



Exos E 2U12 JBOD

GEM 5 SES-3 Addenda

205135000-00-A

March 2023

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Revision History

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

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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 E 2U12 12G SAS JBOD 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.

- HB-1235-E12EBD
- SP-3212-E12EBD
- SP-3212A-E12EBD

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
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
SEP	Storage Enclosure Processor
SES	SCSI Enclosure Services
SGPIO	Serial General Purpose I/O
TWI	Two Wire Interface
VPD	Vital Product Data
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-3 Revision 6
- [2] SCSI Primary Commands - 4 (SPC-4) Revision 36n
- [3] GEM 5 ANSI SES-3 Specification

2 Supported ANSI SES-3 Pages and Elements

Table 1 **Error! Reference source not found.** lists the ANSI SES pages and Vendor Unique SES pages supported by the enclosure. Table 2 **Error! Reference source not found.** 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
03h	Help Text Diagnostic Page	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
94h	Phy Management Diagnostic Page	Control and Status

Table 2 - Supported SES Elements

Element Code	Description	Element count
ANSI SES Elements		
17h	Array Device	12
02h	Power Supply	2
03h	Cooling Element	4
04h	Temperature sensor	8
06h	Audible Alarm	1
07h	Enclosure Services Controller Electronics	2
0Eh	Enclosure	1
12h	Voltage Sensor	4
13h	Current Sensor	4
18h	SAS Expander	2
19h	SAS Connector	6
Vendor Specific SES Elements		
86h	SBB Midplane Interconnect	2
89h	Enclosure Electronics Power	2
8Ah	Enclosure Settings	1
8Bh	Enclosure Electronics Diagnostics	2

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 1 - Drive Bay numbering convention

Drive 0	Drive 1	Drive 2	Drive 3
Drive 4	Drive 5	Drive 6	Drive 7
Drive 8	Drive 9	Drive 10	Drive 11

3.1.2 Enclosure Rear View

Figure 2 – Module Bay numbering convention

PCM 0	SBB Primary Interface (Inverted) (IOM A)	PCM 1
	SBB Secondary Interface (Normal) (IOM B)	

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	Enclosure
...
11	11	Array Device element representing Disk Drive Bay 11	Enclosure
Power Supply Elements			
12	0	Power Supply element representing PCM 0	PCM 0
13	1	Power Supply element representing PCM 1	PCM 1
Cooling Elements			
14	0	Cooling element representing PCM Fan 0	PCM 0
15	1	Cooling element representing PCM Fan 1	PCM 0
16	2	Cooling element representing PCM Fan 0	PCM 1
17	3	Cooling element representing PCM Fan 1	PCM 1
Temperature Sensor Elements			
18	0	Ops Panel Ambient Temperature Sensor	Enclosure
19	1	Midplane Temperature Sensor	Enclosure
20	2	PCM Inlet Temperature Sensor	PCM 0
21	3	PCM Hotspot Temperature Sensor	PCM 0
22	4	PCM Inlet Temperature Sensor	PCM 1
23	5	PCM Hotspot Temperature Sensor	PCM 1
24	6	SBB IOM Inlet Temperature Sensor	SBB IOM A
25	7	SBB IOM Inlet Temperature Sensor	SBB IOM B
Audible Alarm Elements			
26	0	Ops Panel Buzzer State ¹	Enclosure
Enclosure Services Controller Electronics Elements			
27	0	Element associated with SEP device	SBB IOM A
28	1	Element associated with SEP device	SBB IOM B
Enclosure Elements			
29	0	Element representing the Enclosure	Enclosure
Voltage Sensor Elements			
30	0	+12V Rail Voltage Sensor	PCM 0
31	1	+5V Rail Voltage Sensor	PCM 0
32	2	+12V Rail Voltage Sensor	PCM 1
33	3	+5V Rail Voltage Sensor	PCM 1
Current Sensor Elements			
34	0	+12V Rail Current Sensor	PCM 0
35	1	+5V Rail Current Sensor	PCM 0
36	2	+12V Rail Current Sensor	PCM 1
37	3	+5V Rail Current Sensor	PCM 1

Global Element Index	Relative Element Index	Description	Associated FRU
SAS Expander Elements			
38	0	SBB IOM SAS Expander	SBB IOM A
39	1	SBB IOM SAS Expander	SBB IOM B
SAS Connector Elements			
40	0	SAS Connector for IOM MiniSAS HD Port A	SBB IOM A
41	1	SAS Connector for IOM MiniSAS HD Port B	SBB IOM A
42	2	SAS Connector for IOM MiniSAS HD Port C	SBB IOM A
43	3	SAS Connector for IOM MiniSAS HD Port A	SBB IOM B
44	4	SAS Connector for IOM MiniSAS HD Port B	SBB IOM B
45	5	SAS Connector for IOM MiniSAS HD Port C	SBB IOM B
SBB Midplane Interconnect Elements			
46	0	SBB IOM to Midplane Interconnect Electronics	SBB IOM A
47	1	SBB IOM to Midplane Interconnect Electronics	SBB IOM B
Enclosure Electronics Power Elements			
48	0	SBB IOM Power Status and Control	SBB IOM A
49	1	SBB IOM Power Status and Control	SBB IOM B
Enclosure Settings Elements			
50	0	Enclosure Ops Panel Settings	Enclosure
Enclosure Electronics Diagnostics Elements			
51	0	SEP Diagnostics status and Control	SBB IOM A
52	1	SEP Diagnostics status and Control	SBB IOM B
<p>¹The ops panel buzzer is a "no fit" option on the enclosure. In the case a buzzer is not fitted, the audible alarm element will still be represented.</p> <p>² Not available on all Power Supplies. If the sensor is not available on a specific power supply model, the SES Page 02h element status is set to NOT INSTALLED (05h).</p>			

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 4. **Error! Reference source not found.**

Table 4 - Diagnostic Page 00h Layout

Bit Byte	7	6	5	4	3	2	1	0
0	PAGE CODE (00h)							
1	Reserved							
2	(MSB)	PAGE LENGTH (14)						(LSB)
3								
4	SUPPORTED PAGE LIST							
17	(00 01 02 03 05 07 0A 0E 84 85 90 91 92 94 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 5. **Error! Reference source not found.** covers the layout of Page 01h for the enclosure documented within this addendum.

Table 5 - 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 (231)						(LSB)
3								
4	(MSB)	GENERATION CODE						(LSB)
7								
Enclosure Descriptor List ¹								
8	RSVD	RELATIVE ENCLOSURE SERVICES PROCESS ID (0h)			RSVD	NUMBER OF ENCLOSURE SERVICES PROCESSES (0h)		
9	SUBENCLOSURE IDENTIFIER (00h)							
10	NUMBER OF TYPE DESCRIPTOR HEADERS (0Fh)							
11	ENCLOSURE DESCRIPTOR LENGTH (60)							
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								
112								
115								
116								
119								

Bit Byte	7	6	5	4	3	2	1	0
120	Enclosure Power (88 01 00 0F h)							
123								
124	Enclosure Electronics Power Descriptor (89 02 00 1B h)							
127								
128	Enclosure Settings Descriptor (8A 01 00 12 h)							
131								
132	Enclosure Electronics Diagnostics Descriptor (8B 02 00 21 h)							
135								
Type Descriptor Text List ³								
136	SBB Midplane Interconnect Text Descriptor ("SBB Midplane Interconnect")							
160								
161	Enclosure Power Text Descriptor ("Enclosure Power")							
175								
176	Enclosure Electronics Power Text Descriptor ("Enclosure Electronics Power")							
202								
203	Enclosure Settings Text Descriptor ("Enclosure Settings")							
220								
221	Enclosure Electronics Diagnostics Text Descriptor ("Enclosure Electronics Diagnostics")							
253								
¹ See sections 6.2.1 – 6.2.3 in [3] for further details ² See section 6.2.4 in Error! Reference source not found. for further details on the element descriptor format ³ See section 6.2.5 in Error! Reference source not found. 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 6. **Error! Reference source not found.**

Table 6 - 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 (276)						(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								
...								
56	Array Device Element 11 Descriptor							
59								
60	Power Supply Overall Element Descriptor							
63								
64	Power Supply Element 0 Descriptor							
67								
68	Power Supply Element 1 Descriptor							
71								
72	Cooling Overall Element Descriptor							
75								
76	Cooling Element 0 Descriptor							
79								
...								
88	Cooling Element 3 Descriptor							
91								
92	Temperature Sensor Overall Element Descriptor							
95								
96	Temperature Sensor Element 0 Descriptor							
99								
...								

Bit Byte	7	6	5	4	3	2	1	0
124	Temperature Sensor Element 7 Descriptor							
127								
128	Audible Alarm Overall Element Descriptor							
131								
132	Audible Alarm Element 0 Descriptor							
135								
136	Enclosure Services Controller Electronics Overall Element Descriptor							
139								
140	Enclosure Services Controller Electronics Element 0 Descriptor							
143								
144	Enclosure Services Controller Electronics Element 1 Descriptor							
147								
148	Enclosure Overall Element Descriptor							
151								
152	Enclosure Element 0 Descriptor							
155								
156	Voltage Sensor Overall Element Descriptor							
159								
160	Voltage Sensor Element 0 Descriptor							
163								
...	...							
172	Voltage Sensor Element 3 Descriptor							
175								
176	Current Sensor Overall Element Status Descriptor							
179								
180	Current Sensor Element 0 Descriptor							
183								
...	...							
192	Current Sensor Element 3 Descriptor							
195								
196	SAS Expander Overall Element Descriptor							
199								
200	SAS Expander Element 0 Descriptor							
203								
204	SAS Expander Element 1 Descriptor							
207								
208	SAS Connector Overall Element Descriptor							
211								

Bit Byte	7	6	5	4	3	2	1	0
212	SAS Connector ⁴ Element 0 Descriptor							
215								
...	...							
232	SAS Connector Element 5 Descriptor							
235								
236	SBB Midplane Interconnect Overall Element Descriptor							
239								
240	SBB Midplane Interconnect Element 0 Descriptor							
243								
244	SBB Midplane Interconnect Element1 Descriptor							
247								
248	Enclosure Power Overall Element Descriptor							
251								
252	Enclosure Power Element Descriptor							
255								
256	Enclosure Electronics Power Overall Element Descriptor							
259								
260	Enclosure Electronics Power Element 0 Descriptor							
263								
264	Enclosure Electronics Power Element1 Descriptor							
267								
268	Enclosure Settings Overall Element Descriptor							
271								
272	Enclosure Settings Element 0 Descriptor							
275								
276	Enclosure Electronics Diagnostics Overall Element Descriptor							
279								
280	Enclosure Electronics Diagnostics Element 0 Descriptor							
283								
284	Enclosure Electronics Diagnostics Element1 Descriptor							
287								
¹ See section 6.3.2.1 in [3] for details on the SHORT STATUS format ² See section 7 of Error! Reference source not found. for status descriptor format details for each element type ³ See section x of Error! Reference source not found. for threshold descriptor format details ⁴ See Section 3.2, Table 3 (Global Element Index 40-45) for SAS Connector element to physical device mapping.								

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 7 **Error! Reference source not found.** shows which element types are expected to support a threshold.

Table 7 - Threshold Descriptor Support

Element Type	Threshold Descriptor Support
Array Device	No
Power Supply	No
Cooling Element	No
Temperature Sensor	Yes
Audible Alarm	No
Enclosure Services Controller Electronics	No
Enclosure	No
Voltage Sensor	No
Current Sensor	No
SAS Expander	No
SAS Connector	No
SBB Midplane Interconnect	No
Enclosure Electronics Power	No
Enclosure Settings	No
Enclosure Electronics Diagnostics	No
All Overall Elements	No

4.4 SES Page 07h Layout

Table 8 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 8 - SES Page 07h Layout

Bit Byte	7	6	5	4	3	2	1	0
0	PAGE CODE (07h)							
1	Reserved							
2	(MSB)	PAGE LENGTH (1711)						(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)							
...	...							
56	Array Device Element 11 Descriptor							
59	(00 00 00 00 h)							
60	Power Supply Overall Element Descriptor							
63	(00 00 00 00 h)							
64	Power Supply Element 0 Descriptor							
140	(00 00 00 49 h) 73 bytes of descriptor data ¹							
141	Power Supply Element 1 Descriptor							
217	(00 00 00 49 h) 73 bytes of descriptor data ¹							
218	Cooling Overall Element Descriptor							
221	(00 00 00 00 h)							
222	Cooling Element 0 Descriptor							
225	(00 00 00 00 h)							
...	...							
234	Cooling Element 3 Descriptor							

Bit Byte	7	6	5	4	3	2	1	0
237	(00 00 00 00 h)							
238	Temperature Sensor Overall Element Descriptor							
241	(00 00 00 00 h)							
242	Temperature Sensor Element 0 Descriptor							
301	(00 00 00 38 h) 56 bytes of descriptor data ¹							
...	...							
661	Temperature Sensor Element 7 Descriptor							
721	(00 00 00 38 h) 56 bytes of descriptor data ¹							
722	Audible Alarm Overall Element Descriptor							
725	(00 00 00 00 h)							
726	Audible Alarm Element 0 Descriptor							
729	(00 00 00 00 h)							
730	Enclosure Services Controller Electronics Overall Element Descriptor							
733	(00 00 00 00 h)							
734	Enclosure Services Controller Electronics Element 0 Descriptor							
859	(00 00 00 7A h) 122 bytes of descriptor data ¹							
860	Enclosure Services Controller Electronics Element 1 Descriptor							
985	(00 00 00 7A h) 122 bytes of descriptor data ¹							
986	Enclosure Overall Element Descriptor							
989	(00 00 00 00 h)							
990	Enclosure Element 0 Descriptor							
1062	(00 00 00 45 h) 69 bytes of descriptor data ¹							
1063	Voltage Sensor Overall Element Descriptor							
1066	(00 00 00 00 h)							
1067	Voltage Sensor Element 0 Descriptor							
1126	(00 00 00 38 h) 56 bytes of descriptor data ¹							
...	...							
1247	Voltage Sensor Element 3 Descriptor							
1306	(00 00 00 38 h) 56 bytes of descriptor data ¹							
1307	Current Sensor Overall Element Status Descriptor							
1310	(00 00 00 00 h)							
1311	Current Sensor Element 0 Descriptor							
1370	(00 00 00 38 h) 56 bytes of descriptor data ¹							
...	...							
1491	Current Sensor Element 3 Descriptor							
1550	(00 00 00 38 h) 56 bytes of descriptor data ¹							
1551	SAS Expander Overall Element ² Descriptor							

Bit Byte	7	6	5	4	3	2	1	0
1554	(00 00 00 00 h)							
1555	SAS Expander Element 0 Descriptor							
1558	(00 00 00 00 h)							
1559	SAS Expander Element 1 Descriptor							
1562	(00 00 00 00 h)							
1563	SAS Connector Overall Element Descriptor							
1566	(00 00 00 00 h)							
1567	SAS Connector Element 0 Descriptor							
1590	(00 00 00 14 h)							
	20 bytes of descriptor data ¹							
...	...							
1647	SAS Connector Element 5 Descriptor							
1670	(00 00 00 14 h)							
	20 bytes of descriptor data ¹							
1671	SBB Midplane Interconnect Overall Element Descriptor							
1674	(00 00 00 00 h)							
1675	SBB Midplane Interconnect Element 0 Descriptor							
1678	(00 00 00 00 h)							
1679	SBB Midplane Interconnect Element1 Descriptor							
1682	(00 00 00 00 h)							
1683	Enclosure Power Overall Element Descriptor							
1686	(00 00 00 00 h)							
1687	Enclosure Power Element Descriptor							
1690	(00 00 00 00 h)							
1691	Enclosure Electronics Power Overall Element Descriptor							
1694	(00 00 00 00 h)							
1695	Enclosure Electronics Power Element 0 Descriptor							
1698	(00 00 00 00 h)							
1699	Enclosure Electronics Power Element1 Descriptor							
1702	(00 00 00 00 h)							
1703	Enclosure Settings Overall Element Descriptor							
1706	(00 00 00 00 h)							
1707	Enclosure Settings Element 0 Descriptor							
1710	(00 00 00 00 h)							
1711	Enclosure Electronics Diagnostics Overall Element Descriptor							
1714	(00 00 00 00 h)							
1715	Enclosure Electronics Diagnostics Element 0 Descriptor							
1718	(00 00 00 00 h)							
1719	Enclosure Electronics Diagnostics Element1 Descriptor							

Bit Byte	7	6	5	4	3	2	1	0
1802	(00 00 00 00 h)							
¹ See section [3] for descriptor string format ² See Section 3.2, Table 3 (Global Element Index 40-45) for SAS Connector element to physical device mapping.								

4.4.1 Page 07h Descriptor Strings

The descriptor string formats used by each element that supports them are shown in **Error! Reference source not found.** 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 9 - FRU Descriptor string formats

Element Type	Descriptor String
Power Supply	<i>TP=XX;SN=XXXXXXXXXXXXXXXXXX;F1=XXXX;F2=XXXX;VR=XX;VC=XXXX XXXX;PN=XXXXXXXXXX;</i>
Temperature Sensor	<i>NM=XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX;LO=XXXXXXXXXXXX XXXX;</i>
Enclosure Services Controller Electronics	<i>TP=XX;SN=XXXXXXXXXXXXXXXXXX;F1=XXXX;BL=XXXX;VR=XX;VC=XXXX XXXX;CR=XX;FR=XX;FC=XXXXXXXX;PN=XXXXXXXXXX;FF1=XXXXXXX X;PC=XXXXXXXX;</i>
Enclosure	<i>SN=XXXXXXXXXXXXXXXXXX;VR=XX;VC=XXXXXXXX;CR=XX;PN=XXXXXXX XXX;CM=XX;TP=XX;</i>
Voltage Sensor	<i>NM=XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX;LO=XXXXXXXXXXXX XXXX;</i>
Current Sensor	<i>NM=XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX;LO=XXXXXXXXXXXX XXXX;</i>
SAS Connector	<i>WN=XXXXXXXXXXXXXXXXXX;</i>

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 10 - 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 (616)						(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 11 Additional Status Descriptor								
404	INVALID	Reserved	EIP (1)	PROTOCOL IDENTIFIER (6)				
405	ADDITIONAL ELEMENT STATUS DESCRIPTOR LENGTH (34)							
406	Reserved							EIIOE (0)
407	ELEMENT INDEX (11)							
408	NUM OF DEVICE PHY DESCRIPTORS (1)							
409	DESC TYPE (0)	Reserved						NOT ALL PHYS (1)
410	Reserved							
411	DEVICE SLOT NUMBER (11)							
412	Phy Descriptor for Device 11 (SBB IOM A phy)							
439								

Bit Byte	7	6	5	4	3	2	1	0
Expander 0 Additional Status Descriptor								
440	INVALID	Reserved		EIP (1)	PROTOCOL IDENTIFIER (6)			
441	ADDITIONAL ELEMENT STATUS DESCRIPTOR LENGTH (88)							
442	Reserved							EIIOE (0)
443	ELEMENT INDEX (42)							
444	NUM OF EXPANDER PHY DESCRIPTORS (37)							
445	DESC TYPE (1)		Reserved					
446	Reserved							
447	Reserved							
448	EXPANDER SAS ADDRESS							
455	Phy Descriptor 0 for Expander 0 (SBB IOM A)							
456	Phy Descriptor 0 for Expander 0 (SBB IOM A)							
457	Phy Descriptor 0 for Expander 0 (SBB IOM A)							
	...							
528	Phy Descriptor 36 for Expander 0 (SBB IOM A)							
529	Phy Descriptor 36 for Expander 0 (SBB IOM A)							
Expander 1 Additional Status Descriptor								
530	INVALID	Reserved		EIP (1)	PROTOCOL IDENTIFIER (6)			
531	ADDITIONAL ELEMENT STATUS DESCRIPTOR LENGTH (14)							
532	Reserved							EIIOE (0)
533	ELEMENT INDEX (43)							
534	NUM OF EXPANDER PHY DESCRIPTORS (0)							
535	DESC TYPE (1)		Reserved					
536	Reserved							
537	Reserved							
538	EXPANDER SAS ADDRESS							
539	EXPANDER SAS ADDRESS							

4.5.2 SES Page 0Ah Layout for SBB IOM B

Table 11 - 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 (536)						(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 11 Additional Status Descriptor								
404	INVALID	Reserved	EIP (1)	PROTOCOL IDENTIFIER (6)				
405	ADDITIONAL ELEMENT STATUS DESCRIPTOR LENGTH (34)							
406	Reserved							EIIOE (0)
407	ELEMENT INDEX (11)							
408	NUM OF DEVICE PHY DESCRIPTORS (1)							
409	DESC TYPE (0)	Reserved						NOT ALL PHYS (1)
410	Reserved							
411	DEVICE SLOT NUMBER (11)							
412	Phy Descriptor for Device 11 (SBB IOM B phy)							
439								
Expander 0 Additional Status Descriptor								
440	INVALID	Reserved	EIP (1)	PROTOCOL IDENTIFIER (6)				
441	ADDITIONAL ELEMENT STATUS DESCRIPTOR LENGTH (14)							
442	Reserved							EIIOE (0)
443	ELEMENT INDEX (42)							

Bit Byte	7	6	5	4	3	2	1	0
444	NUM OF EXPANDER PHY DESCRIPTORS (0)							
445	DESC TYPE (1)		Reserved					
446	Reserved							
447	Reserved							
448	EXPANDER SAS ADDRESS							
455	EXPANDER SAS ADDRESS							
Expander 1 Additional Status Descriptor								
456	INVALID	Reserved		EIP (1)	PROTOCOL IDENTIFIER (6)			
457	ADDITIONAL ELEMENT STATUS DESCRIPTOR LENGTH (88)							
458	Reserved							EIIOE (0)
459	ELEMENT INDEX (43)							
460	NUM OF EXPANDER PHY DESCRIPTORS (37)							
461	DESC TYPE (1)		Reserved					
462	Reserved							
463	Reserved							
464	EXPANDER SAS ADDRESS							
465	EXPANDER SAS ADDRESS							
466	Phy Descriptor 0 for Expander 0 (SBB IOM B)							
467	Phy Descriptor 0 for Expander 0 (SBB IOM B)							
	...							
538	Phy Descriptor 36 for Expander 0 (SBB IOM B)							
539	Phy Descriptor 36 for Expander 0 (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 12 **Error! Reference source not found.** covers the basic layout of page 91h for the documented product.

Table 12 - SES Page 91h Layout

Bit Byte	7	6	5	4	3	2	1	0
0	PAGE CODE (91h)							
1	Reserved							
2	(MSB)	PAGE LENGTH (2036)						(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	Phy 0 Statistics Descriptor ¹							
43								
...	...							
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 (36)							
1028	PHY STATISTICS DESCRIPTOR LENGTH (28)							
1029	(MSB)	EXPANDER CHANGE COUNT						(LSB)
1030								
1031	Reserved							
1032	Phy 0 Statistics Descriptor ¹							
1087								

Bit Byte	7	6	5	4	3	2	1	0
...	...							
2012	Phy 36 Statistics Descriptor ¹							
2039								
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 resembles that of page 07h with descriptor headers used to advertise the size of additional status 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 13 - SES Page 92h Layout

Bit Byte	7	6	5	4	3	2	1	0
0	PAGE CODE (92h)							
1	Reserved							
2	(MSB)	PAGE LENGTH (3363)						(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)							
	...							
56	Array Device Element 11 Descriptor							
59	(00 00 00 00 h)							
60	Power Supply Overall Element Descriptor							
70	(03 00 00 07 h) 11 bytes of descriptor data							
71	Power Supply Element 0 Descriptor							
78	(01 00 00 04 h) 8 bytes of descriptor data							
79	Power Supply Element 1 Descriptor							
86	(01 00 00 04 h) 8 bytes of descriptor data							
87	Cooling Overall Element Descriptor							
90	(00 00 00 00 h)							
91	Cooling Element 0 Descriptor							
94	(00 00 00 00 h)							
	...							
103	Cooling Element 3 Descriptor							
106	(00 00 00 00 h)							
107	Temperature Sensor Overall Element Descriptor							

Bit Byte	7	6	5	4	3	2	1	0
110	(00 00 00 00 h)							
111	Temperature Sensor Element 0 Descriptor							
114	(00 00 00 00 h)							
...	...							
139	Temperature Sensor Element 7 Descriptor							
142	(00 00 00 00 h)							
143	Audible Alarm Overall Element Descriptor							
146	(00 00 00 00 h)							
147	Audible Alarm Element 0 Descriptor							
150	(00 00 00 00 h)							
151	Enclosure Services Controller Electronics Overall Element Descriptor							
154	(00 00 00 00 h)							
155	Enclosure Services Controller Electronics Element 0 Descriptor							
158	(00 00 00 00 h)							
159	Enclosure Services Controller Electronics Element 1 Descriptor							
162	(00 00 00 00 h)							
163	Enclosure Overall Element Descriptor							
166	(00 00 00 00 h)							
167	Enclosure Element 0 Descriptor							
170	(00 00 00 00 h)							
171	Voltage Sensor Overall Element Descriptor							
174	(00 00 00 00 h)							
175	Voltage Sensor Element 0 Descriptor							
178	(00 00 00 00 h)							
...	...							
187	Voltage Sensor Element 3 Descriptor							
190	(00 00 00 00 h)							
191	Current Sensor Overall Element Status Descriptor							
194	(00 00 00 00 h)							
195	Current Sensor Element 0 Descriptor							
198	(00 00 00 00 h)							
...	...							
207	Current Sensor Element 3 Descriptor							
210	(00 00 00 00 h)							
211	SAS Expander Overall Element Descriptor							
214	(00 00 00 00 h)							
215	SAS Expander Element 0 Descriptor							
218	(00 00 00 00 h)							

Bit Byte	7	6	5	4	3	2	1	0
219	SAS Expander Element 1 Descriptor							
222	(00 00 00 00 h)							
223	SAS Connector Overall Element Descriptor							
226	(00 00 00 00 h)							
227	SAS Connector Element 0 Descriptor							
742	(01 00 02 00 h)							
	512 bytes of descriptor data ¹							
...	...							
2807	SAS Connector Element 5 Descriptor							
3322	(01 00 02 00 h)							
	512 bytes of descriptor data ¹							
3323	SBB Midplane Interconnect Overall Element Descriptor							
3326	(00 00 00 00 h)							
3327	SBB Midplane Interconnect Element 0 Descriptor							
3330	(00 00 00 00 h)							
3331	SBB Midplane Interconnect Element1 Descriptor							
3334	(00 00 00 00 h)							
3335	Enclosure Power Overall Element Descriptor							
3338	(00 00 00 00 h)							
3339	Enclosure Power Element 0 Descriptor							
3342	(00 00 00 00 h)							
3343	Enclosure Electronics Power Overall Element Descriptor							
3346	(00 00 00 00 h)							
3347	Enclosure Electronics Power Element 0 Descriptor							
3350	(00 00 00 00 h)							
3351	Enclosure Electronics Power Element1 Descriptor							
3354	(00 00 00 00 h)							
3355	Enclosure Settings Overall Element Descriptor							
3358	(00 00 00 00 h)							
3359	Enclosure Settings Element 0 Descriptor							
3362	(00 00 00 00 h)							
3363	Enclosure Electronics Diagnostics Overall Element Descriptor							
3366	(00 00 00 00 h)							
3367	Enclosure Electronics Diagnostics Element 0 Descriptor							
3370	(00 00 00 00 h)							
3371	Enclosure Electronics Diagnostics Element1 Descriptor							
3374	(00 00 00 00 h)							
¹ See [3] for extended status descriptor format for SAS connectors								

4.8 Vendor Unique Page 94h Layout

Vendor unique Page 94h is used to report enclosure phy status and perform phy management control. The layouts of the control and status pages are identical, however, the bit definitions within the descriptors vary (see [3] for details). Table 14 **Error! Reference source not found.** covers the basic layout of page 94h for the documented product.

Table 14 - SES Page 94h Layout

Bit Byte	7	6	5	4	3	2	1	0
0	PAGE CODE (94h)							
1	Reserved							
2	(MSB)	PAGE LENGTH (884)						(LSB)
3								
4	(MSB)	GENERATION CODE						(LSB)
7								
Expander 0 Phy Management Descriptor								
8	ELEMENT TYPE CODE (18h)							
9	TYPE RELATIVE INDEX (0)							
10	DESCRIPTOR FORMAT REVISION (01h)							
11	NUMBER OF PHY MANAGEMENT DESCRIPTORS (36)							
12	PHY MANAGEMENT DESCRIPTOR LENGTH (12)							
13	Reserved-Status/RQST ENB –Control (0)							
14								
15	Reserved							
16								
27	Phy 0 Management Descriptor ¹							
...	...							
436	Phy 35 Management Descriptor ¹							
447								
Expander 1 Phy Management Descriptor								
448	ELEMENT TYPE CODE (18h)							
449	TYPE RELATIVE INDEX (1)							
450	DESCRIPTOR FORMAT REVISION (01h)							
451	NUMBER OF PHY MANAGEMENT DESCRIPTORS (36)							
452	PHY MANAGEMENT DESCRIPTOR LENGTH (12)							
453	Reserved-Status/RQST ENB –Control (0)							
454								
455	Reserved							
456								
467	Phy 0 Management Descriptor ¹							

Bit Byte	7	6	5	4	3	2	1	0
...	...							
876	Phy 35 Management Descriptor ¹							
887								
¹ See [3] for full details on the format of the Phy Management status/control descriptor								