	Status
0Ah	Additional Element Status Diagnostic Page	Status
0Eh	Download Microcode Control Diagnostic Page	Control and Status
Vendor Specific Pages		
84h/85h	In-band CLI Control Page	Control and Status
90h	Customer VPD Control Page	Control and Status
91h	Statistics Page	Status
92h	Extended Status Page	Status

Table 2 - Supported SES Elements

Element Code	Description	Element count
ANSI SES Elements		
17h	Array Device	84
04h	Temperature Sensor	18
07h	Enclosure Services Controller Electronics	2
0Eh	Enclosure	1
18h	SAS Expander	10
19h	SAS Connector	20
Vendor Specific SES Elements		
86h	SBB Midplane Interconnect	2
89h	Enclosure Electronics Power	2
8Bh	Enclosure Electronics Diagnostics	2
90h	Sideplane	4

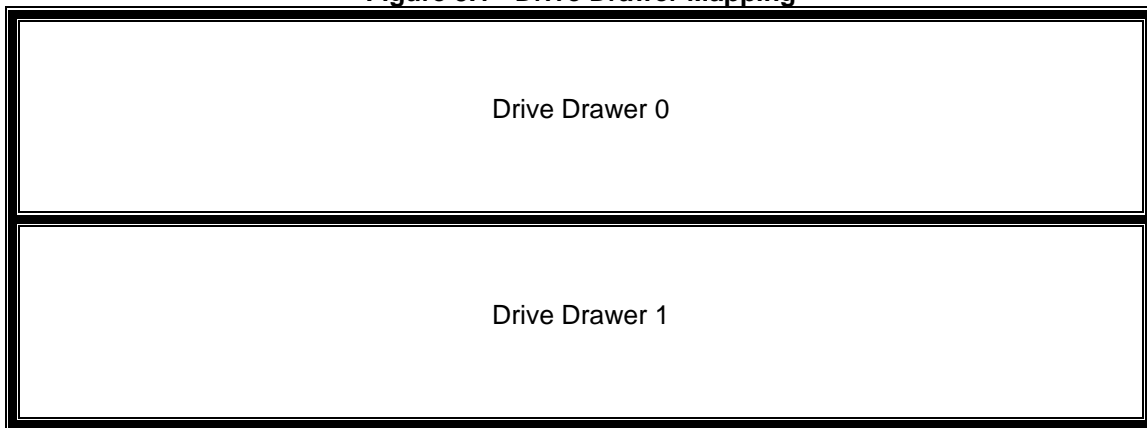
3 Element to Device Mapping

3.1 Enclosure FRU Layout

The layout of the enclosure with respect to physical FRU location is as follows.

3.1.1 Enclosure Front View

Figure 3.1 - Drive Drawer Mapping



3.1.2 Enclosure Top View

Figure 3.2 - Drive Bay numbering convention for drawer 0 (top drawer)

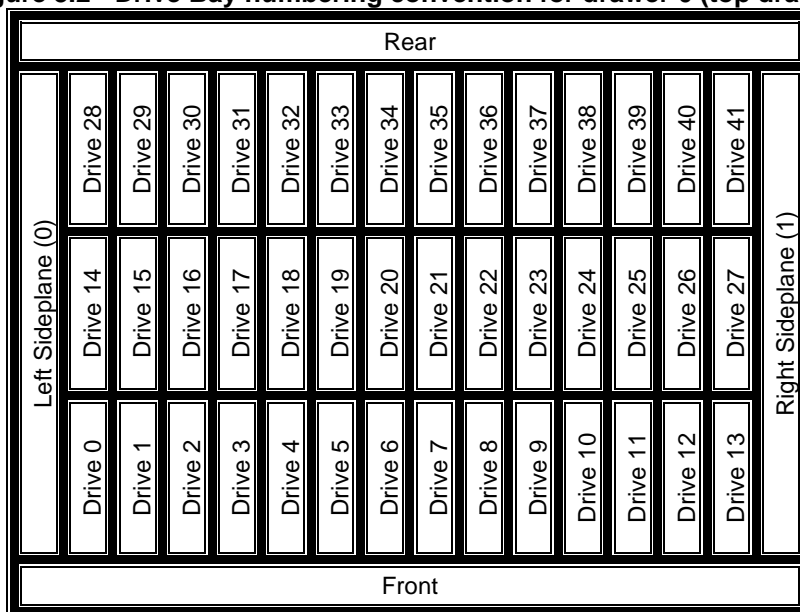
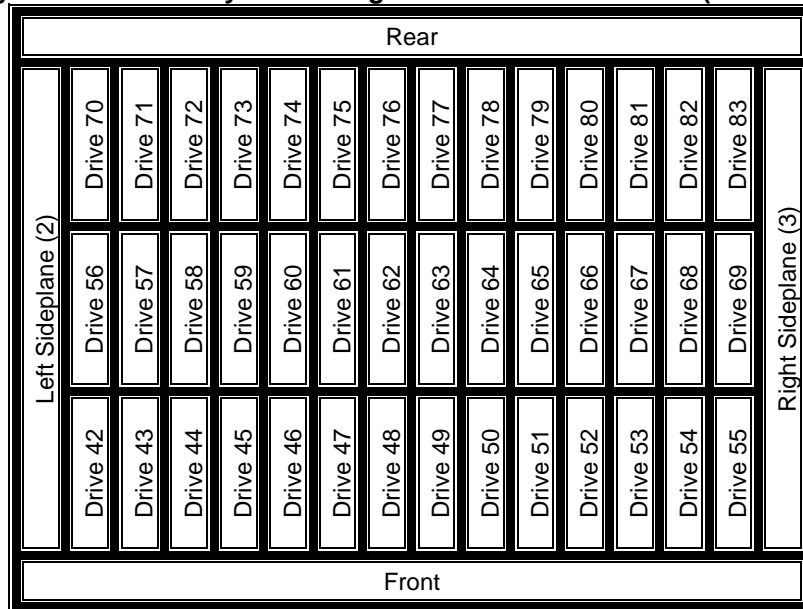
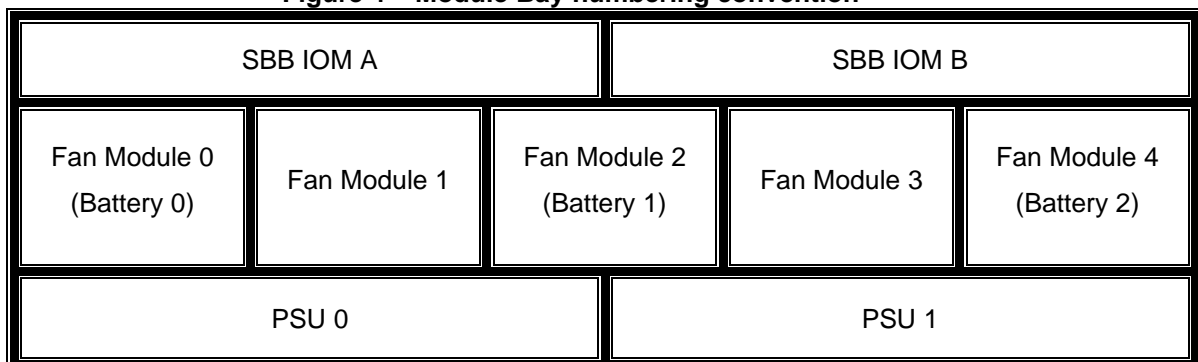


Figure 3.3 - Drive Bay numbering convention for drawer 1 (bottom drawer)



3.1.3 Enclosure Rear View

Figure 4 – Module Bay numbering convention



3.2 SES Element Mapping

For SES Pages 02h, 05h, 07h and 92h the element to physical device mapping is shown in Table 3.

Table 3 - SES Element Descriptions

Global Element Index	Relative Element Index	Description	Associated FRU
Array Device Elements			
0	0	Array Device element representing Disk Drive Bay 0	Drawer 0
...
41	41	Array Device element representing Disk Drive Bay 41	Drawer 0
42	42	Array Device element representing Disk Drive Bay 42	Drawer 1
...
83	83	Array Device element representing Disk Drive Bay 83	Drawer 1
Temperature Sensor Elements			
84	0	Ambient Temperature Sensor 0	Sideplane 0
85	1	Ambient Temperature Sensor 2	Sideplane 2
86	2	Front-Right Baseplane Temperature Sensor	Drawer 0
87	3	Front-Right Baseplane Temperature Sensor	Drawer 1
88	4	Middle-Left Baseplane Temperature Sensor	Drawer 0
89	5	Middle -Left Baseplane Temperature Sensor	Drawer 1
90	6	Rear-Left Baseplane Temperature Sensor	Drawer 0
91	7	Rear-Left Baseplane Temperature Sensor	Drawer 1
92	8	Rear-Right Baseplane Temperature Sensor	Drawer 0
93	9	Rear-Right Baseplane Temperature Sensor	Drawer 1
94	10	24-port Expander Temperature Sensor	Sideplane 1
95	11	24-port Expander Temperature Sensor	Sideplane 3
96	12	24-port Expander Temperature Sensor	Sideplane 0
97	13	24-port Expander Temperature Sensor	Sideplane 2
98	14	36-port Expander Temperature Sensor	Sideplane 0
99	15	36-port Expander Temperature Sensor	Sideplane 2
100	16	36-port Expander Temperature Sensor	Sideplane 1
101	17	36-port Expander Temperature Sensor	Sideplane 3
Enclosure Services Controller Electronics Elements			
102	0	Element associated with SEP device	SBB IOM A
103	1	Element associated with SEP device	SBB IOM B
Enclosure Elements			
104	0	Element representing the Enclosure	Enclosure
SAS Expander Elements			
105	0	36-port SAS Expander	Sideplane 0
106	1	24-port SAS Expander	Sideplane 0
107	2	36-port SAS Expander	Sideplane 1
108	3	24-port SAS Expander	Sideplane 1

Global Element Index	Relative Element Index	Description	Associated FRU
109	4	36-port SAS Expander	Sideplane 2
110	5	24-port SAS Expander	Sideplane 2
111	6	36-port SAS Expander	Sideplane 3
112	7	24-port SAS Expander	Sideplane 3
113	8	SBB IOM SAS Expander	SBB IOM A
114	9	SBB IOM SAS Expander	SBB IOM B
SAS Connector Elements			
115	0	SAS Connector for IOM MiniSAS HD Port A	SBB IOM A
116	1	SAS Connector for IOM MiniSAS HD Port B	SBB IOM A
117	2	Internal IOC Port A	SBB IOM A
118	3	Internal IOC Port B	SBB IOM A
119	4	SAS Connector for IOM MiniSAS HD Port A	SBB IOM B
120	5	SAS Connector for IOM MiniSAS HD Port B	SBB IOM B
121	6	Internal IOC Port A	SBB IOM B
122	7	Internal IOC Port B	SBB IOM B
123	8	SBB IOM A to Sideplane 1 36-port Expander SAS Connector A	SBB IOM A
124	9	SBB IOM A to Sideplane 1 36-port Expander SAS Connector B	SBB IOM A
125	10	SBB IOM A to Sideplane 1 24-port Expander SAS Connector A	SBB IOM A
126	11	SBB IOM A to Sideplane 3 24-port Expander SAS Connector A	SBB IOM A
127	12	SBB IOM A to Sideplane 3 36-port Expander SAS Connector A	SBB IOM A
128	13	SBB IOM A to Sideplane 3 36-port Expander SAS Connector B	SBB IOM A
129	14	SBB IOM B to Sideplane 0 24-port Expander SAS Connector A	SBB IOM B
130	15	SBB IOM B to Sideplane 0 36-port Expander SAS Connector B	SBB IOM B
131	16	SBB IOM B to Sideplane 0 36-port Expander SAS Connector A	SBB IOM B
132	17	SBB IOM B to Sideplane 2 36-port Expander SAS Connector A	SBB IOM B
133	18	SBB IOM B to Sideplane 2 36-port Expander SAS Connector B	SBB IOM B
134	19	SBB IOM B to Sideplane 2 24-port Expander SAS Connector A	SBB IOM B
SBB Midplane Interconnect Elements			
135	0	SBB IOM to Midplane Interconnect Electronics	SBB IOM A
136	1	SBB IOM to Midplane Interconnect Electronics	SBB IOM B
Enclosure Electronics Power Elements			
137	0	SBB IOM Power Status and Control	SBB IOM A
138	1	SBB IOM Power Status and Control	SBB IOM B
Enclosure Electronics Diagnostics Elements			
139	0	SEP Diagnostics status and Control	SBB IOM A
140	1	SEP Diagnostics status and Control	SBB IOM B

3.3 GEMNet Addresses

The *gncli* command is used to issue GEM CLI commands to the Sideplane expanders (see [4] for details). To target a specific expander, this command uses either SES expander IDs or GEMNet addresses. Table 4 shows the GEMNet address/Expander ID to use to target a specific Sideplane expander.

Table 4 - gncli Expander Addresses

Expander	GEMNet Address	Expander Address
Sideplane 0 24-port Expander	3,0,0	<i>exp:1</i>
Sideplane 0 36-port Expander	3,0,1	<i>exp:0</i>
Sideplane 1 24-port Expander	3,0,2	<i>exp:3</i>
Sideplane 1 36-port Expander	3,0,3	<i>exp:2</i>
Sideplane 2 24-port Expander	3,1,0	<i>exp:5</i>
Sideplane 2 36-port Expander	3,1,1	<i>exp:4</i>
Sideplane 3 24-port Expander	3,1,2	<i>exp:7</i>
Sideplane 3 36-port Expander	3,1,3	<i>exp:6</i>

4 Diagnostic Page Layouts

4.1 Diagnostic Page 00h

Diagnostics Page 00h lists all SES pages supported by the SEP. The page 00h response reported by the documented product is shown in Table 5.

Table 5 - Diagnostic Page 00h Layout

Bit Byte	7	6	5	4	3	2	1	0
0	PAGE CODE (00h)							
1	Reserved							
2	(MSB)	PAGE LENGTH (12)						(LSB)
3								
4	SUPPORTED PAGE LIST							
15	(00 01 02 05 07 0A 0E 84 85 90 91 92 h)							

4.2 SES Page 01h

SES Page 01h provides information on enclosure identification and element layout in SES pages 02h, 05h, 07h and 92h. Table 6 covers the layout of Page 01h for the enclosure documented within this addendum.

Table 6 - SES Page 01h Layout

Bit Byte	7	6	5	4	3	2	1	0
0	PAGE CODE (01h)							
1	NUMBER OF SECONDARY SUBENCLOSURES (00h)							
2	(MSB)	PAGE LENGTH (202)						(LSB)
3								
4	(MSB)	GENERATION CODE						(LSB)
7								
Enclosure Descriptor List ¹								
8	RSVD	RELATIVE ENCLOSURE SERVICES PROCESS ID (1h)			RSVD	NUMBER OF ENCLOSURE SERVICES PROCESSES (2h)		
9	SUBENCLOSURE IDENTIFIER (00h)							
10	NUMBER OF TYPE DESCRIPTOR HEADERS (0Ah)							
11	ENCLOSURE DESCRIPTOR LENGTH (3Ch)							
12	ENCLOSURE LOGICAL IDENTIFIER							
19	(Determined by Midplane VPD)							
20	ENCLOSURE VENDOR IDENTIFICATION ("SEAGATE ")							

Bit Byte	7	6	5	4	3	2	1	0
27								
28								
43								
44								
47								
48								
62								
63								
64								
66								
67								
70								
71								
Type Descriptor Header List ²								
72								
75								
76								
79								
80								
83								
84								
87								
88								
91								
92								
95								
96								
99								
100								
103								
104								
107								
108								
111								
Type Descriptor Text List ³								
111								
136								
137								
163								

Bit Byte	7	6	5	4	3	2	1	0
164	Enclosure Electronics Diagnostics Text Descriptor							
205	("Enclosure Electronics Diagnostics")							
¹ See sections 6.2.1 – 6.2.3 in [3] for further details ² See section 6.2.4 in [3] for further details on the element descriptor format ³ See section 6.2.5 in [3] for further details								

4.3 SES Page 02h and Page 05h Layout

SES Page 02h and SES Page 05h both conform to the same overall page layout, with 4-byte elements listed in the same order as defined by SES Page 01h. As such, both page structures are defined in Table 7.

Table 7 - SES Page 02h and SES Page 05h Layout

Bit Byte	7	6	5	4	3	2	1	0
0	PAGE CODE (02h/05h)							
1	SHORT STATUS ¹ (Page 02h) / Reserved (Page 05h)							
2	(MSB)	PAGE LENGTH (624)						(LSB)
3								
4	(MSB)	GENERATION CODE						(LSB)
7								
Status Descriptor List ² (Page 02h) / Threshold Descriptor List ³ (Page 05h)								
8	Array Device Overall Element Descriptor							
11								
12	Array Device Element 0 Descriptor							
15								
...								
344	Array Device Element 83 Descriptor							
347								
348	Temperature Sensor Overall Element Descriptor							
351								
352	Temperature Sensor Element 0 Descriptor							
355								
...								
420	Temperature Sensor Element 17 Descriptor							
423								
424	Enclosure Services Controller Electronics Overall Element Descriptor							
427								
428	Enclosure Services Controller Electronics Element 0 Descriptor							
431								
432	Enclosure Services Controller Electronics Element 1 Descriptor							
435								
436	Enclosure Overall Element Descriptor							
439								
440	Enclosure Element 0 Descriptor							
443								

Bit Byte	7	6	5	4	3	2	1	0
444	SAS Expander Overall Element Descriptor							
447								
448	SAS Expander Element 0 Descriptor							
451								
	...							
484	SAS Expander Element 9 Descriptor							
487								
488	SAS Connector Overall Element Descriptor							
491								
492	SAS Connector Element 0 Descriptor							
495								
	...							
568	SAS Connector Element 19 Descriptor							
571								
572	SBB Midplane Interconnect Overall Element Descriptor							
575								
576	SBB Midplane Interconnect Element 0 Descriptor							
579								
580	SBB Midplane Interconnect Element 1 Descriptor							
583								
584	Enclosure Electronics Power Overall Element Descriptor							
587								
588	Enclosure Electronics Power Element 0 Descriptor							
591								
592	Enclosure Electronics Power Element 1 Descriptor							
595								
596	Enclosure Electronics Diagnostics Overall Element Descriptor							
599								
600	Enclosure Electronics Diagnostics Element 0 Descriptor							
603								
604	Enclosure Electronics Diagnostics Element 1 Descriptor							
607								
608	Sideplane Overall Element Descriptor							
611								
612	Sideplane Element 0 Descriptor							
615								
	...							
624	Sideplane Element 3 Descriptor							

Bit Byte	7	6	5	4	3	2	1	0
627								
¹ See section 6.3.2.1 in [3] for details on the SHORT STATUS format ² See section 7 of [3] for status descriptor format details for each element type ³ See [3] for threshold descriptor format details								

4.3.1 SES Page 05h Threshold Support

Not all SES element types support SES Page 05h threshold status or control descriptors. Where an element does not support a threshold descriptor, it shall set its status descriptor to all zeros, i.e., [00 00 00 00 h]. Table 8 shows which element types are expected to support a threshold.

Table 8 - Threshold Descriptor Support

Element Type	Threshold Descriptor Support
Array Device	No
Temperature Sensor	Yes
Enclosure Services Controller Electronics	No
Enclosure	No
SAS Expander	No
SAS Connector	No
SBB Midplane Interconnect	No
Enclosure Electronics Power	No
Enclosure Electronics Diagnostics	No
Sideplane	No
All Overall Elements	No

4.4 SES Page 07h Layout

Table 9 shows the page 07h layout implemented by the documented product.

GEM uses SES Page 07h to report version and serialization information for each of the enclosure FRUs. It may also provide supplemental information with regards to physical element location within the enclosure. Not all elements provide a descriptor string. Where this is the case, 00h will be reported for the descriptor length.

Please note the example below provides a typical representation of the page output. To allow for variation in output, it is recommended that any client should fully parse the page content and not rely on fixed offsets. For example, the temperature sensor element descriptors will only be reported if the associated FRU is present. The descriptor headers will always be present and report a non-zero value if there is data available to read and parse.

Table 9 - SES Page 07h Layout

Bit Byte	7	6	5	4	3	2	1	0
0	PAGE CODE (07h)							
1	Reserved							
2	(MSB)	PAGE LENGTH (3602)						(LSB)
3								
4	(MSB)	GENERATION CODE						(LSB)
7								
Element Descriptor List								
8	Array Device Overall Element Descriptor							
11	(00 00 00 00 h)							
12	Array Device Element 0 Descriptor							
15	(00 00 00 00 h)							
...								
344	Array Device Element 83 Descriptor							
347	(00 00 00 00 h)							
348	Temperature Sensor Overall Element Descriptor							
351	(00 00 00 00 h)							
352	Temperature Sensor Element 0 Descriptor							
411	(00 00 00 38 h) 56 bytes of descriptor data ¹							
...								
1372	Temperature Sensor Element 17 Descriptor							
1431	(00 00 00 38 h) 56 bytes of descriptor data ¹							
1432	Enclosure Services Controller Electronics Overall Element Descriptor							
1435	(00 00 00 00 h)							
1436	Enclosure Services Controller Electronics Element 0 Descriptor							
1563	(00 00 00 7C h) 124 bytes of descriptor data ¹							
1564	Enclosure Services Controller Electronics Element 1 Descriptor							

Bit Byte	7	6	5	4	3	2	1	0
1691	(00 00 00 7C h) 124 bytes of descriptor data ¹							
1692	Enclosure Overall Element Descriptor							
1695	(00 00 00 00 h)							
1696	Enclosure Element 0 Descriptor							
1770	(00 00 00 47 h) 71 bytes of descriptor data ¹							
1771	SAS Expander Overall Element Descriptor							
1774	(00 00 00 00 h)							
1775	SAS Expander Element 0 Descriptor							
1910	(00 00 00 88 h) 136 bytes of descriptor data ¹							
	...							
2999	SAS Expander Element 9 Descriptor							
3134	(00 00 00 88 h) 136 bytes of descriptor data ¹							
3135	SAS Connector Overall Element Descriptor							
3138	(00 00 00 00 h)							
3139	SAS Connector Element 0 Descriptor							
3158	(00 00 00 14 h) 20 bytes of descriptor data ¹							
	...							
3518	SAS Connector Element 19 Descriptor							
3537	(00 00 00 14 h) 20 bytes of descriptor data ¹							
3538	SBB Midplane Interconnect Overall Element Descriptor							
3561	(00 00 00 00 h)							
3562	SBB Midplane Interconnect Element 0 Descriptor							
3565	(00 00 00 00 h)							
3566	SBB Midplane Interconnect Element 1 Descriptor							
3569	(00 00 00 00 h)							
3570	Enclosure Electronics Power Overall Element Descriptor							
3573	(00 00 00 00 h)							
3574	Enclosure Electronics Power Element 0 Descriptor							
3577	(00 00 00 00 h)							
3578	Enclosure Electronics Power Element 1 Descriptor							
3581	(00 00 00 00 h)							
3582	Enclosure Electronics Diagnostics Overall Element Descriptor							
3585	(00 00 00 00 h)							
3586	Enclosure Electronics Diagnostics Element 0 Descriptor							
3589	(00 00 00 00 h)							
3590	Enclosure Electronics Diagnostics Element 1 Descriptor							
3593	(00 00 00 00 h)							

Bit Byte	7	6	5	4	3	2	1	0
3594	Sideplane Overall Element Descriptor							
3597	(00 00 00 00 h)							
3598	Sideplane Element 0 Descriptor							
3601	(00 00 00 00 h)							
	...							
3602	Sideplane Element 3 Descriptor							
3605	(00 00 00 00 h)							

¹ See section 4.4.1 for descriptor string format, Descriptor length varies as per element value in run time

4.4.1 Page 07h Descriptor Strings

The descriptor string formats used by each element that supports them are shown in Table 10. Note that the string formats may be subject to change over time as new FRUs are supported by the enclosure or additional information becomes available. Refer to [3] for full details on descriptor string decoding.

Table 10 - FRU Descriptor string formats

Element Type	Descriptor String
Power Supply	TP=XX;SN=XXXXXXXXXXXXXXXXXX;F1=XXXX;F2=XXXX;F3=XXXX;VR=XX;VC=XXXXXXXXXX;PN=XXXXXXXXXX;
Cooling	TP=XX;SN=XXXXXXXXXXXXXXXXXX;CF=XX;CC=XXXXXXXXXX;PN=XXXXXXXXXX;
Temperature Sensor	NM=XX;LO=XXXXXXXXXXXXXXXXXX;
Enclosure Services Controller Electronics	TP=XX;SN=XXXXXXXXXXXXXXXXXX;F1=XXXX;BL=XXXX;VR=XX;VC=XXXXXXXXXX;CR=XX;FR=XX;FC=XXXXXXXXXX;PN=XXXXXXXXXX;FF1=XXXXXXXXXX;PC=XXXXXXXXXX;
Enclosure	SN=XXXXXXXXXXXXXXXXXX;VR=XX;VC=XXXXXXXXXX;CR=XX;PN=XXXXXXXXXX;CM=XX;TP=XX;
Voltage Sensor	NM=XX;LO=XXXXXXXXXXXXXXXXXX;
Current Sensor	NM=XX;LO=XXXXXXXXXXXXXXXXXX;
SAS Expander	BL=XXXX;FC=XXXXXXXXXX;VR=XX;VC=XXXXXXXXXX;CR=XX;PC=XXXXXXXXXX;F1=XXXX;FF1=XXXXXXXXXX;SN=XXXXXXXXXXXXXXXXXX;PN=XXXXXXXXXX;
SAS Connector	WN=XXXXXXXXXXXXXXXXXX;

4.5 SES Page 0Ah Layout

SES Page 0Ah only reports phy descriptor data for elements that belong to the directly queried IOM. As such the page layout differs when queried from IOM A or IOM B. Both page formats are shown in the sections below.

4.5.1 SES Page 0Ah Layout for SBB IOM A

Table 11 - SES Page 0Ah Layout for SBB IOM A

Bit Byte	7	6	5	4	3	2	1	0
0	PAGE CODE (0Ah)							
1	Reserved							
2	(MSB)	PAGE LENGTH (3864)						(LSB)
3								
4	(MSB)	GENERATION CODE						(LSB)
7								
Device Slot 0 Additional Status Descriptor								
8	INVALID	Reserved	EIP (1)	PROTOCOL IDENTIFIER (6)				
9	ADDITIONAL ELEMENT STATUS DESCRIPTOR LENGTH (34)							
10	Reserved							EIIOE (0)
11	ELEMENT INDEX (0)							
12	NUM OF DEVICE PHY DESCRIPTORS (1)							
13	DESC TYPE (0)	Reserved						NOT ALL PHYS (1)
14	Reserved							
15	DEVICE SLOT NUMBER (0)							
16	Phy Descriptor for Device 0 (SBB IOM A phy)							
43								
...								
Device Slot 83 Additional Status Descriptor								
2996	INVALID	Reserved	EIP (1)	PROTOCOL IDENTIFIER (6)				
2997	ADDITIONAL ELEMENT STATUS DESCRIPTOR LENGTH (34)							
2998	Reserved							EIIOE (0)
2999	ELEMENT INDEX (83)							
3000	NUM OF DEVICE PHY DESCRIPTORS (1)							
3001	DESC TYPE (0)	Reserved						NOT ALL PHYS (1)
3002	Reserved							
3003	DEVICE SLOT NUMBER (83)							
3004	Phy Descriptor for Device 83 (SBB IOM A phy)							
3031								

Bit Byte	7	6	5	4	3	2	1	0
Expander 0 Additional Status Descriptor								
3032	INVALID	Reserved		EIP (1)	PROTOCOL IDENTIFIER (6)			
3033	ADDITIONAL ELEMENT STATUS DESCRIPTOR LENGTH (86)							
3034	Reserved							EIIOE (0)
3035	ELEMENT INDEX (105)							
3036	NUM OF EXPANDER PHY DESCRIPTORS (36)							
3037	DESC TYPE (1)		Reserved					
3038	Reserved							
3039								
3040	EXPANDER SAS ADDRESS							
3047								
3048	Phy Descriptor 0 for Expander 0 (Sideplane 0)							
3049								
	...							
3118	Phy Descriptor 35 for Expander 0 (Sideplane 0)							
3119								
Expander 1 Additional Status Descriptor								
3120	INVALID	Reserved		EIP (1)	PROTOCOL IDENTIFIER (6)			
3121	ADDITIONAL ELEMENT STATUS DESCRIPTOR LENGTH (62)							
3122	Reserved							EIIOE (0)
3123	ELEMENT INDEX (106)							
3124	NUM OF EXPANDER PHY DESCRIPTORS (24)							
3125	DESC TYPE (1)		Reserved					
3126	Reserved							
3127								
3128	EXPANDER SAS ADDRESS							
3135								
3136	Phy Descriptor 0 for Expander 1 (Sideplane 0)							
3137								
	...							
3182	Phy Descriptor 23 for Expander 1 (Sideplane 0)							
3183								
Expander 2 Additional Status Descriptor								
3184	INVALID	Reserved		EIP (1)	PROTOCOL IDENTIFIER (6)			
3185	ADDITIONAL ELEMENT STATUS DESCRIPTOR LENGTH (86)							
3186	Reserved							EIIOE (0)
3187	ELEMENT INDEX (107)							

Bit Byte	7	6	5	4	3	2	1	0
3188	NUM OF EXPANDER PHY DESCRIPTORS (36)							
3189	DESC TYPE (1)		Reserved					
3190	Reserved							
3191	Reserved							
3192	EXPANDER SAS ADDRESS							
3199	EXPANDER SAS ADDRESS							
3200	Phy Descriptor 0 for Expander 2 (Sideplane 1)							
3201	Phy Descriptor 0 for Expander 2 (Sideplane 1)							
	...							
3270	Phy Descriptor 35 for Expander 2 (Sideplane 1)							
3271	Phy Descriptor 35 for Expander 2 (Sideplane 1)							
Expander 3 Additional Status Descriptor								
3272	INVALID	Reserved		EIP (1)	PROTOCOL IDENTIFIER (6)			
3273	ADDITIONAL ELEMENT STATUS DESCRIPTOR LENGTH (62)							
3274	Reserved							EIIOE (0)
3275	ELEMENT INDEX (108)							
3276	NUM OF EXPANDER PHY DESCRIPTORS (24)							
3277	DESC TYPE (1)		Reserved					
3278	Reserved							
3279	Reserved							
3280	EXPANDER SAS ADDRESS							
3287	EXPANDER SAS ADDRESS							
3288	Phy Descriptor 0 for Expander 3 (Sideplane 1)							
3289	Phy Descriptor 0 for Expander 3 (Sideplane 1)							
	...							
3334	Phy Descriptor 23 for Expander 3 (Sideplane 1)							
3335	Phy Descriptor 23 for Expander 3 (Sideplane 1)							
Expander 4 Additional Status Descriptor								
3336	INVALID	Reserved		EIP (1)	PROTOCOL IDENTIFIER (6)			
3337	ADDITIONAL ELEMENT STATUS DESCRIPTOR LENGTH (86)							
3338	Reserved							EIIOE (0)
3339	ELEMENT INDEX (109)							
3340	NUM OF EXPANDER PHY DESCRIPTORS (36)							
3341	DESC TYPE (1)		Reserved					
3342	Reserved							
3343	Reserved							
3344	EXPANDER SAS ADDRESS							

Bit Byte	7	6	5	4	3	2	1	0
3351								
3352								
3353	Phy Descriptor 0 for Expander 4 (Sideplane 2)							
	...							
3422								
3423	Phy Descriptor 35 for Expander 4 (Sideplane 2)							
Expander 5 Additional Status Descriptor								
3424	INVALID	Reserved	EIP (1)	PROTOCOL IDENTIFIER (6)				
3425	ADDITIONAL ELEMENT STATUS DESCRIPTOR LENGTH (62)							
3426	Reserved							EIIOE (0)
3427	ELEMENT INDEX (110)							
3428	NUM OF EXPANDER PHY DESCRIPTORS (24)							
3429	DESC TYPE (1)	Reserved						
3430	Reserved							
3431	Reserved							
3432	EXPANDER SAS ADDRESS							
3439								
3440								
3441	Phy Descriptor 0 for Expander 5 (Sideplane 2)							
	...							
3486								
3487	Phy Descriptor 23 for Expander 5 (Sideplane 2)							
Expander 6 Additional Status Descriptor								
3488	INVALID	Reserved	EIP (1)	PROTOCOL IDENTIFIER (6)				
3489	ADDITIONAL ELEMENT STATUS DESCRIPTOR LENGTH (86)							
3490	Reserved							EIIOE (0)
3491	ELEMENT INDEX (111)							
3492	NUM OF EXPANDER PHY DESCRIPTORS (36)							
3493	DESC TYPE (1)	Reserved						
3494	Reserved							
3495	Reserved							
2496	EXPANDER SAS ADDRESS							
3503								
3504								
3505	Phy Descriptor 0 for Expander 6 (Sideplane 3)							
	...							
3574	Phy Descriptor 35 for Expander 6 (Sideplane 3)							

Bit Byte	7	6	5	4	3	2	1	0
3575								
Expander 7 Additional Status Descriptor								
3576	INVALID	Reserved		EIP (1)	PROTOCOL IDENTIFIER (6)			
3577	ADDITIONAL ELEMENT STATUS DESCRIPTOR LENGTH (62)							
3578	Reserved							EIIOE (0)
3579	ELEMENT INDEX (112)							
3580	NUM OF EXPANDER PHY DESCRIPTORS (24)							
3581	DESC TYPE (1)		Reserved					
3582	Reserved							
3583	Reserved							
3584	EXPANDER SAS ADDRESS							
3591								
3592	Phy Descriptor 0 for Expander 7 (Sideplane 3)							
3593								
	...							
3638	Phy Descriptor 23 for Expander 7 (Sideplane 3)							
3639								
Expander 8 Additional Status Descriptor								
3640	INVALID	Reserved		EIP (1)	PROTOCOL IDENTIFIER (6)			
3641	ADDITIONAL ELEMENT STATUS DESCRIPTOR LENGTH (112)							
3642	Reserved							EIIOE (0)
3643	ELEMENT INDEX (113)							
3644	NUM OF EXPANDER PHY DESCRIPTORS (0)							
3645	DESC TYPE (1)		Reserved					
3646	Reserved							
3647	Reserved							
3648	EXPANDER SAS ADDRESS							
3655								
3656	Phy Descriptor 0 for Expander 8 (SBB IOM A)							
3657								
	...							
3752	Phy Descriptor n for Expander 8 (SBB IOM A)							
3753								
Expander 9 Additional Status Descriptor								
3754	INVALID	Reserved		EIP (1)	PROTOCOL IDENTIFIER (6)			
3755	ADDITIONAL ELEMENT STATUS DESCRIPTOR LENGTH (112)							
3756	Reserved							EIIOE (0)

Bit Byte	7	6	5	4	3	2	1	0
3757	ELEMENT INDEX (114)							
3758	NUM OF EXPANDER PHY DESCRIPTORS (49)							
3759	DESC TYPE (1)		Reserved					
3760	Reserved							
3761	Reserved							
3762	EXPANDER SAS ADDRESS							
3769	EXPANDER SAS ADDRESS							
3770	Phy Descriptor 0 for Expander 9 (SBB IOM B)							
3771	Phy Descriptor 0 for Expander 9 (SBB IOM B)							
	...							
3866	Phy Descriptor 48 for Expander 9 (SBB IOM B)							
3867	Phy Descriptor 48 for Expander 9 (SBB IOM B)							

4.5.2 SES Page 0Ah Layout for SBB IOM B

Table 12 - SES Page 0Ah Layout for SBB IOM B

Bit Byte	7	6	5	4	3	2	1	0
0	PAGE CODE (0Ah)							
1	Reserved							
2	(MSB)	PAGE LENGTH (3864)						(LSB)
3								
4	(MSB)	GENERATION CODE						(LSB)
7								
Device Slot 0 Additional Status Descriptor								
8	INVALID	Reserved	EIP (1)	PROTOCOL IDENTIFIER (6)				
9	ADDITIONAL ELEMENT STATUS DESCRIPTOR LENGTH (34)							
10	Reserved							EIIOE (0)
11	ELEMENT INDEX (0)							
12	NUM OF DEVICE PHY DESCRIPTORS (1)							
13	DESC TYPE (0)	Reserved						NOT ALL PHYS (1)
14	Reserved							
15	DEVICE SLOT NUMBER (0)							
16	Phy Descriptor for Device 0 (SBB IOM B phy)							
43								
...								
Device Slot 83 Additional Status Descriptor								
2996	INVALID	Reserved	EIP (1)	PROTOCOL IDENTIFIER (6)				
2997	ADDITIONAL ELEMENT STATUS DESCRIPTOR LENGTH (34)							
2998	Reserved							EIIOE (0)
2999	ELEMENT INDEX (83)							
3000	NUM OF DEVICE PHY DESCRIPTORS (1)							
3001	DESC TYPE (0)	Reserved						NOT ALL PHYS (1)
3002	Reserved							
3003	DEVICE SLOT NUMBER (83)							
3004	Phy Descriptor for Device 83 (SBB IOM B phy)							
3031								
Expander 0 Additional Status Descriptor								
3032	INVALID	Reserved	EIP (1)	PROTOCOL IDENTIFIER (6)				
3033	ADDITIONAL ELEMENT STATUS DESCRIPTOR LENGTH (86)							
3034	Reserved							EIIOE (0)
3035	ELEMENT INDEX (105)							

Bit Byte	7	6	5	4	3	2	1	0
3036	NUM OF EXPANDER PHY DESCRIPTORS (36)							
3037	DESC TYPE (1)		Reserved					
3038	Reserved							
3039	Reserved							
3040	EXPANDER SAS ADDRESS							
3047	EXPANDER SAS ADDRESS							
3048	Phy Descriptor 0 for Expander 0 (Sideplane 0)							
3049	Phy Descriptor 0 for Expander 0 (Sideplane 0)							
	...							
3118	Phy Descriptor 35 for Expander 0 (Sideplane 0)							
3119	Phy Descriptor 35 for Expander 0 (Sideplane 0)							
Expander 1 Additional Status Descriptor								
3120	INVALID	Reserved		EIP (1)	PROTOCOL IDENTIFIER (6)			
3121	ADDITIONAL ELEMENT STATUS DESCRIPTOR LENGTH (62)							
3122	Reserved							EIIOE (0)
3123	ELEMENT INDEX (106)							
3124	NUM OF EXPANDER PHY DESCRIPTORS (24)							
3125	DESC TYPE (1)		Reserved					
3126	Reserved							
3127	Reserved							
3128	EXPANDER SAS ADDRESS							
3135	EXPANDER SAS ADDRESS							
3136	Phy Descriptor 0 for Expander 1 (Sideplane 0)							
3137	Phy Descriptor 0 for Expander 1 (Sideplane 0)							
	...							
3182	Phy Descriptor 23 for Expander 1 (Sideplane 0)							
3183	Phy Descriptor 23 for Expander 1 (Sideplane 0)							
Expander 2 Additional Status Descriptor								
3184	INVALID	Reserved		EIP (1)	PROTOCOL IDENTIFIER (6)			
3185	ADDITIONAL ELEMENT STATUS DESCRIPTOR LENGTH (86)							
3186	Reserved							EIIOE (0)
3187	ELEMENT INDEX (107)							
3188	NUM OF EXPANDER PHY DESCRIPTORS (36)							
3189	DESC TYPE (1)		Reserved					
3190	Reserved							
3191	Reserved							
3192	EXPANDER SAS ADDRESS							

Bit Byte	7	6	5	4	3	2	1	0
3199								
3200	Phy Descriptor 0 for Expander 2 (Sideplane 1)							
3201								
	...							
3270	Phy Descriptor 35 for Expander 2 (Sideplane 1)							
3271								
Expander 3 Additional Status Descriptor								
3272	INVALID	Reserved	EIP (1)	PROTOCOL IDENTIFIER (6)				
3273	ADDITIONAL ELEMENT STATUS DESCRIPTOR LENGTH (62)							
3274	Reserved							EIIOE (0)
3275	ELEMENT INDEX (108)							
3276	NUM OF EXPANDER PHY DESCRIPTORS (24)							
3277	DESC TYPE (1)	Reserved						
3278	Reserved							
3279								
3280	EXPANDER SAS ADDRESS							
3287								
3288	Phy Descriptor 0 for Expander 3 (Sideplane 1)							
3289								
	...							
3334	Phy Descriptor 23 for Expander 3 (Sideplane 1)							
3335								
Expander 4 Additional Status Descriptor								
3336	INVALID	Reserved	EIP (1)	PROTOCOL IDENTIFIER (6)				
3337	ADDITIONAL ELEMENT STATUS DESCRIPTOR LENGTH (86)							
3338	Reserved							EIIOE (0)
3339	ELEMENT INDEX (109)							
3340	NUM OF EXPANDER PHY DESCRIPTORS (36)							
3341	DESC TYPE (1)	Reserved						
3342	Reserved							
3343								
3344	EXPANDER SAS ADDRESS							
3351								
3352	Phy Descriptor 0 for Expander 4 (Sideplane 2)							
3353								
	...							
3422	Phy Descriptor 35 for Expander 4 (Sideplane 2)							

Bit Byte	7	6	5	4	3	2	1	0
3423								
Expander 5 Additional Status Descriptor								
3424	INVALID	Reserved	EIP (1)	PROTOCOL IDENTIFIER (6)				
3425	ADDITIONAL ELEMENT STATUS DESCRIPTOR LENGTH (62)							
3426	Reserved							EIIOE (0)
3427	ELEMENT INDEX (110)							
3428	NUM OF EXPANDER PHY DESCRIPTORS (24)							
3429	DESC TYPE (1)	Reserved						
3430	Reserved							
3431	Reserved							
3432	EXPANDER SAS ADDRESS							
3439	EXPANDER SAS ADDRESS							
3440	Phy Descriptor 0 for Expander 5 (Sideplane 2)							
3441	Phy Descriptor 0 for Expander 5 (Sideplane 2)							
	...							
3486	Phy Descriptor 23 for Expander 5 (Sideplane 2)							
3487	Phy Descriptor 23 for Expander 5 (Sideplane 2)							
Expander 6 Additional Status Descriptor								
3488	INVALID	Reserved	EIP (1)	PROTOCOL IDENTIFIER (6)				
3489	ADDITIONAL ELEMENT STATUS DESCRIPTOR LENGTH (86)							
3490	Reserved							EIIOE (0)
3491	ELEMENT INDEX (111)							
3492	NUM OF EXPANDER PHY DESCRIPTORS (36)							
3493	DESC TYPE (1)	Reserved						
3494	Reserved							
3495	Reserved							
2496	EXPANDER SAS ADDRESS							
3503	EXPANDER SAS ADDRESS							
3504	Phy Descriptor 0 for Expander 6 (Sideplane 3)							
3505	Phy Descriptor 0 for Expander 6 (Sideplane 3)							
	...							
3574	Phy Descriptor 35 for Expander 6 (Sideplane 3)							
3575	Phy Descriptor 35 for Expander 6 (Sideplane 3)							
Expander 7 Additional Status Descriptor								
3576	INVALID	Reserved	EIP (1)	PROTOCOL IDENTIFIER (6)				
3577	ADDITIONAL ELEMENT STATUS DESCRIPTOR LENGTH (62)							
3578	Reserved							EIIOE (0)

Bit Byte	7	6	5	4	3	2	1	0
3579	ELEMENT INDEX (112)							
3580	NUM OF EXPANDER PHY DESCRIPTORS (24)							
3581	DESC TYPE (1)		Reserved					
3582	Reserved							
3583	Reserved							
3584	EXPANDER SAS ADDRESS							
3591	EXPANDER SAS ADDRESS							
3592	Phy Descriptor 0 for Expander 7 (Sideplane 3)							
3593	Phy Descriptor 0 for Expander 7 (Sideplane 3)							
	...							
3638	Phy Descriptor 23 for Expander 7 (Sideplane 3)							
3639	Phy Descriptor 23 for Expander 7 (Sideplane 3)							
Expander 8 Additional Status Descriptor								
3640	INVALID	Reserved	EIP (1)	PROTOCOL IDENTIFIER (6)				
3641	ADDITIONAL ELEMENT STATUS DESCRIPTOR LENGTH (112)							
3642	Reserved							EIIOE (0)
3643	ELEMENT INDEX (113)							
3644	NUM OF EXPANDER PHY DESCRIPTORS (0)							
3645	DESC TYPE (1)		Reserved					
3646	Reserved							
3647	Reserved							
3648	EXPANDER SAS ADDRESS							
3655	EXPANDER SAS ADDRESS							
3656	Phy Descriptor 0 for Expander 8 (SBB IOM A)							
3657	Phy Descriptor 0 for Expander 8 (SBB IOM A)							
	...							
3752	Phy Descriptor n for Expander 8 (SBB IOM A)							
3753	Phy Descriptor n for Expander 8 (SBB IOM A)							
Expander 9 Additional Status Descriptor								
3754	INVALID	Reserved	EIP (1)	PROTOCOL IDENTIFIER (6)				
3755	ADDITIONAL ELEMENT STATUS DESCRIPTOR LENGTH (112)							
3756	Reserved							EIIOE (0)
3757	ELEMENT INDEX (114)							
3758	NUM OF EXPANDER PHY DESCRIPTORS (49)							
3759	DESC TYPE (1)		Reserved					
3760	Reserved							
3761	Reserved							

Bit Byte	7	6	5	4	3	2	1	0
3762	EXPANDER SAS ADDRESS							
3769	EXPANDER SAS ADDRESS							
3770	Phy Descriptor 0 for Expander 9 (SBB IOM B)							
3771	Phy Descriptor 0 for Expander 9 (SBB IOM B)							
	...							
3866	Phy Descriptor 48 for Expander 9 (SBB IOM B)							
3867	Phy Descriptor 48 for Expander 9 (SBB IOM B)							

4.6 Vendor Unique Page 91h Layout

Vendor unique Page 91h is used to report enclosure statistics counters. The layouts of the control and status pages are identical, however, the bit definitions within the descriptors vary (see [3] for details). Table 13 covers the basic layout of page 91h for the documented product.

Table 13 - SES Page 91h Layout

Bit Byte	7	6	5	4	3	2	1	0
0	PAGE CODE (91h)							
1	Reserved							
2	(MSB)	PAGE LENGTH (9492)						(LSB)
3								
4	(MSB)	GENERATION CODE						(LSB)
7								
Expander 0 Phy Statistics Descriptor								
8	ELEMENT TYPE CODE (18h)							
9	TYPE RELATIVE INDEX (0)							
10	DESCRIPTOR FORMAT REVISION (01h)							
11	NUMBER OF PHY STATISTICS DESCRIPTORS (36)							
12	PHY STATISTICS DESCRIPTOR LENGTH (28)							
13	(MSB)	EXPANDER CHANGE COUNT						(LSB)
14								
15	Reserved							
16								
43	Phy 0 Statistics Descriptor ¹							
...								
996	Phy 35 Statistics Descriptor ¹							
1023								
Expander 1 Phy Statistics Descriptor								
1024	ELEMENT TYPE CODE (18h)							
1025	TYPE RELATIVE INDEX (1)							
1026	DESCRIPTOR FORMAT REVISION (01h)							
1027	NUMBER OF PHY STATISTICS DESCRIPTORS (24)							
1028	PHY STATISTICS DESCRIPTOR LENGTH (28)							
1029	(MSB)	EXPANDER CHANGE COUNT						(LSB)
1030								
1031	Reserved							
1032								
1059	Phy 0 Statistics Descriptor ¹							

Bit Byte	7	6	5	4	3	2	1	0
	...							
1676	Phy 23 Statistics Descriptor ¹							
1703	Phy 23 Statistics Descriptor ¹							
	Expander 2 Phy Statistics Descriptor							
1704	ELEMENT TYPE CODE (18h)							
1705	TYPE RELATIVE INDEX (2)							
1706	DESCRIPTOR FORMAT REVISION (01h)							
1707	NUMBER OF PHY STATISTICS DESCRIPTORS (36)							
1708	PHY STATISTICS DESCRIPTOR LENGTH (28)							
1709	(MSB)	EXPANDER CHANGE COUNT						(LSB)
1710		EXPANDER CHANGE COUNT						(LSB)
1711	Reserved							
1712	Phy 0 Statistics Descriptor ¹							
3739	Phy 0 Statistics Descriptor ¹							
	...							
2692	Phy 35 Statistics Descriptor ¹							
2719	Phy 35 Statistics Descriptor ¹							
	Expander 3 Phy Statistics Descriptor							
2720	ELEMENT TYPE CODE (18h)							
2721	TYPE RELATIVE INDEX (3)							
2722	DESCRIPTOR FORMAT REVISION (01h)							
2723	NUMBER OF PHY STATISTICS DESCRIPTORS (24)							
2724	PHY STATISTICS DESCRIPTOR LENGTH (28)							
2725	(MSB)	EXPANDER CHANGE COUNT						(LSB)
2726		EXPANDER CHANGE COUNT						(LSB)
2727	Reserved							
2728	Phy 0 Statistics Descriptor ¹							
2756	Phy 0 Statistics Descriptor ¹							
	...							
3372	Phy 23 Statistics Descriptor ¹							
3399	Phy 23 Statistics Descriptor ¹							
	Expander 4 Phy Statistics Descriptor							
3400	ELEMENT TYPE CODE (18h)							
3401	TYPE RELATIVE INDEX (4)							
3402	DESCRIPTOR FORMAT REVISION (01h)							
3403	NUMBER OF PHY STATISTICS DESCRIPTORS (36)							
3404	PHY STATISTICS DESCRIPTOR LENGTH (28)							

Bit Byte	7	6	5	4	3	2	1	0	
3405	(MSB)	EXPANDER CHANGE COUNT							
3406								(LSB)	
3407	Reserved								
3408	Phy 0 Statistics Descriptor ¹								
3435	...								
3388	Phy 35 Statistics Descriptor ¹								
4415	Expander 5 Phy Statistics Descriptor								
4416	ELEMENT TYPE CODE (18h)								
4417	TYPE RELATIVE INDEX (5)								
4418	DESCRIPTOR FORMAT REVISION (01h)								
4419	NUMBER OF PHY STATISTICS DESCRIPTORS (24)								
4420	PHY STATISTICS DESCRIPTOR LENGTH (28)								
4421	(MSB)	EXPANDER CHANGE COUNT							
4422								(LSB)	
4423	Reserved								
4424	Phy 0 Statistics Descriptor ¹								
4451	...								
5068	Phy 23 Statistics Descriptor ¹								
5095	Expander 6 Phy Statistics Descriptor								
5096	ELEMENT TYPE CODE (18h)								
5097	TYPE RELATIVE INDEX (6)								
5098	DESCRIPTOR FORMAT REVISION (01h)								
5099	NUMBER OF PHY STATISTICS DESCRIPTORS (36)								
6000	PHY STATISTICS DESCRIPTOR LENGTH (28)								
6001	(MSB)	EXPANDER CHANGE COUNT							
6002								(LSB)	
6003	Reserved								
6004	Phy 0 Statistics Descriptor ¹								
6031	...								
6084	Phy 35 Statistics Descriptor ¹								
6111	Expander 7 Phy Statistics Descriptor								

Bit Byte	7	6	5	4	3	2	1	0
6112	ELEMENT TYPE CODE (18h)							
6113	TYPE RELATIVE INDEX (7)							
6114	DESCRIPTOR FORMAT REVISION (01h)							
6115	NUMBER OF PHY STATISTICS DESCRIPTORS (24)							
6116	PHY STATISTICS DESCRIPTOR LENGTH (28)							
6117	(MSB)	EXPANDER CHANGE COUNT						(LSB)
6118								
6119	Reserved							
6120	Phy 0 Statistics Descriptor ¹							
6147								
	...							
6764	Phy 23 Statistics Descriptor ¹							
6791								
	Expander 8 Phy Statistics Descriptor							
6792	ELEMENT TYPE CODE (18h)							
6793	TYPE RELATIVE INDEX (8)							
6794	DESCRIPTOR FORMAT REVISION (01h)							
6795	NUMBER OF PHY STATISTICS DESCRIPTORS (48)							
6796	PHY STATISTICS DESCRIPTOR LENGTH (28)							
6797	(MSB)	EXPANDER CHANGE COUNT						(LSB)
6798								
6799	Reserved							
6800	Phy 0 Statistics Descriptor ¹							
6827								
	...							
8116	Phy 47 Statistics Descriptor ¹							
8143								
	Expander 9 Phy Statistics Descriptor							
8144	ELEMENT TYPE CODE (18h)							
8145	TYPE RELATIVE INDEX (9)							
8146	DESCRIPTOR FORMAT REVISION (01h)							
8147	NUMBER OF PHY STATISTICS DESCRIPTORS (48)							
8148	PHY STATISTICS DESCRIPTOR LENGTH (28)							
8149	(MSB)	EXPANDER CHANGE COUNT						(LSB)
8150								
8151	Reserved							
8152	Phy 0 Statistics Descriptor ¹							

Bit Byte	7	6	5	4	3	2	1	0
8179								
	...							
9468	Phy 47 Statistics Descriptor ¹							
9495								
¹ See [3] for full details on the format of the Phy Statistics status/control descriptor								

4.7 Vendor Unique Page 92h Layout

Vendor unique Page 92h extends the status that can be represented in page 02h for each element. The page structure itself represents that of page 07h with descriptor headers used to advertise the size of additional data available for each element. Not all elements provide page 92h descriptors and where this is the case the descriptor length will be set to 0.

As with Page 07h, the example Page 92h output provided below is subject to change based on FRUs and cables that may or may not be present at the time of capture. The descriptor header will indicate if there is any data to be read.

Table 14 - SES Page 92h Layout

Bit Byte	7	6	5	4	3	2	1	0
0	PAGE CODE (92h)							
1	Reserved							
2	(MSB)	PAGE LENGTH (2672)						(LSB)
3								
4	(MSB)	GENERATION CODE						(LSB)
7								
Extended Status Descriptor List								
8	Array Device Overall Element Descriptor							
11	(00 00 00 00 h)							
12	Array Device Element 0 Descriptor							
15	(00 00 00 00 h)							
...								
344	Array Device Element 83 Descriptor							
347	(00 00 00 00 h)							
348	Temperature Sensor Overall Element Descriptor							
351	(00 00 00 00 h)							
352	Temperature Sensor Element 0 Descriptor							
355	(00 00 00 00 h)							
...								
420	Temperature Sensor Element 17 Descriptor							
423	(00 00 00 00 h)							
424	Enclosure Services Controller Electronics Overall Element Descriptor							
427	(00 00 00 00 h)							
428	Enclosure Services Controller Electronics Element 0 Descriptor							
431	(00 00 00 00 h)							
432	Enclosure Services Controller Electronics Element 1 Descriptor							
435	(00 00 00 00 h)							
436	Enclosure Overall Element Descriptor							
439	(00 00 00 00 h)							

Bit Byte	7	6	5	4	3	2	1	0
440	Enclosure Element 0 Descriptor (00 00 00 00 h)							
443								
444	SAS Expander Overall Element Descriptor (00 00 00 00 h)							
447								
448	SAS Expander Element 0 Descriptor (00 00 00 00 h)							
451								
	...							
484	SAS Expander Element 9 Descriptor (00 00 00 00 h)							
487								
488	SAS Connector Overall Element Descriptor (00 00 00 00 h)							
491								
492	SAS Connector Element 0 Descriptor (00 00 02 00 h)							
1007								
	512 bytes of descriptor data ¹							
	...							
2636	SAS Connector Element 19 Descriptor (00 00 00 00 h)							
2639								
2640	SBB Midplane Interconnect Overall Element Descriptor (00 00 00 00 h)							
2643								
2644	SBB Midplane Interconnect Element 0 Descriptor (00 00 00 00 h)							
2647								
2648	SBB Midplane Interconnect Element 1 Descriptor (00 00 00 00 h)							
2651								
2652	Enclosure Electronics Power Overall Element Descriptor (00 00 00 00 h)							
2655								
2656	Enclosure Electronics Power Element 0 Descriptor (00 00 00 00 h)							
2659								
2660	Enclosure Electronics Power Element 1 Descriptor (00 00 00 00 h)							
2663								
2664	Enclosure Electronics Diagnostics Overall Element Descriptor (00 00 00 00 h)							
2667								
2668	Enclosure Electronics Diagnostics Element 0 Descriptor (00 00 00 00 h)							
2671								
2672	Enclosure Electronics Diagnostics Element 1 Descriptor (00 00 00 00 h)							
2675								
¹ See [3] for extended status descriptor format for SAS connectors								

5 Zone Modes

The AP-BV-1 controller incorporates an embedded SAS IOC for the purpose of accessing the disk drives. The IOC supports 16 Phys but can only form wide ports with a maximum width of 8 phys. When both ports are attached to the same SAS expander, as is the case for the AP-BV-1, I/O may become unbalanced between the two ports.

To account for this, the AP-BV-1 controller implements several zoning schemes that can be used to deterministically control how traffic from the two IOC wide-ports is shared amongst internal and expansion drives.

5.1 Zone Mode Configurations

This section details the zone configurations that can be applied to the AP-BV-1 controllers in the Exos E 5U84 enclosure, using the zone modes feature. The supported zone mode configurations are described in Table 15. Refer to [3] for further details of the zone mode feature.

Table 15 - Zone Mode Configurations

Zone mode	Zone Configuration	Description
1	HA Performance Mode	Default zone mode optimized for dual-path high-availability (HA), single-enclosure performance. See 5.2.1
2	HA Expansion Mode	Zone mode optimized for dual-path high-availability (HA), multi-enclosure topologies. See 5.2.2
3	HA Hybrid Mode	Zone mode optimized for high availability (HA) performance, with support for expansion enclosures that are to be excluded from the ZPSDS. See 5.2.3
4	Single Core Mode	Zone mode emulating previous generations of AP with single-core SAS IOCs. See 5.2.4
5	SCSN Performance Mode	Zone mode optimized for single-enclosure performance with drives evenly divided between the two redundant enclosure data paths. See 5.2.5
6	SCSN Expansion Mode	Zone mode optimized for expansion with drives divided between the two redundant enclosure data paths. See 5.2.6

5.2 Zone Configuration Layouts

For simplicity, this section provides a generalized view of the zone group assignments implemented by each of the zone modes. In this view, each zone group is represented as a letter, rather than the numerical identified implemented within SAS. Full details of the actual phy zone group assignments and permissions tables are included in 5.

5.2.1 Zone mode 1 - HA Performance Mode

Zone mode 1 is optimized for dual-path high-availability (HA), single-enclosure performance.

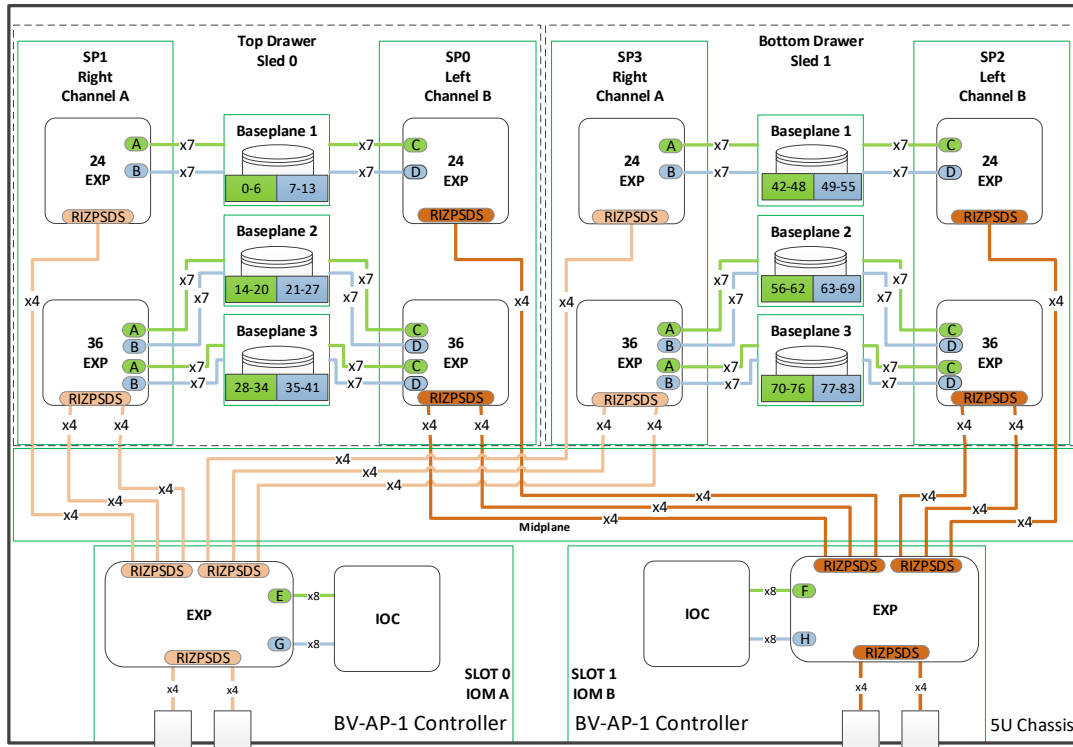
This zone mode segregates the disk drives into two even groups and assigns them to each of the embedded IOC x8 SAS ports, ensuring both ports are fully utilized for balanced I/O.

The expansion ports are configured with the Requested Inside ZPSDS bit set to '1', permitting the ZPSDS to be extended to downstream enclosures, if expansion is desired. However, it should be noted that downstream enclosures must implement a compatible zone group assignment and permissions table.

If the ZPSDS is not extended beyond the expansion port, bandwidth for downstream drives may not evenly distribute across the on-board IOC ports.

Zone mode 1 is the default zone mode enabled by the AP-BV-1 controller if no alternative zone mode is configured.

Figure 5 shows the generalized zoning scheme implemented by zone mode 1.



(A) = Zone Group

5U SAS ZM1

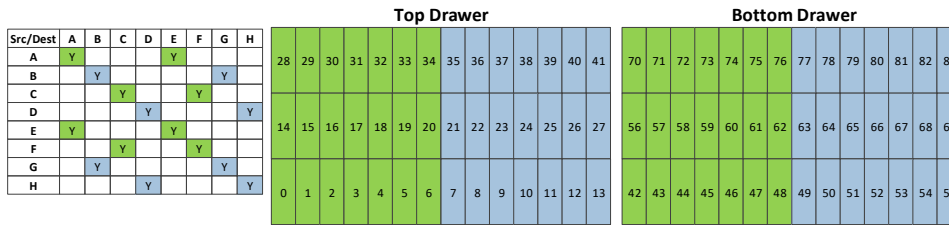


Figure 5 - Zone mode 1 configuration

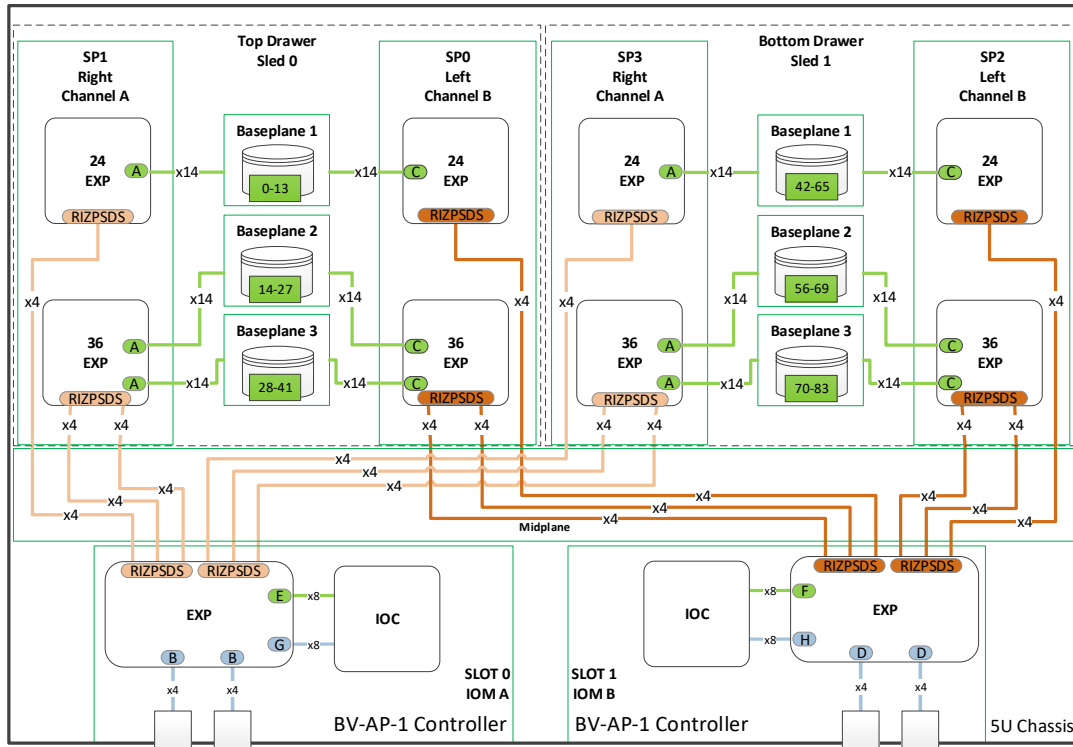
5.2.2 Zone mode 2 - HA Expansion Mode

Zone mode 2 is optimized for dual-path high-availability (HA), multi-enclosure topologies.

The zone mode assigns the enclosure's internal drives to a single IOC port and the drives of all expansion enclosures to the remaining IOC port.

The expansion ports are configured with the Requested Inside ZPSDS bit set to '0', and therefore no requirement is placed on the expansion enclosures to implement zoning.

Figure 4 shows the generalized zoning scheme implemented by zone mode 2.



(A) = Zone Group

5U SAS ZM2

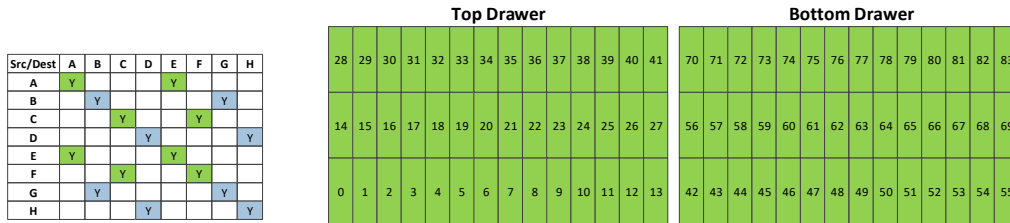


Figure 6 - Zone Mode 2 configuration

5.2.3 Zone Mode 3 - HA Hybrid

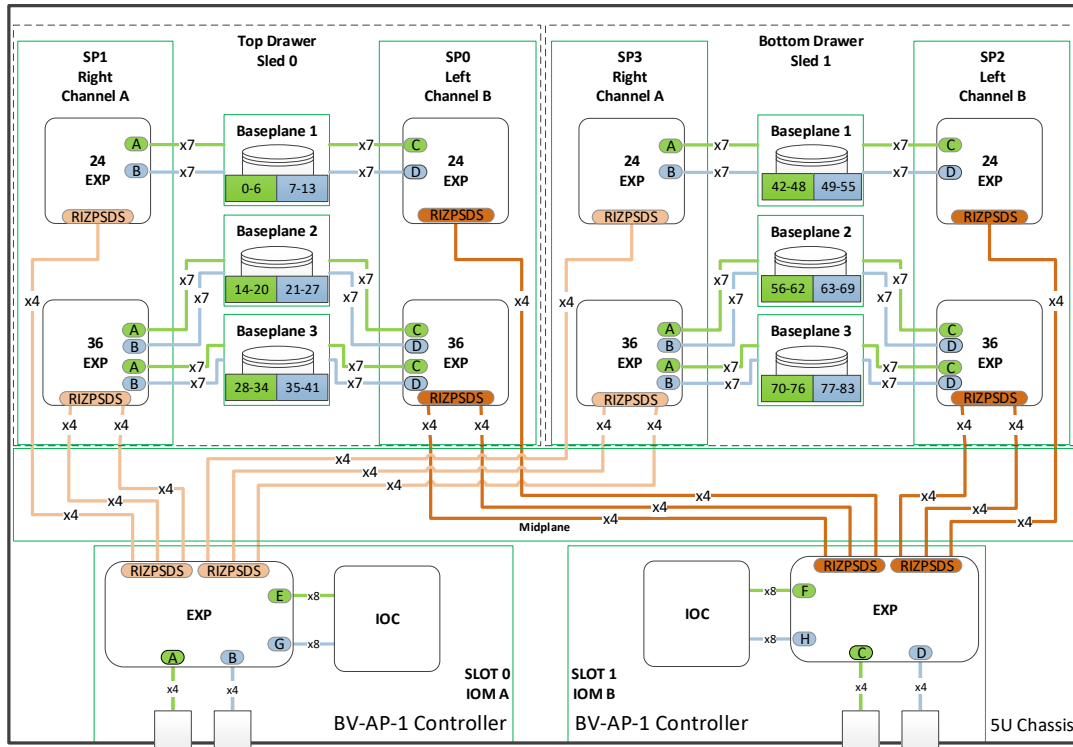
Zone mode 3 is optimized for high availability (HA) performance, along with support for expansion enclosures that should be excluded from the ZPSDS.

The zone mode splits the internal disk drives into two even groups and assigns them to each of the embedded IOC x8 SAS ports, ensuring both ports are fully utilized for balanced I/O.

The expansion ports are also divided between the two zones, ensuring that expansion enclosures attached to expansion port 0 are visible to IOC port 0 and expansion enclosures attached to expansion port 1 are visible to IOC 1.

The expansion enclosures are not required to implement zoning or extend the ZPSDS, however, as the expansion ports belong to separate zone groups, it is not permitted to chain to a single enclosure using a x8 wide port.

Figure 5 shows the generalized zoning scheme implemented by zone mode 3.



(A) = Zone Group

5U SAS ZM3

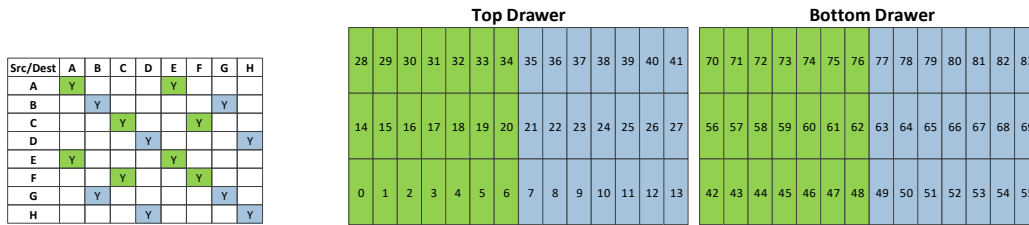


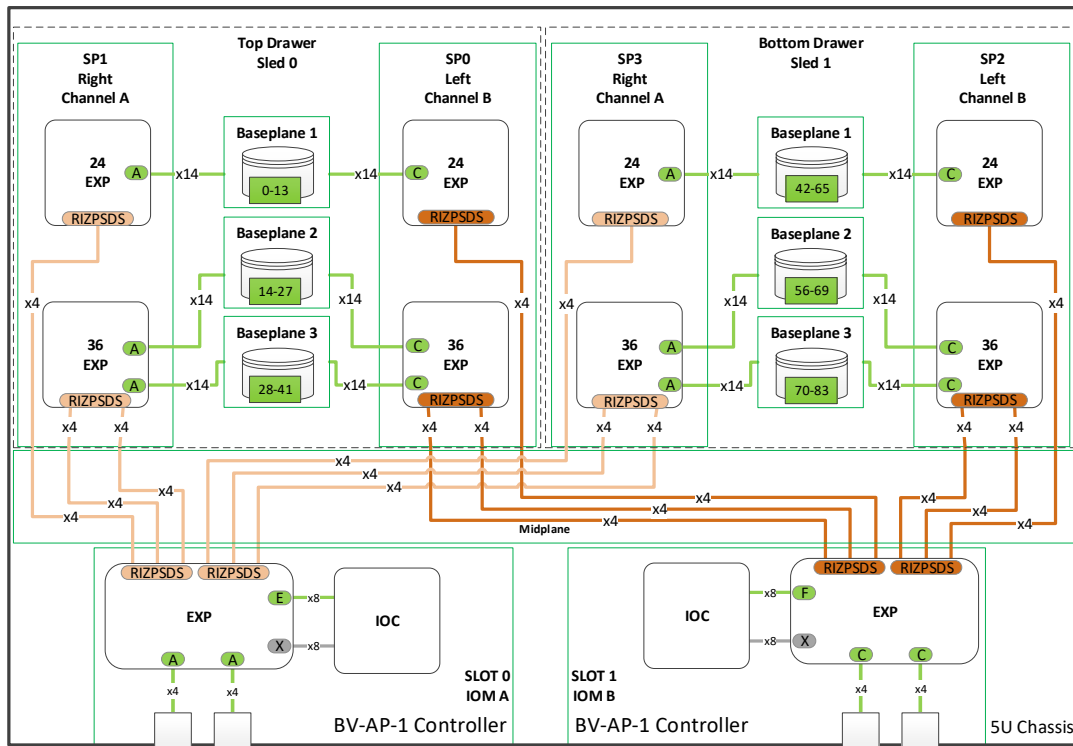
Figure 7 - Zone Mode 3 configuration

5.2.4 Zone Mode 4 - HA Single Core Mode

Zone mode 4 emulates previous generations of AP controllers that utilized IOC with a single SAS core. This is useful when an I/O stack is not configured to handle multi-pathed access to the enclosure SES targets.

In this mode, only one of the IOC ports has access to both internal and external SAS devices, with the second IOC port having no access to any part of the SAS topology.

Figure 6 shows the generalized zoning scheme implemented by zone mode 4.



(A) = Zone Group

5U SAS ZM4



Figure 8 - Zone Mode 4 configuration

5.2.5 Zone Mode 5 - SCSN Performance Mode

Zone mode 5 is optimized for single-enclosure performance where the drives are divided evenly between the two redundant enclosure data paths (known as Single Controller-Share Nothing),

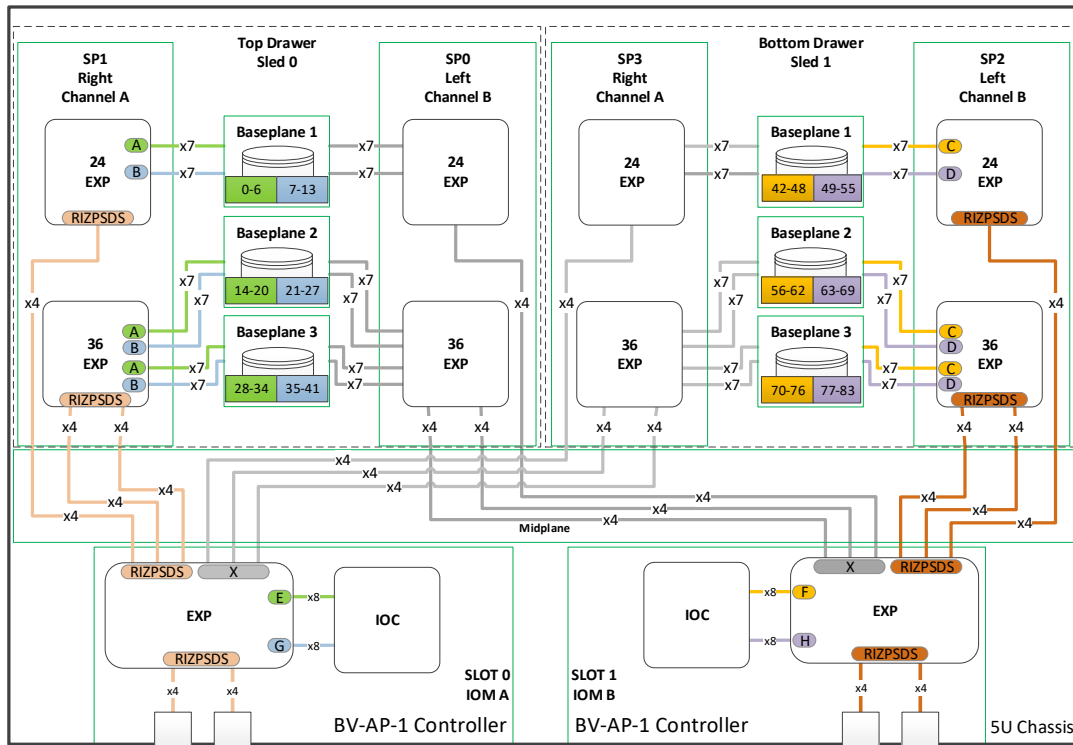
The share nothing configs are mostly used with host I/O stacks that are not multi-path or HA-aware but there is still a desire to use the full enclosure bandwidth. In such cases each enclosure controller can be viewed as a separate storage node with access to half of the total enclosure drive population. If the controller fails, the partner controller will not have access to its drives.

On each controller, this zone mode splits the disk drives into four even groups and assigns two of the groups to each of embedded IOC x8 SAS ports, ensuring both ports are fully utilized for balanced I/O. The drive groups that are not assigned locally are assigned evenly to the IOC ports on the partner controller, ensuring that only half the drives are visible on each path.

The expansion ports are configured with the Requested Inside ZPSDS bit set to '1', allowing the ZPSDS to be extended to downstream enclosures, if expansion is desired. However, it

should be noted that downstream enclosures must implement a compatible zone group assignment and permissions table

Figure 7 shows the generalized zoning scheme implemented by zone mode 5



(A) = Zone Group

5U SAS ZM5

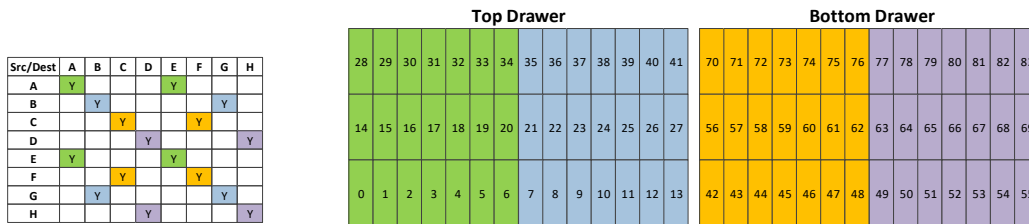


Figure 9 - Zone Mode 5 configuration

5.2.6 Zone Mode 6 - SCSN expansion

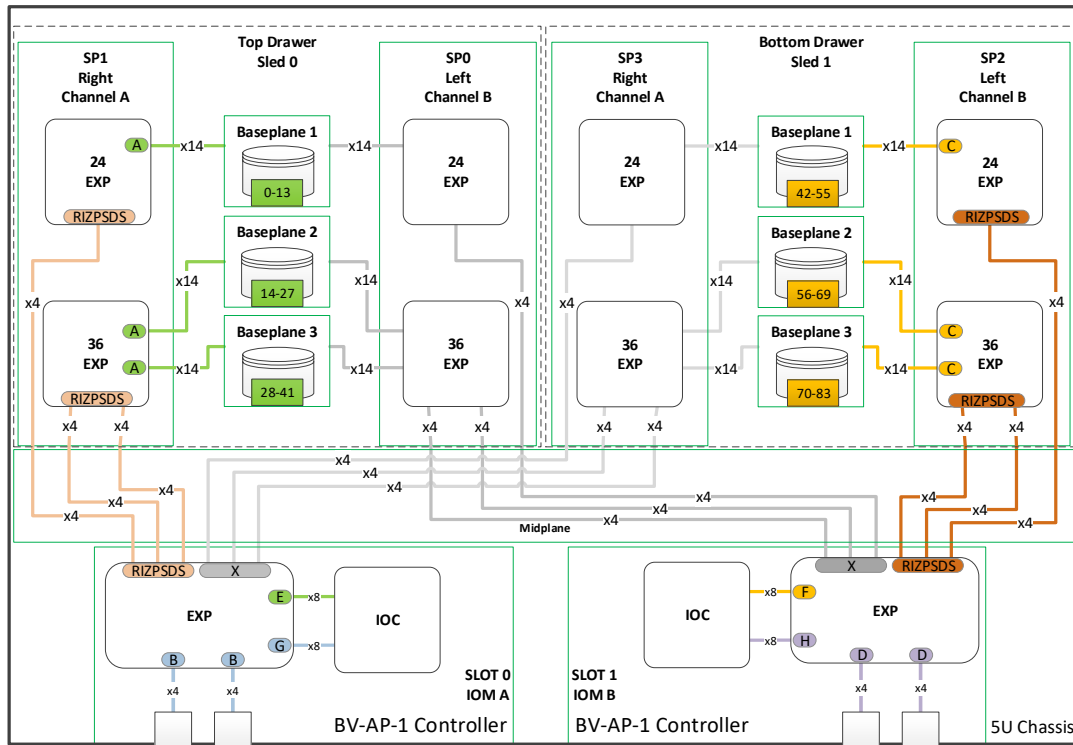
Zone mode 6 is optimized for expansion where the drives are divided between the two redundant enclosure data paths (known as Single Controller-Share Nothing),

The share nothing configs are mostly used with host I/O stacks that are not multi-path or HA-aware but there is still a desire to use the full enclosure bandwidth. In such cases each enclosure controller can be viewed as a separate storage node with access to half of the total drive population. If the controller fails, the partner controller will not have access to its drives.

On each controller, this zone mode splits the disk drives into 2 even groups and assigns one of the groups to a single port on the IOC. The other group is assigned to single port on the IOC of the partner controller, ensuring that only half the drives are visible on each path. The second IOC port of each controller is assigned to their respective expansion ports.

The expansion ports are configured with the Requested Inside ZPSDS bit set to '0', and therefore no requirement is placed on the expansion enclosures to implement zoning.

Figure 8 shows the generalized zoning scheme implemented by zone mode 6.



(A) = Zone Group

5U SAS ZM6

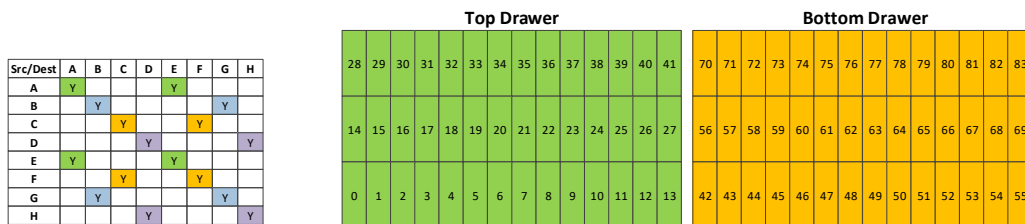


Figure 10 - Zone Mode 6 configuration

Appendix A Detailed Zone Configuration

A-1 Zone mode 1 configuration

A-1.1 Zone mode 1 IOM phy settings

Table 16 – IOM Phy Zone Settings for Zone Mode 1

Phy Type	Phy ID	Phy ID (hex)	IOM A		IOM B		RIZPSDS IZP ZGP
			Expander ¹	ZG	Expander ¹	ZG	
MiniSAS 0	0	0h	N/A	1	N/A	1	7h
	1	1h	N/A	1	N/A	1	7h
	2	2h	N/A	1	N/A	1	7h
	3	3h	N/A	1	N/A	1	7h
MiniSAS 1	4	4h	N/A	1	N/A	1	7h
	5	5h	N/A	1	N/A	1	7h
	6	6h	N/A	1	N/A	1	7h
	7	7h	N/A	1	N/A	1	7h
IOC 0	8	8h	N/A	10	N/A	10	3h
	9	9h	N/A	10	N/A	10	3h
	10	Ah	N/A	10	N/A	10	3h
	11	Bh	N/A	10	N/A	10	3h
	12	Ch	N/A	10	N/A	10	3h
	13	Dh	N/A	10	N/A	10	3h
	14	Eh	N/A	10	N/A	10	3h
	15	Fh	N/A	10	N/A	10	3h
IOC 1	16	10h	N/A	11	N/A	11	3h
	17	11h	N/A	11	N/A	11	3h
	18	12h	N/A	11	N/A	11	3h
	19	13h	N/A	11	N/A	11	3h
	20	14h	N/A	11	N/A	11	3h
	21	15h	N/A	11	N/A	11	3h
	22	16h	N/A	11	N/A	11	3h
	23	17h	N/A	11	N/A	11	3h
Internal Ports	24	18h	TR24	1	BL24	1	7h
	25	19h	TR24	1	BL24	1	7h
	26	1Ah	TR24	1	BL24	1	7h
	27	1Bh	TR24	1	BL24	1	7h
	28	1Ch	TR36	1	BL36	1	7h
	29	1Dh	TR36	1	BL36	1	7h
	30	1Eh	TR36	1	BL36	1	7h
	31	1Fh	TR36	1	BL36	1	7h
	32	20h	TR36	1	BL36	1	7h
	33	21h	TR36	1	BL36	1	7h

Phy Type	Phy ID	Phy ID (hex)	IOM A		IOM B		RIZPSDS IZP ZGP
			Expander ¹	ZG	Expander ¹	ZG	
	34	22h	TR36	1	BL36	1	7h
	35	23h	TR36	1	BL36	1	7h
	36	24h	BR24	1	TL24	1	7h
	37	25h	BR24	1	TL24	1	7h
	38	26h	BR24	1	TL24	1	7h
	39	27h	BR24	1	TL24	1	7h
	40	28h	BR36	1	TL36	1	7h
	41	29h	BR36	1	TL36	1	7h
	42	2Ah	BR36	1	TL36	1	7h
	43	2Bh	BR36	1	TL36	1	7h
	44	2Ch	BR36	1	TL36	1	7h
	45	2Dh	BR36	1	TL36	1	7h
	46	2Eh	BR36	1	TL36	1	7h
	47	2Fh	BR36	1	TL36	1	7h

¹Attached sideplane expander key: R=Right sideplane, L=Left sideplane, T=Top-drawer, B=Bottom-drawer, 24=24-port, 36=36-port

A-1.2 Zone mode 1 sideplane phy settings

Unless otherwise stated, the settings documented in the following table are applicable to both enclosure drawers. The drive indexes shown in the table are for the top drawer. Adding 42 to the top-drawer drive bay index will give the corresponding bottom-drawer drive bay index.

Table 17 – Sideplane Phy Zone Settings for Zone Mode 1

Phy Type	Left-hand Sideplane				Right-hand Sideplane			
	Phy ID	Drive Bay	ZG	RI IZP ZGP	Phy ID	Drive Bay	ZG	RI IZP ZGP
24-port Expander								
HDD	0	0	50	3h	0	0	50	3h
	1	1	50	3h	1	1	50	3h
	2	2	50	3h	2	2	50	3h
	3	3	51	3h	3	3	51	3h
	4	4	52	3h	4	4	52	3h
	5	5	53	3h	5	5	53	3h
	6	6	53	3h	6	6	53	3h
	7	7	54	3h	7	7	54	3h
	8	8	54	3h	8	8	54	3h
	9	9	54	3h	9	9	54	3h
	10	10	55	3h	10	10	55	3h
	11	11	56	3h	11	11	56	3h
	12	12	57	3h	12	12	57	3h
	13	13	57	3h	13	13	57	3h
Internal	14	N/A	1	7h	14	N/A	1	7h

Phy Type	Left-hand Sideplane				Right-hand Sideplane			
	Phy ID	Drive Bay	ZG	RI IZP ZGP	Phy ID	Drive Bay	ZG	RI IZP ZGP
Port	15	N/A	1	7h	15	N/A	1	7h
	16	N/A	1	7h	16	N/A	1	7h
	17	N/A	1	7h	17	N/A	1	7h
Unmapped	18	N/A	N/A	N/A	18	N/A	N/A	N/A
	19	N/A	N/A	N/A	19	N/A	N/A	N/A
	20	N/A	N/A	N/A	20	N/A	N/A	N/A
	21	N/A	N/A	N/A	21	N/A	N/A	N/A
	22	N/A	N/A	N/A	22	N/A	N/A	N/A
	23	N/A	N/A	N/A	23	N/A	N/A	N/A
36-port Expander								
HDD	0	14	50	3h	0	14	50	3h
	1	15	50	3h	1	15	50	3h
	2	16	51	3h	2	16	51	3h
	3	17	51	3h	3	17	51	3h
	4	18	52	3h	4	18	52	3h
	5	19	53	3h	5	19	53	3h
	6	20	53	3h	6	20	53	3h
	7	21	54	3h	7	21	54	3h
	8	22	54	3h	8	22	54	3h
	9	23	55	3h	9	23	55	3h
	10	24	55	3h	10	24	55	3h
	11	25	56	3h	11	25	56	3h
	12	26	57	3h	12	26	57	3h
	13	27	57	3h	13	27	57	3h
	14	28	50	3h	14	28	50	3h
	15	29	50	3h	15	29	50	3h
	16	30	51	3h	16	30	51	3h
	17	31	52	3h	17	31	52	3h
	18	32	53	3h	18	32	53	3h
	19	33	53	3h	19	33	53	3h
	20	34	53	3h	20	34	53	3h
	21	35	54	3h	21	35	54	3h
	22	36	54	3h	22	36	54	3h
	23	37	55	3h	23	37	55	3h
	24	38	58	3h	24	38	58	3h
	25	39	57	3h	25	39	57	3h
	26	40	57	3h	26	40	57	3h
	27	41	57	3h	27	41	57	3h
Internal Port	28	N/A	1	7h	28	N/A	1	7h
	29	N/A	1	7h	29	N/A	1	7h
	30	N/A	1	7h	30	N/A	1	7h
	31	N/A	1	7h	31	N/A	1	7h
	32	N/A	1	7h	32	N/A	1	7h
	33	N/A	1	7h	33	N/A	1	7h

Phy Type	Left-hand Sideplane				Right-hand Sideplane			
	Phy ID	Drive Bay	ZG	RI IZP ZGP	Phy ID	Drive Bay	ZG	RI IZP ZGP
	34	N/A	1	7h	34	N/A	1	7h
	35	N/A	1	7h	35	N/A	1	7h

A-1.3 Zone mode 1 permissions table

Note that all source and destination permissions not documented in the ZPT below should be assumed to be set to '0', except when stipulated otherwise in SPL [5].

Table 18 - Zone Permissions Table for Zone Mode 1

Dst ZG Src ZG	0	1	2	...	10	11	...	50	51	52	53	54	55	56	57	58
0	1	1	0	...	0	0	...	0	0	0	0	0	0	0	0	0
1	1	1	1	...	1	1	...	1	1	1	1	1	1	1	1	1
2	0	1	1	...	0	0	...	0	0	0	0	0	0	0	0	0
...
10	0	1	0	...	1	0	...	1	1	1	1	0	0	0	0	0
11	0	1	0	...	0	1	...	0	0	0	0	1	1	1	1	1
...
50	0	1	0	...	1	0	...	1	0	0	0	0	0	0	0	0
51	0	1	0	...	1	0	...	0	1	0	0	0	0	0	0	0
52	0	1	0	...	1	0	...	0	0	1	0	0	0	0	0	0
53	0	1	0	...	1	0	...	0	0	0	1	0	0	0	0	0
54	0	1	0	...	0	1	...	0	0	0	0	1	0	0	0	0
55	0	1	0	...	0	1	...	0	0	0	0	0	1	0	0	0
56	0	1	0	...	0	1	...	0	0	0	0	0	0	1	0	0
57	0	1	0	...	0	1	...	0	0	0	0	0	0	0	1	0
58	0	1	0	...	0	1	...	0	0	0	0	0	0	0	0	1

A-2 Zone mode 2 configuration

A-2.1 Zone mode 2 IOM phy settings

Table 19 – IOM Phy Zone Settings for Zone Mode 2

Phy Type	Phy ID	Phy ID (hex)	IOM A		IOM B		RIZPSDS IZP ZGP
			Expander ¹	ZG	Expander ¹	ZG	
MiniSAS 0	0	0h	N/A	8	N/A	8	3h
	1	1h	N/A	8	N/A	8	3h
	2	2h	N/A	8	N/A	8	3h
	3	3h	N/A	8	N/A	8	3h
MiniSAS 1	4	4h	N/A	8	N/A	8	3h
	5	5h	N/A	8	N/A	8	3h
	6	6h	N/A	8	N/A	8	3h
	7	7h	N/A	8	N/A	8	3h
IOC 0	8	8h	N/A	10	N/A	10	3h
	9	9h	N/A	10	N/A	10	3h
	10	Ah	N/A	10	N/A	10	3h
	11	Bh	N/A	10	N/A	10	3h
	12	Ch	N/A	10	N/A	10	3h
	13	Dh	N/A	10	N/A	10	3h
	14	Eh	N/A	10	N/A	10	3h
	15	Fh	N/A	10	N/A	10	3h
IOC 1	16	10h	N/A	11	N/A	11	3h
	17	11h	N/A	11	N/A	11	3h
	18	12h	N/A	11	N/A	11	3h
	19	13h	N/A	11	N/A	11	3h
	20	14h	N/A	11	N/A	11	3h
	21	15h	N/A	11	N/A	11	3h
	22	16h	N/A	11	N/A	11	3h
	23	17h	N/A	11	N/A	11	3h
Internal Ports	24	18h	TR24	1	BL24	1	7h
	25	19h	TR24	1	BL24	1	7h
	26	1Ah	TR24	1	BL24	1	7h
	27	1Bh	TR24	1	BL24	1	7h
	28	1Ch	TR36	1	BL36	1	7h
	29	1Dh	TR36	1	BL36	1	7h
	30	1Eh	TR36	1	BL36	1	7h
	31	1Fh	TR36	1	BL36	1	7h
	32	20h	TR36	1	BL36	1	7h
	33	21h	TR36	1	BL36	1	7h
	34	22h	TR36	1	BL36	1	7h
	35	23h	TR36	1	BL36	1	7h
	36	24h	BR24	1	TL24	1	7h
	37	25h	BR24	1	TL24	1	7h

Phy Type	Phy ID	Phy ID (hex)	IOM A		IOM B		RIZPSDS IZP ZGP
			Expander ¹	ZG	Expander ¹	ZG	
	38	26h	BR24	1	TL24	1	7h
	39	27h	BR24	1	TL24	1	7h
	40	28h	BR36	1	TL36	1	7h
	41	29h	BR36	1	TL36	1	7h
	42	2Ah	BR36	1	TL36	1	7h
	43	2Bh	BR36	1	TL36	1	7h
	44	2Ch	BR36	1	TL36	1	7h
	45	2Dh	BR36	1	TL36	1	7h
	46	2Eh	BR36	1	TL36	1	7h
	47	2Fh	BR36	1	TL36	1	7h

¹Attached sideplane expander key: R=Right sideplane, L=Left sideplane, T=Top-drawer, B=Bottom-drawer, 24=24-port, 36=36-port

A-2.2 Zone mode 2 sideplane phy settings

Unless otherwise stated, the settings documented in the following table are applicable to both enclosure drawers. The drive indexes shown in the table are for the top drawer. Adding 42 to the top-drawer drive bay index will give the corresponding bottom-drawer drive bay index.

Table 20 – Sideplane Phy Zone Settings for Zone Mode 2

Phy Type	Left-hand Sideplane				Right-hand Sideplane			
	Phy ID	Drive Bay	ZG	RI IZP ZGP	Phy ID	Drive Bay	ZG	RI IZP ZGP
24-port Expander								
HDD	0	0	50	3h	0	0	50	3h
	1	1	50	3h	1	1	50	3h
	2	2	50	3h	2	2	50	3h
	3	3	51	3h	3	3	51	3h
	4	4	52	3h	4	4	52	3h
	5	5	53	3h	5	5	53	3h
	6	6	53	3h	6	6	53	3h
	7	7	54	3h	7	7	54	3h
	8	8	54	3h	8	8	54	3h
	9	9	54	3h	9	9	54	3h
	10	10	55	3h	10	10	55	3h
	11	11	56	3h	11	11	56	3h
	12	12	57	3h	12	12	57	3h
Internal Port	13	13	57	3h	13	13	57	3h
	14	N/A	1	7h	14	N/A	1	7h
	15	N/A	1	7h	15	N/A	1	7h
	16	N/A	1	7h	16	N/A	1	7h
	17	N/A	1	7h	17	N/A	1	7h
	18	N/A	N/A	N/A	18	N/A	N/A	N/A

Phy Type	Left-hand Sideplane				Right-hand Sideplane			
	Phy ID	Drive Bay	ZG	RI IZP ZGP	Phy ID	Drive Bay	ZG	RI IZP ZGP
Unmapped	19	N/A	N/A	N/A	19	N/A	N/A	N/A
	20	N/A	N/A	N/A	20	N/A	N/A	N/A
	21	N/A	N/A	N/A	21	N/A	N/A	N/A
	22	N/A	N/A	N/A	22	N/A	N/A	N/A
	23	N/A	N/A	N/A	23	N/A	N/A	N/A
36-port Expander								
HDD	0	14	50	3h	0	14	50	3h
	1	15	50	3h	1	15	50	3h
	2	16	51	3h	2	16	51	3h
	3	17	51	3h	3	17	51	3h
	4	18	52	3h	4	18	52	3h
	5	19	53	3h	5	19	53	3h
	6	20	53	3h	6	20	53	3h
	7	21	54	3h	7	21	54	3h
	8	22	54	3h	8	22	54	3h
	9	23	55	3h	9	23	55	3h
	10	24	55	3h	10	24	55	3h
	11	25	56	3h	11	25	56	3h
	12	26	57	3h	12	26	57	3h
	13	27	57	3h	13	27	57	3h
	14	28	50	3h	14	28	50	3h
	15	29	50	3h	15	29	50	3h
	16	30	51	3h	16	30	51	3h
	17	31	52	3h	17	31	52	3h
	18	32	53	3h	18	32	53	3h
	19	33	53	3h	19	33	53	3h
	20	34	53	3h	20	34	53	3h
	21	35	54	3h	21	35	54	3h
	22	36	54	3h	22	36	54	3h
	23	37	55	3h	23	37	55	3h
	24	38	58	3h	24	38	58	3h
	25	39	57	3h	25	39	57	3h
	26	40	57	3h	26	40	57	3h
	27	41	57	3h	27	41	57	3h
Internal Port	28	N/A	1	7h	28	N/A	1	7h
	29	N/A	1	7h	29	N/A	1	7h
	30	N/A	1	7h	30	N/A	1	7h
	31	N/A	1	7h	31	N/A	1	7h
	32	N/A	1	7h	32	N/A	1	7h
	33	N/A	1	7h	33	N/A	1	7h
	34	N/A	1	7h	34	N/A	1	7h
	35	N/A	1	7h	35	N/A	1	7h

A-2.3 Zone mode 2 permissions table

Note that all source and destination permissions not documented in the ZPT below should be assumed to be set to '0', except when stipulated otherwise in SPL [5].

Table 21 - Zone Permissions Table for Zone Mode 2

Dst ZG Src ZG	0	1	2	...	8	...	10	11	...	50	51	52	53	54	55	56	57	58
0	1	1	0	...	0	...	0	0	...	0	0	0	0	0	0	0	0	0
1	1	1	1	...	1	...	1	1	...	1	1	1	1	1	1	1	1	1
2	0	1	1	...	0	...	0	0	...	0	0	0	0	0	0	0	0	0
...
8	0	1	0	...	1	...	0	1	...	0	0	0	0	0	0	0	0	0
...
10	0	1	0	...	0	...	1	0	...	1	1	1	1	1	1	1	1	1
11	0	1	0	...	1	...	0	1	...	0	0	0	0	0	0	0	0	0
...
50	0	1	0	...	0	...	1	0	...	1	0	0	0	0	0	0	0	0
51	0	1	0	...	0	...	1	0	...	0	1	0	0	0	0	0	0	0
52	0	1	0	...	0	...	1	0	...	0	0	1	0	0	0	0	0	0
53	0	1	0	...	0	...	1	0	...	0	0	0	1	0	0	0	0	0
54	0	1	0	...	0	...	1	0	...	0	0	0	0	1	0	0	0	0
55	0	1	0	...	0	...	1	0	...	0	0	0	0	0	1	0	0	0
56	0	1	0	...	0	...	1	0	...	0	0	0	0	0	0	1	0	0
57	0	1	0	...	0	...	1	0	...	0	0	0	0	0	0	0	1	0
58	0	1	0	...	0	...	1	0	...	0	0	0	0	0	0	0	0	1

A-3 Zone mode 3 configuration

A-3.1 Zone mode 3 IOM phy settings

Table 22 – IOM Phy Zone Settings for Zone Mode 3

Phy Type	Phy ID	Phy ID (hex)	IOM A		IOM B		RIZPSDS IZP ZGP
			Expander ¹	ZG	Expander ¹	ZG	
MiniSAS 0	0	0h	N/A	8	N/A	8	3h
	1	1h	N/A	8	N/A	8	3h
	2	2h	N/A	8	N/A	8	3h
	3	3h	N/A	8	N/A	8	3h
MiniSAS 1	4	4h	N/A	9	N/A	9	3h
	5	5h	N/A	9	N/A	9	3h
	6	6h	N/A	9	N/A	9	3h
	7	7h	N/A	9	N/A	9	3h
IOC 0	8	8h	N/A	10	N/A	10	3h
	9	9h	N/A	10	N/A	10	3h
	10	Ah	N/A	10	N/A	10	3h
	11	Bh	N/A	10	N/A	10	3h
	12	Ch	N/A	10	N/A	10	3h
	13	Dh	N/A	10	N/A	10	3h
	14	Eh	N/A	10	N/A	10	3h
	15	Fh	N/A	10	N/A	10	3h
IOC 1	16	10h	N/A	11	N/A	11	3h
	17	11h	N/A	11	N/A	11	3h
	18	12h	N/A	11	N/A	11	3h
	19	13h	N/A	11	N/A	11	3h
	20	14h	N/A	11	N/A	11	3h
	21	15h	N/A	11	N/A	11	3h
	22	16h	N/A	11	N/A	11	3h
	23	17h	N/A	11	N/A	11	3h
Internal Ports	24	18h	TR24	1	BL24	1	7h
	25	19h	TR24	1	BL24	1	7h
	26	1Ah	TR24	1	BL24	1	7h
	27	1Bh	TR24	1	BL24	1	7h
	28	1Ch	TR36	1	BL36	1	7h
	29	1Dh	TR36	1	BL36	1	7h
	30	1Eh	TR36	1	BL36	1	7h
	31	1Fh	TR36	1	BL36	1	7h
	32	20h	TR36	1	BL36	1	7h
	33	21h	TR36	1	BL36	1	7h
	34	22h	TR36	1	BL36	1	7h
	35	23h	TR36	1	BL36	1	7h
	36	24h	BR24	1	TL24	1	7h
	37	25h	BR24	1	TL24	1	7h

Phy Type	Phy ID	Phy ID (hex)	IOM A		IOM B		RIZPSDS IZP ZGP
			Expander ¹	ZG	Expander ¹	ZG	
	38	26h	BR24	1	TL24	1	7h
	39	27h	BR24	1	TL24	1	7h
	40	28h	BR36	1	TL36	1	7h
	41	29h	BR36	1	TL36	1	7h
	42	2Ah	BR36	1	TL36	1	7h
	43	2Bh	BR36	1	TL36	1	7h
	44	2Ch	BR36	1	TL36	1	7h
	45	2Dh	BR36	1	TL36	1	7h
	46	2Eh	BR36	1	TL36	1	7h
	47	2Fh	BR36	1	TL36	1	7h

¹Attached sideplane expander key: R=Right sideplane, L=Left sideplane, T=Top-drawer, B=Bottom-drawer, 24=24-port, 36=36-port

A-3.2 Zone mode 3 sideplane phy settings

Unless otherwise stated, the settings documented in the following table are applicable to both enclosure drawers. The drive indexes shown in the table are for the top drawer. Adding 42 to the top-drawer drive bay index will give the corresponding bottom-drawer drive bay index.

Table 23 – Sideplane Phy Zone Settings for Zone Mode 3

Phy Type	Left-hand Sideplane				Right-hand Sideplane			
	Phy ID	Drive Bay	ZG	RI IZP ZGP	Phy ID	Drive Bay	ZG	RI IZP ZGP
24-port Expander								
HDD	0	0	50	3h	0	0	50	3h
	1	1	50	3h	1	1	50	3h
	2	2	50	3h	2	2	50	3h
	3	3	51	3h	3	3	51	3h
	4	4	52	3h	4	4	52	3h
	5	5	53	3h	5	5	53	3h
	6	6	53	3h	6	6	53	3h
	7	7	54	3h	7	7	54	3h
	8	8	54	3h	8	8	54	3h
	9	9	54	3h	9	9	54	3h
	10	10	55	3h	10	10	55	3h
	11	11	56	3h	11	11	56	3h
	12	12	57	3h	12	12	57	3h
Internal Port	13	13	57	3h	13	13	57	3h
	14	N/A	1	7h	14	N/A	1	7h
	15	N/A	1	7h	15	N/A	1	7h
	16	N/A	1	7h	16	N/A	1	7h
	17	N/A	1	7h	17	N/A	1	7h
	18	N/A	N/A	N/A	18	N/A	N/A	N/A

Phy Type	Left-hand Sideplane				Right-hand Sideplane			
	Phy ID	Drive Bay	ZG	RI IZP ZGP	Phy ID	Drive Bay	ZG	RI IZP ZGP
Unmapped	19	N/A	N/A	N/A	19	N/A	N/A	N/A
	20	N/A	N/A	N/A	20	N/A	N/A	N/A
	21	N/A	N/A	N/A	21	N/A	N/A	N/A
	22	N/A	N/A	N/A	22	N/A	N/A	N/A
	23	N/A	N/A	N/A	23	N/A	N/A	N/A
36-port Expander								
HDD	0	14	50	3h	0	14	50	3h
	1	15	50	3h	1	15	50	3h
	2	16	51	3h	2	16	51	3h
	3	17	51	3h	3	17	51	3h
	4	18	52	3h	4	18	52	3h
	5	19	53	3h	5	19	53	3h
	6	20	53	3h	6	20	53	3h
	7	21	54	3h	7	21	54	3h
	8	22	54	3h	8	22	54	3h
	9	23	55	3h	9	23	55	3h
	10	24	55	3h	10	24	55	3h
	11	25	56	3h	11	25	56	3h
	12	26	57	3h	12	26	57	3h
	13	27	57	3h	13	27	57	3h
	14	28	50	3h	14	28	50	3h
	15	29	50	3h	15	29	50	3h
	16	30	51	3h	16	30	51	3h
	17	31	52	3h	17	31	52	3h
	18	32	53	3h	18	32	53	3h
	19	33	53	3h	19	33	53	3h
	20	34	53	3h	20	34	53	3h
	21	35	54	3h	21	35	54	3h
	22	36	54	3h	22	36	54	3h
	23	37	55	3h	23	37	55	3h
	24	38	58	3h	24	38	58	3h
	25	39	57	3h	25	39	57	3h
	26	40	57	3h	26	40	57	3h
	27	41	57	3h	27	41	57	3h
Internal Port	28	N/A	1	7h	28	N/A	1	7h
	29	N/A	1	7h	29	N/A	1	7h
	30	N/A	1	7h	30	N/A	1	7h
	31	N/A	1	7h	31	N/A	1	7h
	32	N/A	1	7h	32	N/A	1	7h
	33	N/A	1	7h	33	N/A	1	7h
	34	N/A	1	7h	34	N/A	1	7h
	35	N/A	1	7h	35	N/A	1	7h

A-3.3 Zone mode 3 permissions table

Note that all source and destination permissions not documented in the ZPT below should be assumed to be set to '0', except when stipulated otherwise in SPL [5].

Table 24 - Zone Permissions Table for Zone Mode 3

Dst ZG Src ZG	0	1	2	...	8	9	10	11	...	50	51	52	53	54	55	56	57	58
0	1	1	0	...	0	0	0	0	...	0	0	0	0	0	0	0	0	0
1	1	1	1	...	1	1	1	1	...	1	1	1	1	1	1	1	1	1
2	0	1	1	...	0	0	0	0	...	0	0	0	0	0	0	0	0	0
...
8	0	1	0	...	1	0	1	0	...	1	1	1	1	0	0	0	0	0
9	0	1	0	...	0	1	0	1	...	0	0	0	0	1	1	1	1	1
10	0	1	0	...	1	0	1	0	...	1	1	1	1	0	0	0	0	0
11	0	1	0	...	0	1	0	1	...	0	0	0	0	1	1	1	1	1
...
50	0	1	0	...	1	0	1	0	...	1	0	0	0	0	0	0	0	0
51	0	1	0	...	1	0	1	0	...	0	1	0	0	0	0	0	0	0
52	0	1	0	...	1	0	1	0	...	0	0	1	0	0	0	0	0	0
53	0	1	0	...	1	0	1	0	...	0	0	0	1	0	0	0	0	0
54	0	1	0	...	0	1	0	1	...	0	0	0	0	1	0	0	0	0
55	0	1	0	...	0	1	0	1	...	0	0	0	0	0	1	0	0	0
56	0	1	0	...	0	1	0	1	...	0	0	0	0	0	0	1	0	0
57	0	1	0	...	0	1	0	1	...	0	0	0	0	0	0	0	1	0
58	0	1	0	...	0	1	0	1	...	0	0	0	0	0	0	0	0	1

A-4 Zone mode 4 configuration

A-4.1 Zone mode 4 IOM phy settings

Table 25 – IOM Phy Zone Settings for Zone Mode 4

Phy Type	Phy ID	Phy ID (hex)	IOM A		IOM B		RIZPSDS IZP ZGP
			Expander ¹	ZG	Expander ¹	ZG	
MiniSAS 0	0	0h	N/A	8	N/A	8	3h
	1	1h	N/A	8	N/A	8	3h
	2	2h	N/A	8	N/A	8	3h
	3	3h	N/A	8	N/A	8	3h
MiniSAS 1	4	4h	N/A	9	N/A	9	3h
	5	5h	N/A	9	N/A	9	3h
	6	6h	N/A	9	N/A	9	3h
	7	7h	N/A	9	N/A	9	3h
IOC 0	8	8h	N/A	10	N/A	10	3h
	9	9h	N/A	10	N/A	10	3h
	10	Ah	N/A	10	N/A	10	3h
	11	Bh	N/A	10	N/A	10	3h
	12	Ch	N/A	10	N/A	10	3h
	13	Dh	N/A	10	N/A	10	3h
	14	Eh	N/A	10	N/A	10	3h
	15	Fh	N/A	10	N/A	10	3h
IOC 1	16	10h	N/A	11	N/A	11	3h
	17	11h	N/A	11	N/A	11	3h
	18	12h	N/A	11	N/A	11	3h
	19	13h	N/A	11	N/A	11	3h
	20	14h	N/A	11	N/A	11	3h
	21	15h	N/A	11	N/A	11	3h
	22	16h	N/A	11	N/A	11	3h
	23	17h	N/A	11	N/A	11	3h
Internal Ports	24	18h	TR24	1	BL24	1	7h
	25	19h	TR24	1	BL24	1	7h
	26	1Ah	TR24	1	BL24	1	7h
	27	1Bh	TR24	1	BL24	1	7h
	28	1Ch	TR36	1	BL36	1	7h
	29	1Dh	TR36	1	BL36	1	7h
	30	1Eh	TR36	1	BL36	1	7h
	31	1Fh	TR36	1	BL36	1	7h
	32	20h	TR36	1	BL36	1	7h
	33	21h	TR36	1	BL36	1	7h
	34	22h	TR36	1	BL36	1	7h
	35	23h	TR36	1	BL36	1	7h
	36	24h	BR24	1	TL24	1	7h
	37	25h	BR24	1	TL24	1	7h

Phy Type	Phy ID	Phy ID (hex)	IOM A		IOM B		RIZPSDS IZP ZGP
			Expander ¹	ZG	Expander ¹	ZG	
	38	26h	BR24	1	TL24	1	7h
	39	27h	BR24	1	TL24	1	7h
	40	28h	BR36	1	TL36	1	7h
	41	29h	BR36	1	TL36	1	7h
	42	2Ah	BR36	1	TL36	1	7h
	43	2Bh	BR36	1	TL36	1	7h
	44	2Ch	BR36	1	TL36	1	7h
	45	2Dh	BR36	1	TL36	1	7h
	46	2Eh	BR36	1	TL36	1	7h
	47	2Fh	BR36	1	TL36	1	7h

¹Attached sideplane expander key: R=Right sideplane, L=Left sideplane, T=Top-drawer, B=Bottom-drawer, 24=24-port, 36=36-port

A-4.2 Zone mode 4 sideplane phy settings

Unless otherwise stated, the settings documented in the following table are applicable to both enclosure drawers. The drive indexes shown in the table are for the top drawer. Adding 42 to the top-drawer drive bay index will give the corresponding bottom-drawer drive bay index.

Table 26 – Sideplane Phy Zone Settings for Zone Mode 4

Phy Type	Left-hand Sideplane				Right-hand Sideplane			
	Phy ID	Drive Bay	ZG	RI IZP ZGP	Phy ID	Drive Bay	ZG	RI IZP ZGP
24-port Expander								
HDD	0	0	50	3h	0	0	50	3h
	1	1	50	3h	1	1	50	3h
	2	2	50	3h	2	2	50	3h
	3	3	51	3h	3	3	51	3h
	4	4	52	3h	4	4	52	3h
	5	5	53	3h	5	5	53	3h
	6	6	53	3h	6	6	53	3h
	7	7	54	3h	7	7	54	3h
	8	8	54	3h	8	8	54	3h
	9	9	54	3h	9	9	54	3h
	10	10	55	3h	10	10	55	3h
	11	11	56	3h	11	11	56	3h
	12	12	57	3h	12	12	57	3h
Internal Port	13	13	57	3h	13	13	57	3h
	14	N/A	1	7h	14	N/A	1	7h
	15	N/A	1	7h	15	N/A	1	7h
	16	N/A	1	7h	16	N/A	1	7h
	17	N/A	1	7h	17	N/A	1	7h
	18	N/A	N/A	N/A	18	N/A	N/A	N/A

Phy Type	Left-hand Sideplane				Right-hand Sideplane			
	Phy ID	Drive Bay	ZG	RI IZP ZGP	Phy ID	Drive Bay	ZG	RI IZP ZGP
Unmapped	19	N/A	N/A	N/A	19	N/A	N/A	N/A
	20	N/A	N/A	N/A	20	N/A	N/A	N/A
	21	N/A	N/A	N/A	21	N/A	N/A	N/A
	22	N/A	N/A	N/A	22	N/A	N/A	N/A
	23	N/A	N/A	N/A	23	N/A	N/A	N/A
36-port Expander								
HDD	0	14	50	3h	0	14	50	3h
	1	15	50	3h	1	15	50	3h
	2	16	51	3h	2	16	51	3h
	3	17	51	3h	3	17	51	3h
	4	18	52	3h	4	18	52	3h
	5	19	53	3h	5	19	53	3h
	6	20	53	3h	6	20	53	3h
	7	21	54	3h	7	21	54	3h
	8	22	54	3h	8	22	54	3h
	9	23	55	3h	9	23	55	3h
	10	24	55	3h	10	24	55	3h
	11	25	56	3h	11	25	56	3h
	12	26	57	3h	12	26	57	3h
	13	27	57	3h	13	27	57	3h
	14	28	50	3h	14	28	50	3h
	15	29	50	3h	15	29	50	3h
	16	30	51	3h	16	30	51	3h
	17	31	52	3h	17	31	52	3h
	18	32	53	3h	18	32	53	3h
	19	33	53	3h	19	33	53	3h
	20	34	53	3h	20	34	53	3h
	21	35	54	3h	21	35	54	3h
	22	36	54	3h	22	36	54	3h
	23	37	55	3h	23	37	55	3h
	24	38	58	3h	24	38	58	3h
	25	39	57	3h	25	39	57	3h
	26	40	57	3h	26	40	57	3h
	27	41	57	3h	27	41	57	3h
Internal Port	28	N/A	1	7h	28	N/A	1	7h
	29	N/A	1	7h	29	N/A	1	7h
	30	N/A	1	7h	30	N/A	1	7h
	31	N/A	1	7h	31	N/A	1	7h
	32	N/A	1	7h	32	N/A	1	7h
	33	N/A	1	7h	33	N/A	1	7h
	34	N/A	1	7h	34	N/A	1	7h
	35	N/A	1	7h	35	N/A	1	7h

A-4.3 Zone mode 4 permissions table

Note that all source and destination permissions not documented in the ZPT below should be assumed to be set to '0', except when stipulated otherwise in SPL [5].

Table 27 - Zone Permissions Table for Zone Mode 4

Dst ZG Src ZG	0	1	2	...	8	9	10	11	...	50	51	52	53	54	55	56	57	58
0	1	1	0	...	0	0	0	0	...	0	0	0	0	0	0	0	0	0
1	1	1	1	...	1	1	1	0 ^a	...	1	1	1	1	1	1	1	1	1
2	0	1	1	...	0	0	0	0	...	0	0	0	0	0	0	0	0	0
...
8	0	1	0	...	1	0	1	0	...	1	1	1	1	1	1	1	1	1
9	0	1	0	...	0	1	1	0	...	1	1	1	1	1	1	1	1	1
10	0	1	0	...	1	1	1	0	...	1	1	1	1	1	1	1	1	1
11	0	0 ^a	0	...	0	0	0	1	...	0	0	0	0	0	0	0	0	0
...
50	0	1	0	...	1	1	1	0	...	1	0	0	0	0	0	0	0	0
51	0	1	0	...	1	1	1	0	...	0	1	0	0	0	0	0	0	0
52	0	1	0	...	1	1	1	0	...	0	0	1	0	0	0	0	0	0
53	0	1	0	...	1	1	1	0	...	0	0	0	1	0	0	0	0	0
54	0	1	0	...	1	1	1	0	...	0	0	0	0	1	0	0	0	0
55	0	1	0	...	1	1	1	0	...	0	0	0	0	0	1	0	0	0
56	0	1	0	...	1	1	1	0	...	0	0	0	0	0	0	1	0	0
57	0	1	0	...	1	1	1	0	...	0	0	0	0	0	0	0	1	0
58	0	1	0	...	1	1	1	0	...	0	0	0	0	0	0	0	0	1

^a ZG1 access is intentionally disallowed to suppress SEP access from second IOC port

A-5 Zone mode 5 configuration

A-5.1 Zone mode 5 IOM phy settings

Table 28 – IOM Phy Zone Settings for Zone Mode 5

Phy Type	Phy ID	Phy ID (hex)	IOM A		IOM B		RIZPSDS IZP ZGP
			Expander ¹	ZG	Expander ¹	ZG	
MiniSAS 0	0	0h	N/A	1	N/A	1	7h
	1	1h	N/A	1	N/A	1	7h
	2	2h	N/A	1	N/A	1	7h
	3	3h	N/A	1	N/A	1	7h
MiniSAS 1	4	4h	N/A	1	N/A	1	7h
	5	5h	N/A	1	N/A	1	7h
	6	6h	N/A	1	N/A	1	7h
	7	7h	N/A	1	N/A	1	7h
IOC 0	8	8h	N/A	10	N/A	16	3h
	9	9h	N/A	10	N/A	16	3h
	10	Ah	N/A	10	N/A	16	3h
	11	Bh	N/A	10	N/A	16	3h
	12	Ch	N/A	10	N/A	16	3h
	13	Dh	N/A	10	N/A	16	3h
	14	Eh	N/A	10	N/A	16	3h
	15	Fh	N/A	10	N/A	16	3h
IOC 1	16	10h	N/A	11	N/A	17	3h
	17	11h	N/A	11	N/A	17	3h
	18	12h	N/A	11	N/A	17	3h
	19	13h	N/A	11	N/A	17	3h
	20	14h	N/A	11	N/A	17	3h
	21	15h	N/A	11	N/A	17	3h
	22	16h	N/A	11	N/A	17	3h
	23	17h	N/A	11	N/A	17	3h
Internal Ports	24	18h	TR24	1	BL24	1	7h
	25	19h	TR24	1	BL24	1	7h
	26	1Ah	TR24	1	BL24	1	7h
	27	1Bh	TR24	1	BL24	1	7h
	28	1Ch	TR36	1	BL36	1	7h
	29	1Dh	TR36	1	BL36	1	7h
	30	1Eh	TR36	1	BL36	1	7h
	31	1Fh	TR36	1	BL36	1	7h
	32	20h	TR36	1	BL36	1	7h
	33	21h	TR36	1	BL36	1	7h
	34	22h	TR36	1	BL36	1	7h
	35	23h	TR36	1	BL36	1	7h
	36	24h	BR24	18	TL24	19	3h
	37	25h	BR24	18	TL24	19	3h

Phy Type	Phy ID	Phy ID (hex)	IOM A		IOM B		RIZPSDS IZP ZGP
			Expander ¹	ZG	Expander ¹	ZG	
	38	26h	BR24	18	TL24	19	3h
	39	27h	BR24	18	TL24	19	3h
	40	28h	BR36	18	TL36	19	3h
	41	29h	BR36	18	TL36	19	3h
	42	2Ah	BR36	18	TL36	19	3h
	43	2Bh	BR36	18	TL36	19	3h
	44	2Ch	BR36	18	TL36	19	3h
	45	2Dh	BR36	18	TL36	19	3h
	46	2Eh	BR36	18	TL36	19	3h
	47	2Fh	BR36	18	TL36	19	3h

¹Attached sideplane expander key: R=Right sideplane, L=Left sideplane, T=Top-drawer, B=Bottom-drawer, 24=24-port, 36=36-port

A-5.2 Zone mode 5 sideplane phy settings

Unless otherwise stated, the settings documented in the following table are applicable to both enclosure drawers. The drive indexes shown in the table are for the top drawer. Adding 42 to the top-drawer drive bay index will give the corresponding bottom-drawer drive bay index.

Table 29 – Sideplane Phy Zone Settings for Zone Mode 5

Phy Type	Left-hand Sideplane				Right-hand Sideplane			
	Phy ID	Drive Bay	ZG	RI IZP ZGP	Phy ID	Drive Bay	ZG	RI IZP ZGP
24-port Expander								
HDD	0	0	50	3h	0	0	50	3h
	1	1	50	3h	1	1	50	3h
	2	2	50	3h	2	2	50	3h
	3	3	51	3h	3	3	51	3h
	4	4	52	3h	4	4	52	3h
	5	5	53	3h	5	5	53	3h
	6	6	53	3h	6	6	53	3h
	7	7	54	3h	7	7	54	3h
	8	8	54	3h	8	8	54	3h
	9	9	54	3h	9	9	54	3h
	10	10	55	3h	10	10	55	3h
	11	11	56	3h	11	11	56	3h
	12	12	57	3h	12	12	57	3h
Internal Port	13	13	57	3h	13	13	57	3h
	14	N/A	1	7h	14	N/A	1	7h
	15	N/A	1	7h	15	N/A	1	7h
	16	N/A	1	7h	16	N/A	1	7h
	17	N/A	1	7h	17	N/A	1	7h
	18	N/A	N/A	N/A	18	N/A	N/A	N/A

Phy Type	Left-hand Sideplane				Right-hand Sideplane			
	Phy ID	Drive Bay	ZG	RI IZP ZGP	Phy ID	Drive Bay	ZG	RI IZP ZGP
Unmapped	19	N/A	N/A	N/A	19	N/A	N/A	N/A
	20	N/A	N/A	N/A	20	N/A	N/A	N/A
	21	N/A	N/A	N/A	21	N/A	N/A	N/A
	22	N/A	N/A	N/A	22	N/A	N/A	N/A
	23	N/A	N/A	N/A	23	N/A	N/A	N/A
36-port Expander								
HDD	0	14	50	3h	0	14	50	3h
	1	15	50	3h	1	15	50	3h
	2	16	51	3h	2	16	51	3h
	3	17	51	3h	3	17	51	3h
	4	18	52	3h	4	18	52	3h
	5	19	53	3h	5	19	53	3h
	6	20	53	3h	6	20	53	3h
	7	21	54	3h	7	21	54	3h
	8	22	54	3h	8	22	54	3h
	9	23	55	3h	9	23	55	3h
	10	24	55	3h	10	24	55	3h
	11	25	56	3h	11	25	56	3h
	12	26	57	3h	12	26	57	3h
	13	27	57	3h	13	27	57	3h
	14	28	50	3h	14	28	50	3h
	15	29	50	3h	15	29	50	3h
	16	30	51	3h	16	30	51	3h
	17	31	52	3h	17	31	52	3h
	18	32	53	3h	18	32	53	3h
	19	33	53	3h	19	33	53	3h
	20	34	53	3h	20	34	53	3h
	21	35	54	3h	21	35	54	3h
	22	36	54	3h	22	36	54	3h
	23	37	55	3h	23	37	55	3h
	24	38	58	3h	24	38	58	3h
	25	39	57	3h	25	39	57	3h
	26	40	57	3h	26	40	57	3h
	27	41	57	3h	27	41	57	3h
Internal Port	28	N/A	1	7h	28	N/A	1	7h
	29	N/A	1	7h	29	N/A	1	7h
	30	N/A	1	7h	30	N/A	1	7h
	31	N/A	1	7h	31	N/A	1	7h
	32	N/A	1	7h	32	N/A	1	7h
	33	N/A	1	7h	33	N/A	1	7h
	34	N/A	1	7h	34	N/A	1	7h
	35	N/A	1	7h	35	N/A	1	7h

A-5.3 Zone mode 5 permissions table

Note that all source and destination permissions not documented in the ZPT below should be assumed to be set to '0', except when stipulated otherwise in SPL [5].

Table 30 - Zone Permissions Table for Zone Mode 5

Dst ZG Src ZG	0	1	2	...	10	11	...	16	17	18	19	...	50	51	52	53	54	55	56	57	58
0	1	1	0	...	0	0	...	0	0	0	0	...	0	0	0	0	0	0	0	0	0
1	1	1	1	...	1	1	...	1	1	1	1	...	1	1	1	1	1	1	1	1	1
2	0	1	1	...	0	0	...	0	0	0	0	...	0	0	0	0	0	0	0	0	0
...
10	0	1	0	...	1	0	...	0	0	0	0	...	1	1	1	1	0	0	0	0	0
11	0	1	0	...	0	1	...	0	0	0	0	...	0	0	0	0	1	1	1	1	1
...
16	0	1	0	...	0	0	...	1	0	0	0	...	1	1	1	1	0	0	0	0	0
17	0	1	0	...	0	0	...	0	1	0	0	...	0	0	0	0	1	1	1	1	1
18	0	1	0	...	0	0	...	0	0	1	0	...	0	0	0	0	0	0	0	0	0
19	0	1	0	...	0	0	...	0	0	0	1	...	0	0	0	0	0	0	0	0	0
...
50	0	1	0	...	1	0	...	1	0	0	0	...	1	0	0	0	0	0	0	0	0
51	0	1	0	...	1	0	...	1	0	0	0	...	0	1	0	0	0	0	0	0	0
52	0	1	0	...	1	0	...	1	0	0	0	...	0	0	1	0	0	0	0	0	0
53	0	1	0	...	1	0	...	1	0	0	0	...	0	0	0	1	0	0	0	0	0
54	0	1	0	...	0	1	...	0	1	0	0	...	0	0	0	0	1	0	0	0	0
55	0	1	0	...	0	1	...	0	1	0	0	...	0	0	0	0	0	1	0	0	0
56	0	1	0	...	0	1	...	0	1	0	0	...	0	0	0	0	0	0	1	0	0
57	0	1	0	...	0	1	...	0	1	0	0	...	0	0	0	0	0	0	0	1	0
58	0	1	0	...	0	1	...	0	1	0	0	...	0	0	0	0	0	0	0	0	1

A-6 Zone mode 6 configuration

A-6.1 Zone mode 6 IOM phy settings

Table 31 – IOM Phy Zone Settings for Zone Mode 6

Phy Type	Phy ID	Phy ID (hex)	IOM A		IOM B		RIZPSDS IZP ZGP
			Expander ¹	ZG	Expander ¹	ZG	
MiniSAS 0	0	0h	N/A	8	N/A	8	3h
	1	1h	N/A	8	N/A	8	3h
	2	2h	N/A	8	N/A	8	3h
	3	3h	N/A	8	N/A	8	3h
MiniSAS 1	4	4h	N/A	9	N/A	9	3h
	5	5h	N/A	9	N/A	9	3h
	6	6h	N/A	9	N/A	9	3h
	7	7h	N/A	9	N/A	9	3h
IOC 0	8	8h	N/A	10	N/A	16	3h
	9	9h	N/A	10	N/A	16	3h
	10	Ah	N/A	10	N/A	16	3h
	11	Bh	N/A	10	N/A	16	3h
	12	Ch	N/A	10	N/A	16	3h
	13	Dh	N/A	10	N/A	16	3h
	14	Eh	N/A	10	N/A	16	3h
	15	Fh	N/A	10	N/A	16	3h
IOC 1	16	10h	N/A	11	N/A	17	3h
	17	11h	N/A	11	N/A	17	3h
	18	12h	N/A	11	N/A	17	3h
	19	13h	N/A	11	N/A	17	3h
	20	14h	N/A	11	N/A	17	3h
	21	15h	N/A	11	N/A	17	3h
	22	16h	N/A	11	N/A	17	3h
	23	17h	N/A	11	N/A	17	3h
Internal Ports	24	18h	TR24	1	BL24	1	7h
	25	19h	TR24	1	BL24	1	7h
	26	1Ah	TR24	1	BL24	1	7h
	27	1Bh	TR24	1	BL24	1	7h
	28	1Ch	TR36	1	BL36	1	7h
	29	1Dh	TR36	1	BL36	1	7h
	30	1Eh	TR36	1	BL36	1	7h
	31	1Fh	TR36	1	BL36	1	7h
	32	20h	TR36	1	BL36	1	7h
	33	21h	TR36	1	BL36	1	7h
	34	22h	TR36	1	BL36	1	7h
	35	23h	TR36	1	BL36	1	7h
	36	24h	BR24	18	TL24	19	3h
	37	25h	BR24	18	TL24	19	3h

Phy Type	Phy ID	Phy ID (hex)	IOM A		IOM B		RIZPSDS IZP ZGP
			Expander ¹	ZG	Expander ¹	ZG	
	38	26h	BR24	18	TL24	19	3h
	39	27h	BR24	18	TL24	19	3h
	40	28h	BR36	18	TL36	19	3h
	41	29h	BR36	18	TL36	19	3h
	42	2Ah	BR36	18	TL36	19	3h
	43	2Bh	BR36	18	TL36	19	3h
	44	2Ch	BR36	18	TL36	19	3h
	45	2Dh	BR36	18	TL36	19	3h
	46	2Eh	BR36	18	TL36	19	3h
	47	2Fh	BR36	18	TL36	19	3h

¹Attached sideplane expander key: R=Right sideplane, L=Left sideplane, T=Top-drawer, B=Bottom-drawer, 24=24-port, 36=36-port

A-6.2 Zone mode 6 sideplane phy settings

Unless otherwise stated, the settings documented in the following table are applicable to both enclosure drawers. The drive indexes shown in the table are for the top drawer. Adding 42 to the top-drawer drive bay index will give the corresponding bottom-drawer drive bay index.

Table 32 – Sideplane Phy Zone Settings for Zone Mode 6

Phy Type	Left-hand Sideplane				Right-hand Sideplane			
	Phy ID	Drive Bay	ZG	RI IZP ZGP	Phy ID	Drive Bay	ZG	RI IZP ZGP
24-port Expander								
HDD	0	0	50	3h	0	0	50	3h
	1	1	50	3h	1	1	50	3h
	2	2	50	3h	2	2	50	3h
	3	3	51	3h	3	3	51	3h
	4	4	52	3h	4	4	52	3h
	5	5	53	3h	5	5	53	3h
	6	6	53	3h	6	6	53	3h
	7	7	54	3h	7	7	54	3h
	8	8	54	3h	8	8	54	3h
	9	9	54	3h	9	9	54	3h
	10	10	55	3h	10	10	55	3h
	11	11	56	3h	11	11	56	3h
	12	12	57	3h	12	12	57	3h
Internal Port	13	13	57	3h	13	13	57	3h
	14	N/A	1	7h	14	N/A	1	7h
	15	N/A	1	7h	15	N/A	1	7h
	16	N/A	1	7h	16	N/A	1	7h
	17	N/A	1	7h	17	N/A	1	7h
	18	N/A	N/A	N/A	18	N/A	N/A	N/A

Phy Type	Left-hand Sideplane				Right-hand Sideplane			
	Phy ID	Drive Bay	ZG	RI IZP ZGP	Phy ID	Drive Bay	ZG	RI IZP ZGP
Unmapped	19	N/A	N/A	N/A	19	N/A	N/A	N/A
	20	N/A	N/A	N/A	20	N/A	N/A	N/A
	21	N/A	N/A	N/A	21	N/A	N/A	N/A
	22	N/A	N/A	N/A	22	N/A	N/A	N/A
	23	N/A	N/A	N/A	23	N/A	N/A	N/A
36-port Expander								
HDD	0	14	50	3h	0	14	50	3h
	1	15	50	3h	1	15	50	3h
	2	16	51	3h	2	16	51	3h
	3	17	51	3h	3	17	51	3h
	4	18	52	3h	4	18	52	3h
	5	19	53	3h	5	19	53	3h
	6	20	53	3h	6	20	53	3h
	7	21	54	3h	7	21	54	3h
	8	22	54	3h	8	22	54	3h
	9	23	55	3h	9	23	55	3h
	10	24	55	3h	10	24	55	3h
	11	25	56	3h	11	25	56	3h
	12	26	57	3h	12	26	57	3h
	13	27	57	3h	13	27	57	3h
	14	28	50	3h	14	28	50	3h
	15	29	50	3h	15	29	50	3h
	16	30	51	3h	16	30	51	3h
	17	31	52	3h	17	31	52	3h
	18	32	53	3h	18	32	53	3h
	19	33	53	3h	19	33	53	3h
	20	34	53	3h	20	34	53	3h
	21	35	54	3h	21	35	54	3h
	22	36	54	3h	22	36	54	3h
	23	37	55	3h	23	37	55	3h
	24	38	58	3h	24	38	58	3h
	25	39	57	3h	25	39	57	3h
	26	40	57	3h	26	40	57	3h
	27	41	57	3h	27	41	57	3h
Internal Port	28	N/A	1	7h	28	N/A	1	7h
	29	N/A	1	7h	29	N/A	1	7h
	30	N/A	1	7h	30	N/A	1	7h
	31	N/A	1	7h	31	N/A	1	7h
	32	N/A	1	7h	32	N/A	1	7h
	33	N/A	1	7h	33	N/A	1	7h
	34	N/A	1	7h	34	N/A	1	7h
	35	N/A	1	7h	35	N/A	1	7h

A-6.3 Zone mode 6 permissions table

Note that all source and destination permissions not documented in the ZPT below should be assumed to be set to '0', except when stipulated otherwise in SPL [5].

Table 33 - Zone Permissions Table for Zone Mode 6

Dst ZG Src ZG	0	1	2	...	8	9	10	11	...	16	17	18	19	...	50	51	52	53	54	55	56	57	58
0	1	1	0	...	0	0	0	0	...	0	0	0	0	...	0	0	0	0	0	0	0	0	0
1	1	1	1	...	1	1	1	1	...	1	1	1	1	...	1	1	1	1	1	1	1	1	1
2	0	1	1	...	0	0	0	0	...	0	0	0	0	...	0	0	0	0	0	0	0	0	0
...
8	0	1	0	...	1	0	1	0	...	1	0	0	0	...	0	0	0	0	0	0	0	0	0
9	0	1	0	...	0	1	0	1	...	0	1	0	0	...	0	0	0	0	0	0	0	0	0
10	0	1	0	...	1	0	1	0	...	0	0	0	0	...	1	1	1	1	0	0	0	0	0
11	0	1	0	...	0	1	0	1	...	0	0	0	0	...	0	0	0	0	1	1	1	1	1
...
16	0	1	0	...	1	0	0	0	...	1	0	0	0	...	1	1	1	1	0	0	0	0	0
17	0	1	0	...	0	1	0	0	...	0	1	0	0	...	0	0	0	0	1	1	1	1	1
18	0	1	0	...	0	0	0	0	...	0	0	1	0	...	0	0	0	0	0	0	0	0	0
19	0	1	0	...	0	0	0	0	...	0	0	0	1	...	0	0	0	0	0	0	0	0	0
...
50	0	1	0	...	0	0	1	0	...	1	0	0	0	...	1	0	0	0	0	0	0	0	0
51	0	1	0	...	0	0	1	0	...	1	0	0	0	...	0	1	0	0	0	0	0	0	0
52	0	1	0	...	0	0	1	0	...	1	0	0	0	...	0	0	1	0	0	0	0	0	0
53	0	1	0	...	0	0	1	0	...	1	0	0	0	...	0	0	0	1	0	0	0	0	0
54	0	1	0	...	0	0	1	0	...	1	0	0	0	...	0	0	0	0	1	0	0	0	0
55	0	1	0	...	0	0	1	0	...	1	0	0	0	...	0	0	0	0	0	1	0	0	0
56	0	1	0	...	0	0	1	0	...	1	0	0	0	...	0	0	0	0	0	0	1	0	0
57	0	1	0	...	0	0	1	0	...	1	0	0	0	...	0	0	0	0	0	0	0	1	0
58	0	1	0	...	0	0	1	0	...	1	0	0	0	...	0	0	0	0	0	0	0	0	1