

SES Firmware Management Interface Specification

4U60 Storage Enclosure | G460-J-12

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1.1 Long Live Data™ | www.hgst.com



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Revision History

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

1 Introduction

1.1 Purpose

This document describes the management interface of the CLS SES firmware.

The purpose of this document is to provide the detailed descriptions about SMP/SCSI/SES and CLI interfaces. It also serves as the integration guide that outlines how to communicate with Enclosure at host side via SMP/SCSI/SES and how to interact with the Enclosure using the CLI.

1.2 Scope

This document covers the detailed input/output information for the following items:

- SMP commands for SAS Expander Management
- SCSI commands to access SAS Expander
- SCSI Enclosure Service pages and elements for in-band Enclosure Management
- Command Line Interface commands for out-of-band Enclosure Management

1.3 Intended Audience

The intended audience of this document is:

- System architects
- Firmware engineers
- Validation test engineers
- Customer experience test engineers
- System application engineers

1.4 Terms and Abbreviations

CLI – Command Line Interface

EMM – Enclosure Management Module

EMIP – PMC Embedded 32-bit Micro Processor

FRU – Field Replaceable Unit

HDD – Hard Disk Drive

PS – Power Supply

SAS – Serial Attached SCSI

SATA – Serial Advanced Technology Attachment

SCSI – Small Computer System Interface

SES – SCSI Enclosure Service

SMP – Serial Management Protocol

VPD – Vital Product Data

2 SMP Interface

CLS SES firmware fully supports and services all the required SMP commands for expanders as defined in the T10 SPL-3 specification, Revision 07

Supported SMP Commands

Table 1 Supported SMP functions

Operation Code	Command Name	Mandatory	
		SES-3	CLS SES
00h	REPORT GENERAL	YES	YES
01h	Report Manufacturer Information	YES	YES
02h	Read GPIO Register	No	YES
03h	Report Self-Configuration	YES	YES
04h	Report Zone Permission Table	YES	YES
05h	Report Zone Manager Password	YES	YES
06h	Report Broadcast	YES	YES
10h	Discover	YES	YES
11h	Report PHY Error Log	YES	YES
12h	REPORT PHY SATA	YES	YES
13h	Report Route Information	YES	YES
14h	Report PHY Event	YES	YES
20h	Discover List	YES	YES
21h	Report PHY Event List	YES	YES
22h	Report Expander Route Table List	YES	YES

3 SCSI Interface

The client addresses SCSI Commands to the expander's SSP port. The client sends commands to the logical unit number (LUN) implementing the PERIPHERAL DEVICE TYPE of 0Dh (obtained from the INQUIRY command) to indicate this is a SES device. This LUN is always zero.

3.1 Supported SCSI Commands

The SCSI commands defined for CLS SES firmware are listed in the following table.

Table 2 Supported SCSI Commands

Operation Code	Command Name	Mandatory		Reference
		SES-3	CLS SES	
00h	TEST UNIT READY	YES	YES	Test Unit Ready
12h	INQUIRY	YES	YES	Inquiry
1Ch	RECEIVE DIAGNOSTIC RESULTS	YES	YES	Receive Diagnostic Results
1Dh	SEND DIAGNOSTIC	YES	YES	Send Diagnostic
3Bh	WRITE BUFFER	NO	YES	Write Buffer
3Ch	READ BUFFER	NO	YES	Read Buffer
4Ch	LOG SELECT	NO	YES	LOG SELECT
4Dh	LOG SENSE	NO	YES	LOG SENSE
55h	MODE SELECT(10)	NO	YES	MODE SELECT
5Ah	MODE SENSE(10)	NO	YES	MODE SENSE
A0h	REPORT LUNS	YES	YES	Report LUN

If a client sends a CDB with an OPERATION CODE that is not supported, the CLS SES firmware returns a CHECK CONDITION with a sense key of ILLEGAL REQUEST and an ASC/ASCQ of INVALID COMMAND OPERATION CODE. If the OPERATION CODE is valid but another field is not, the CLS SES firmware returns an ASC/ASCQ of INVALID FIELD IN CDB.

If a client sends a command with an invalid field in the parameter data, the CLS SES firmware usually terminates the command with a CHECK CONDITION, a sense key of ILLEGAL REQUEST and an ASC/ASCQ of INVALID FIELD IN PARAMETER LIST.

3.1.1 Test Unit Ready

The TEST UNIT READY command provides a method to check if the CLS SES firmware is ready.

Table 3 TEST UNIT READY command

TEST UNIT READY command								
Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (00h)							
1	Reserved							
...								
4								
5	CONTROL(00h)							

CONTROL Always zero.

If the CLS SES firmware is ready to accept commands, it returns GOOD status. Otherwise, it returns a CHECK CONDITION with a sense key of NOT READY and an ASC/ASCQ of ENCLOSURE SERVICES UNAVAILABLE. This condition indicates that the CLS SES firmware is starting up.

3.1.2 Inquiry

The INQUIRY command requests information about the enclosure. The INQUIRY data is returned even if the CLS SES firmware is not ready for other commands, and even if all the information is not yet available (e.g., because it has to be read from devices' no-volatile memory that have not yet started up). If information is not yet available, affected ASCII fields will be set to all spaces (20h) and other affected fields will be set to zero. Fields with values shown as literal constant are always available.

Table 4 INQUIRY command

INQUIRY command									
Bit Byte	7	6	5	4	3	2	1	0	
0	OPERATION CODE (12h)								
1	Reserved						Obsolete	EVPD	
2	PAGE CODE								
3	(MSB)	ALLOCATION LENGTH						(LSB)	
4									
5	CONTROL(00h)								

EVPD and **PAGE CODE** If EVPD and PAGE CODE are zero, the CLS SES firmware returns Standard INQUIRY Data ([Standard INQUIRY Data](#)). If EVPD is one and PAGE CODE is zero, then the CLS SES firmware returns the Supported VPD Pages ([Supported VPD Pages VPD Page](#)). If EVPD is one and PAGE CODE is the code of a supported VPD page, then returns that VPD page. For any other values of these fields, it returns a CHECK CONDITION with a sense key of ILLEGAL REQUEST and an ASC/ASCQ of INVALID FIELD IN CDB.

ALLOCATION LENGTH The number of bytes requested by the client. It should be at least as long as the length of the requested page, as covered below. If shorter, the page is truncated at this length.

CONTROL Always zero.

3.1.2.1 Standard INQUIRY Data

Table 5 Standard INQUIRY data format

Standard INQUIRY data format								
Bit Byte	7	6	5	4	3	2	1	0
0	PERIPHERAL QUALIFIER			PERIPHERAL DEVICE TYPE				
1	RMB	LU_CONG	Reserved					
2	VERSION							
3	Reserved	Reserved	NORMACA	HISUP	RESPONSE DATA FORMAT(2h)			
4	ADDITIONAL LENGTH (n-4)							
5	SCCS	ACC	TPGS		3PC	Reserved		PROTECT
6	Obsolete	ENCSERV	VS	MULTIP	Obsolete	Reserved	Reserved	ADDR16
7	Obsolete	Reserved	WBUS16	SUNC	Obsolete	Reserved	CMDQUE	VS
8	(MSB) T10 VENDOR IDENTIFICATION (LSB)							
...								
15								
16	(MSB) PRODUCT IDENTIFICATION (LSB)							
...								
31								
32	(MSB) PRODUCT REVISION LEVEL (LSB)							
...								
35								
36	Vendor specific							
...								
55								
56	Reserved				CLOCKING		QAS	IUS
57	Reserved							
58	(MSB) VERSION DESCRIPTOR 1 (LSB)							
59								
...								
72	(MSB) VERSION DESCRIPTOR 8 (LSB)							
73								
74	Reserved							
...								
95								

PERIPHERAL QUALIFIER If the INQUIRY command was directed to LUN 0, the value is zero to indicate that this is a supported logical unit. If any other LUN is specified, the value is 3 to indicate that the LUN is not supported.

PERIPHERAL DEVICE TYPE For LUN 0, always 0Dh, to indicate this is a SES device.

VERSION Always 06h to indicate compliance with SPC-4.

RESPONSE DATA FORMAT Always 2, which indicates that the data is in the format specified in SPC-4

ENC SERV Always one, which indicates that the device contains an embedded enclosure services component.

MULTIP Always zero, which indicates that the logical unit is in a SCSI target device with a single SCSI target port.

CMDQUE Always one, which indicates that the logical unit supports the command management model defined in SAM-5.

T10 VENDOR IDENTIFICATION An 8-byte left-aligned ASCII string containing the vendor identification assigned by INCITS.

PRODUCT IDENTIFICATION A 16-byte left-aligned ASCII string, identifying the fact that this is an enclosure implementing CLS SES firmware.

RODUCT REVISION LEVEL A 4-bytes left-aligned ASCII data that identifies the product revision and is defined by the manufacturer.

The remaining fields in the INQUIRY data are always kept zero.

3.1.2.2 Supported VPD Pages VPD Page

Table 6 Supported VPD Pages VPD page

Supported VPD Pages VPD page								
Bit Byte	7	6	5	4	3	2	1	0
0	PERIPHERAL QUALIFIER			PERIPHERAL DEVICE TYPE				
1	PAGE CODE (00h)							
2	(MSB) PAGE LENGTH (n-3) (LSB)							
3								
4	Supported VPD page list							
...								
n								

Supported VPD Pages shown as below:

- Supported VPD Pages VPD page

- Device Identification VPD Page
- Extended Inquiry VPD Page

3.1.2.3 Device Identification VPD Page

Table 7 Device Identification VPD page

Device Identification VPD page								
Bit Byte	7	6	5	4	3	2	1	0
0	PERIPHERAL QUALIFIER			PERIPHERAL DEVICE TYPE				
1	PAGE CODE (83h)							
2	(MSB) PAGE LENGTH (n-3) (LSB)							
3								
Designation Descriptor - Target Port Identifier								
4	PROTOCOL QUALIFIER (6h)				CODE SET (1h)			
5	PIV (1b)	Reserved	ASSOCIATION(01b)		DESIGNATOR TYPE (3h)			
6	Reserved							
7	DESIGNATOR LENGTH (8)							
8	SAS ADDRESS							
...								
15								
Designation Descriptor - Addressed Logical Unit Identifier								
16	PROTOCOL QUALIFIER (0h)				CODE SET (1h)			
17	PIV (0b)	Reserved	ASSOCIATION(10b)		DESIGNATOR TYPE (3h)			
18	Reserved							
19	DESIGNATOR LENGTH (8)							
20	SAS ADDRESS							
...								
27								
Designation Descriptor - Relative Target Port Identifier								
28	PROTOCOL QUALIFIER (6h)				CODE SET (1h)			
29	PIV (1b)	Reserved	ASSOCIATION(01b)		DESIGNATOR TYPE (4h)			
30	Reserved							
31	DESIGNATOR LENGTH (4)							
32	Obsolete							
33								
34	RELATIVE TARGET PORT							
35								

Supported Designation Descriptors shown as below:

- Target Port Identifier

- Addressed Logical Unit Identifier
- Relative Target Port Identifier
The relative port identifier of the target port on which the INQUIRY command was receive.

3.1.2.4 Extended Inquiry VPD Page

Table 8 Extend INQUIRY Data VPD page

Extended INQUIRY Data VPD page								
Bit Byte	7	6	5	4	3	2	1	0
0	PERIPHERAL QUALIFIER			PERIPHERAL DEVICE TYPE				
1	PAGE CODE (86h)							
2	(MSB) PAGE LENGTH (3Ch) (LSB)							
3								
4	ACTIVATE MICROCODE	SPT			GRD_CHK	APP_CHK	REF_CHK	
5	Reserved	UASK_SUP	GROUP_SUP	PRIOR_SUP	HEADSUP	ORDSUP	SIMPSUP	
6	Reserved				WU_SUP	CRD_SUP	NV_SUP	V_SUP
7	Reserved			P_I_I_SUP	Reserved			LUICLR
8	Reserved			R_SUP	Reserved			CBCS
9	Reserved				MULTI I_T NEXUS MICROCODE DOWNLOAD			
10	(MSB) EXTENDED SELF-TEST COMPLETION MINUTES (LSB)							
11								
12	POA_SUP	HRA_SUP	VSA_SUP	Reserved				
13	MAXIMUM SUPPORTED SENSE DATA LENGTH							
14	Reserved							
...								
63								

Detail definitions of each field refer to SCSI Primary Commands – 4 (SPC-4)

3.1.3 Receive Diagnostic Results

The RECEIVE DIAGNOSTIC RESULTS command is used by the client to receive enclosure status from the CLS SES firmware in the IO control module. RECEIVE DIAGNOSTIC RESULTS command format shown in [RECEIVE DIAGNOSTIC RESULTS Command](#). And refer to [Diagnostic Pages](#) for supported “status” Diagnostic Pages.

3.1.4 Send Diagnostic

The SEND DIAGNOSTIC command is used by the initiator to send SES control commands to the CLS SES firmware in the IO control module. SEND DIAGNOSTIC command format shown in [SEND DIAGNOSTIC Command](#). And refer to [Diagnostic Pages](#) for supported “control” Diagnostic Pages.

3.1.5 Write Buffer

The WRITE BUFFER allows the client to write to a memory such as an EEPROM in the enclosure.

Table 9 WRITE BUFFER command

WRITE BUFFER command								
Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (3Bh)							
1	MODE SPECIFIC			MODE				
2	BUFFER ID							
3	(MSB) BUFFER OFFSET (LSB)							
4								
5								
6	(MSB) PARAMETER LIST LENGTH (LSB)							
7								
8								
9								

MODE Following MODE is supported by CLS SES firmware for WRITE BUFFER command

- 01h – Vendor specific
- 07h – Download microcode with offsets, save, and activate
- 0Eh – Download microcode with offset, save and defer activate
- 0Fh – Activate deferred microcode

Any WRITE BUFFER commands received with a mode rather than MODE listed above will return CHECK CONDITION, with the sense key set to ILLEGAL REQUEST, and ASC/ASCQ set to INVALID FIELD IN CDB.

The Vendor Specific mode (01h) is analogous to the Vendor Specific mode of the READ BUFFER command, The Vendor Specific mode is really Data Mode, and the Buffer ID field is used to extend the Buffer Offset field to 4 bytes. Warnings regarding use of the Vendor Specific mode of the READ BUFFER command apply equally, at least, to the WRITE BUFFER command.

Unlike Vendor Specific mode, the Download Microcode modes (07h, 0Eh and 0Fh) of the WRITE BUFFER command are fully intended for use in a product. The Download Microcode modes of the WRITE BUFFER command are treated as SES “Download Microcode Control diagnostic page”

3.1.6 Read Buffer

The READ BUFFER command allows the client to read a buffer in RAM, EEPROM or flash memory in the enclosure.

Table 10 READ BUFFER command

READ BUFFER command								
Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (3Ch)							

1	Reserved	MODE
2	BUFFER ID	
3	(MSB)	BUFFER OFFSET (LSB)
4		
5		
6	(MSB)	ALLOCATION LENGTH (LSB)
7		
8		
9	CONTROL(00h)	

MODE The function of this command and the meaning of fields within the CDB depend on the contents of the MODE field. Only mode = 01h (Vendor specific) is supported by CLS SES firmware. Any READ BUFFER commands received with a mode rather than 01h will return CHECK CONDITION, with the sense key set to ILLEGAL REQUEST, and ASC/ASCQ set to INVALID FIELD IN CDB.

BUFFER ID and **BUFFER OFFSET** The format of the CDB is identical to the SPC- 4 READ BUFFER command Data mode except that the Buffer ID field, byte 2, is used to extend the Buffer Offset, bytes 3 to 5, to make a 4 byte offset field. This allows the initiator to specify any address in the virtual memory space.

CLS SES firmware does not validate the address before attempting the read, so an invalid address may result in a memory fault.

ALLOCATION LENGTH The number of bytes that the client has allocated in the Data-In Buffer

The READ BUFFER command is intended for debugging during development, and careful consideration should be given to using it to provide product functionality.

3.1.7 LOG SELECT

Table 11 LOG SELECT command

LOG SELECT Command									
Bit	7	6	5	4	3	2	1	0	
0	OPERATION CODE (4Ch)								
1	Reserved						PCR	SP	
2	PC	PAGE CODE							
3	SUBPAGE CODE								
4	Reserved								
5									
6									
7	(MSB)	PARAMETER LIST LENGTH							
8								(LSB)	

9	CONTROL
---	---------

The following log subpages are supported for the LOG SELECT command

- Main Firmware Log Retrieve Last n Entries
- Main Firmware Log Filter Control
- EMIP Firmware Log Retrieve Last n Entries
- EMIP Firmware Log Filter Control

Detail definitions of each field refer to SCSI Primary Commands – 4 (SPC-4)

3.1.7.1 Log Retrieve Last n Entries log page

Table 12 Log Retrieve Format

Log Retrieval Format								
Bit Byte	7	6	5	4	3	2	1	0
0	DS	SPF(1b)	PAGE CODE(30h)					
1	SUBPAGE CODE (01h or 03h)							
2	(MSB) PAGE LENGTH(n-3)							
3	(LSB)							
4	Log Retrieve Parameter							
...								
n								

Log Retrieve is used to get the data entries that firmware supplied. It is useful to get the data to analyze current system status or to debug the system. LOG SELECT sets the last n entries to tell the CLS SES firmware the number of entries reported and the LOG SENSE coordinate with LOG SELECT to report the real entry numbers to the host.

Table 13 Log Retrieve Parameter Format

Log Retrieve Parameter Format								
Bit Byte	7	6	5	4	3	2	1	0
0	(MSB) PARAMETER CODE							
1	(LSB)							
2	DU	Obsolete	TSD	ETC	TMC	FORMAT AND LINKING		
3	PARAMETER LENGTH(n-3)							
4	EMM EVENT LOG							
...								
n								

FORMAT AND LINKING Only binary format is used and PC bit in LOG SELECT CDB will be omitted.

TMC, ETC, TSD, DU These bits are not implemented and just fill zero.

Table 14 EMM Event Log Format for Main Firmware Log Retrieve

EMM Event Log Format for Main Firmware Log Retrieve									
Bit	7	6	5	4	3	2	1	0	
Byte									
0	(MSB)	LAST N LOG ENTRIES							(LSB)
1									
2		Reserved							
3									

LAST N LOG ENTRIES The field reflects how many log entries are requested. If last n entries is larger than max entries or 0, last n entries will be modified to max entries.

Table 15 EMM Event Log Format for EMIP Firmware Log Retrieve

EMM Event Log Format for EMIP Firmware Log Retrieve									
Bit	7	6	5	4	3	2	1	0	
Byte									
0	(MSB)	LAST N LOG ENTRIES							(LSB)
1									
2		Logical PHY ID							
3		Reserved							

LAST N LOG ENTRIES The field reflects how many log entries are requested. If last n entries is larger than max entries or 0, last n entries will be modified to max entries.

Logical PHY ID The field specifies the logical PHY ID to retrieve the EMIP firmware log on this PHY. The valid range of logical PHY ID is zero to (logical PHY count- 1) . Each EMIP log select command can only retrieve the EMIP log for a single PHY at a time.

3.1.7.2 Log Filter Control log page

Table 16 Log Filter Format

Log Filter Format								
Bit	7	6	5	4	3	2	1	0
Byte								
0	DS	SPF(1b)	PAGE CODE(30h)					
1	SUBPAGE CODE (02h or 04h)							
2	(MSB)							
	PAGE LENGTH(n-3)							

3	(LSB)
4	
...	Log Filter Parameter
n	

Log Filter is used to set the filter rules for the log. It can change the filter level and update pattern to indicate what specific log can go to the entries.

Table 17 Log Filter Parameter Format

Log Filter Parameter Format								
Bit Byte	7	6	5	4	3	2	1	0
0	(MSB) PARAMETER CODE (LSB)							
1	DU	Obsolete	TSD	ETC	TMC	FORMAT AND LINKING		
3	PARAMETER LENGTH(n-3)							
4	FILTER CONTROL							
...								
n								

Table 18 Log Filter Control Format for Main Firmware Log Filter

Log Filter Control Format for Main Firmware Log Filter								
Bit Byte	7	6	5	4	3	2	1	0
0	FILTER LEVEL							
1	FILTER COUNT n(MAX 16)							
2	LOG FILTER DESCRIPTOR LIST(first)							
...								
14	LOG FILTER DESCRIPTOR LIST(last)							
2+(n-1)*13								
...								
14+(n-1)*13								

Table 19 Log Filter Control Format for EMIP Firmware Log Filter

Log Filter Control Format for EMIP Firmware Log Filter								
Bit Byte	7	6	5	4	3	2	1	0
0	Logical PHY ID							
1	FILTER COUNT n(MAX 16)							

2	LOG FILTER DESCRIPTOR LIST(first)
...	
14	
2+(n-1)*13	LOG FILTER DESCRIPTOR LIST(last)
...	
14+(n-1)*13	

Logical PHY ID The field specifies the logical PHY ID to filter the EMIP firmware log on this PHY. The valid range of logical PHY ID is zero to (logical PHY count- 1) . Each EMIP log select command can only filter the EMIP log for a single PHY at a time.

Table 20 Log Filter Descriptor Format for Main Firmware Log Filter

Log Filter Descriptor Format for Main Firmware Log Filter								
Bit	7	6	5	4	3	2	1	0
0	APPLICATION FILTER INDEX							
1	MASK							
...								
4								
5	PATTERN							
...	FILTER TYPE							
8								
9								
...	Reserved							
12								

Table 21 Log Filter Descriptor Format for EMIP Firmware Log Filter

Log Filter Descriptor Format for EMIP Firmware Log Filter								
Bit	7	6	5	4	3	2	1	0
0	APPLICATION FILTER INDEX							
1	MASK							
...								
4								
5	Mode							
...	Reserved							
8								
9								
...	Reserved							
12								

APPLICATION FILTER INDEX select command and starts from 0.

This field is the index of the filter descriptor in this log

MASK This field specifies the 32 bits EMIP event log mask to indicate which event EMIP firmware will do event logging.

MODE This field specifies the EMIP event mode. The EMIP event mode is defined as below:

- 0x000000: EMIP IDLE mode.
- 0x000001: EMIP BCT mode.
- 0x000002: EMIP SAS buffering mode.
- 0x000003: EMIP SATA buffering mode.

For the filter control field description, please refer PM73206_04 SXP 12G Software/Firmware User Manual.

3.1.8 LOG SENSE

Table 22 LOG SENSE command

LOG SENSE Command								
Bit	7	6	5	4	3	2	1	0
Byte								
0	OPERATION CODE (4Dh)							
1	Reserved						Obsolete	SP
2	PC		PAGE CODE					
3	SUBPAGE CODE							
4								
5	Reserved							
6								
7	(MSB)							
	PARAMETER LIST LENGTH							
8	(LSB)							
9	CONTROL							

3.1.8.1 Supported Pages and Subpages log page

CLS SES firmware reports all kinds of the supported pages and subpages. Use LOG SENSE and set the page to 0x00 and subpage to 0xff, then supported pages and subpages will be listed.

Table 23 Pages and Subpages supported.

Page	Subpage	Description
30h	01h	Main Firmware Log Retrieve log page
	02h	Main Firmware Log Filter log page
	03h	EMIP Firmware Log Retrieve log page

0	OPERATION CODE (55h)			
1	Reserved	PF	Reserved	SP
2	Reserved			
...				
6				
7				
8	(MSB)	PARAMETER LIST LENGTH		(LSB)
9	CONTROL(00h)			

The following mode pages are supported for the MODE SELECT command:

- Control
- Protocol Specific Port

3.1.9.1 Control mode page

Table 26 SAS Control mode page

SAS Control Mode Page								
Bit	7	6	5	4	3	2	1	0
0	PS (0b)	SPF (0b)	PAGE CODE (0Ah)					
1	PAGE LENGTH (0Ah)							
2	TST			TMF_ONLY	DPICZ	D_SENSE	GLTSD	RLEC
3	QUEUE ALGORITHM MODIFIER				NUAR	QErr		Obsolete
4	VS	RAC	UA_INTLCK_CTRL		SWP	Obsolete		
5	ATO	TAS	ATMPE	RWWP	Reserved	AUTOLOAD MODE		
6	Obsolete							
7								
8	(MSB)	BUSY TIMEOUT PERIOD						(LSB)
9								
10	(MSB)	EXTENDED SELF-TEST COMPLETION TIME						(LSB)
11								

Currently, CLS SES firmware only supports that Qerr, TAS and TST are 0. If one of them is set to non-zero, CLS SES firmware returns CHECK CONDITION status with additional INVALID PARAMETERS LIST. SPF(0), PS(0), PAGE CODE(0x0A) and PAGE LENGTH(0x0A) are also checked. If one of them has the wrong value, the CLS SES firmware returns CHECK CONDITION status with additional INVALID PARAMETERS LIST. The other bits, setting value are not implemented.

Detail definitions of each field refer to SCSI Primary Commands – 4 (SPC-4).

Byte								
0	PS (0b)	SPF (0b)	PAGE CODE (02h)					
1	PAGE LENGTH (0Eh)							
2	Reserved							
3	Reserved							
4	(MSB)	Bus Inactivity Time Limit						(LSB)
5	Reserved							
6	Reserved							
7	Reserved							
8	(MSB)	Maximum Connect Time Limit						(LSB)
9	Reserved							
10	(MSB)	Maximum Burst Size (0009h)						(LSB)
11	Reserved							
12	Reserved							
13	Reserved							
14	(MSB)	First Burst Size						(LSB)
15	Reserved							

Maximum Connect Time Limit The field specifies the maximum duration of a single interconnect tenancy. If the connect time limit is exceeded, then the target port must conclude the interconnect tenancy. The virtual SSP Port in the CLS SES firmware supports the MCT timer.

Remaining fields of Disconnect-Reconnect mode page are not supported.

Detail definitions of each field refer to SCSI Primary Commands – 4 (SPC-4).

3.1.10.2 Protocol Specific Logical Unit mode page

Table 31 SAS Logical Unit mode page (Short Format)

SAS Logical Unit Mode Page - Short Format								
Bit	7	6	5	4	3	2	1	0
Byte								
0	PS (0b)	SPF (0b)	PAGE CODE (18h)					
1	PAGE LENGTH (06h)							
2	Reserved			Transport Layer Retries (0b)	Protocol Identifier (6h)			
3	Reserved							
4	Reserved							

5	
6	
7	

Transport Layer Retries This bit set to one specifies that, for commands received in COMMAND frames with the TLR CONTROL field, the target port must support transport layer retries for XFER_RDY and DATA frames for the logical unit. The bit is not implemented.

Remaining fields of Protocol Specific Logical Unit mode page are not supported.

Detail definitions of each field refer to SCSI Primary Commands – 4 (SPC-4).

3.1.11 Report LUN

The REPORT LUNs return a list of the logical units. CLS SES firmware reports only a single logical unit (LUN 0).

Table 32 Report LUN command

REPORT LUNS command									
Bit Byte	7	6	5	4	3	2	1	0	
0	OPERATION CODE (0Ah)								
1	Reserved								
2	SELECT REPORT								
3	Reserved								
4	Reserved								
5	Reserved								
7	(MSB)	ALLOCATION LENGTH						(LSB)	
8	Reserved								
9	Reserved								
10	Reserved								
11	CONTROL(00h)								

Table 33 Report LUNs Data

REPORT LUNS Data									
Bit Byte	7	6	5	4	3	2	1	0	
0	(MSB)	LUN LIST LENGTH (8h)						(LSB)	
...	Reserved								
3	Reserved								
4	Reserved								
...	Reserved								
7	Reserved								

8	FIRST LUN (0h)
..	
15	

3.2 Status Code

CLS SES firmware returns the following SCSI status codes:

Table 34 Supported Sense Code

Value	Name	Task Ended
00h	COOD	Yes, no sense data
02h	CHECK CONDITION	Yes, with sense data
08h	BUSY	Yes, no sense data
28h	TASK SET FULL	Yes, no sense data
40h	TASK ABORTED	Yes, no sense data

3.3 Sense Keys and Additional Sense Codes

The SENSE KEY, ASC and ASCQ fields in the sense data returned by CLS SES firmware when the status code of a SCSI command is CHECK CONDITION, may have the following values:

Table 35 Supported SENSE KEY, ASC and ASCQ

Sense Key	ASC	ASCQ	Description
0x06	0x29	0x03	BUS DEVICE RESET OCCURRED
0x06	0x2F	0x00	COMMAND CLEARED BY ANOTHER INITIATOR
0x0B	0x44	0x00	INTERNAL TARGET FAILURE
0x05	0x20	0x00	INVALID COMMAND OPERATION CODE
0x05	0x24	0x00	INVALID FIELD IN CDB
0x05	0x26	0x00	INVALID FIELD IN PARAMETER LIST
0x05	0x49	0x00	INVALID MESSAGE ERROR
0x05	0x25	0x00	LOGICAL UNIT NOT SUPPORTED
0x06	0x29	0x00	POWER ON, RESET, OR BUS DEVICE RESET OCCURRED
0x05	0x35	0x01	UNSUPPORTED ENCLOSURE FUNCTION
0x05	0x39	0x00	SAVING PARAMETERS NOT SUPPORTED
0x0B	0x0E	0x01	INFORMATION UNIT TOO SHORT
0x0B	0x4B	0x02	TOO MUCH WRITE DATA

0x0B	0x4B	0x03	ACK/NACK TIMEOUT
0x0B	0x4B	0x04	NAK RECEIVED
0x0B	0x4B	0x05	DATA OFFSET ERROR
0x0B	0x4B	0x06	INITIATOR RESPONSE TIMEOUT

4 SCSI Enclosure Service

This section provides detailed definition of diagnostics pages and SES elements supported for CLS SES firmware

4.1 SES Overview

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

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

CLS SES firmware applies "Standalone Enclosure Services Process" model that can be accessed by external host directly via the data channel. In shared mode when two Canisters work in one enclosure, both Canisters manages the enclosure services in "Active-Active" mode that provide a redundant service model to external host. In SES-3 Spec, this concept of "Multiple enclosure services processes in an enclosure" is illustrated in a figure as below:

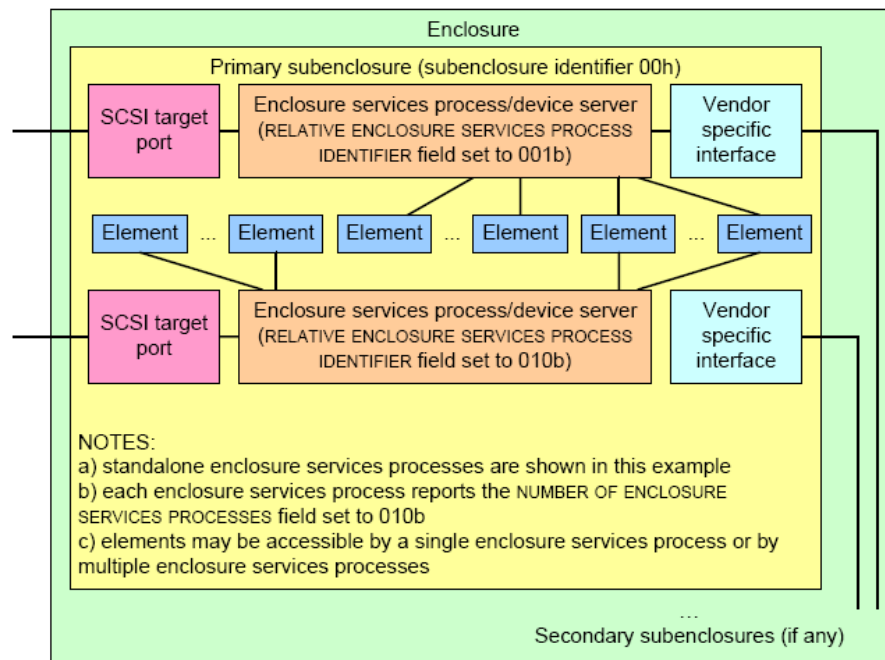


Figure 1 – Multiple Services Processes in an Enclosure

It is recommended for management application running at host side to use "Polling" as the reporting method when managing Enclosure via CLS SES firmware.

Asynchronous event notification(Broadcast(SES)) is also triggered when SAS domain about changes that occur to its Enclosure Status (02h) diagnostic page.¹

¹ Current CLS SES firmware support Broadcast(SES) triggered by HDD,Power supply and ESCE hotswap

4.1.1 RECEIVE DIAGNOSTIC RESULTS Command

The RECEIVE DIAGNOSTIC RESULTS command requests the device server to return data based on the most recent SEND DIAGNOSTIC command or a diagnostic page specified by the PAGE CODE field. The CDB of this command is defined as below:

Table 36 RECEIVE DIAGNOSTIC RESULTS Command

RECEIVE DIAGNOSTIC RESULTS command								
Bit	7	6	5	4	3	2	1	0
0	OPERATION CODE (1Ch)							
1	Reserved							PCV
2	PAGE CODE							
3	ALLOCATION LENGTH							
4								
5	CONTROL							

PCV

This field (page code valid) specifies the enclosure services process returns either data based on the most recent SEND DIAGNOSTIC command (PCV = 0b) or is a diagnostic page specified by the PAGE CODE field (PCV = 1b).

4.1.2 SEND DIAGNOSTIC Command

The "SEND DIAGNOSTIC" command requests the enclosure services process to perform diagnostic operations on the SCSI target device, on the logical unit, or on both according to the parameter list. The CDB of this command is defined as below:

Table 37 SEND DIAGNOSTIC Command

SEND DIAGNOSTIC command								
Bit	7	6	5	4	3	2	1	0
0	OPERATION CODE (1Dh)							
1	SELF-TEST CODE			PF	Reserved	SELFTEST	DEVOFFL	UNITOFFL
2	Reserved							
3	PARAMETER LIST LENGTH							
4								
5	CONTROL							

PF

A page format (PF) bit set to one specifies that the SEND DIAGNOSTIC parameters and any parameters returned by a following RECEIVE DIAGNOSTIC RESULTS command with the PCV bit set to zero contain a single diagnostic page. A PF bit set to zero specifies that all SEND DIAGNOSTIC parameters are vendor specific.

4.2 Diagnostic Pages

The table below shows the list of diagnostics pages that are supported in CLS SES firmware:

Table 38 CLS SES firmwareSupported SES Pages

Page Code	Page Name	Control or Status	Description
00h	Supported Diagnostic Pages	Status	Contains a list of all diagnostic page codes implemented by this SES device.
01h	Configuration	Status	Returns information about the enclosure, including the list of SES elements in the enclosure.
02h	Enclosure Control	Control	Provides access to the control elements identified by the Configuration page.
	Enclosure Status	Status	Provides access to the status elements identified by the Configuration page.
04h	String Out	Control	Performs vendor-specific in-band diagnostics commands.
	String In	Status	Returns vendor-specific diagnostics binary string.
05h	Threshold Out	Control	Establish threshold values for sensor elements: including temperature / voltage / current sensors.
	Threshold In	Status	Reports threshold values for sensor elements: including temperature / voltage / current sensors.
07h	Element Descriptor	Status	Provides descriptive information for each element.
0Ah	Additional Element Status	Status	Provides additional information for device slot elements.
0Eh	Download Microcode Control	Control	Firmware upgrade.
	Download Microcode Status	Status	
10h	CLI Over SES Control	Control	Performs CLI commands. Or specify offset and length to fetch data.
	CLI Over SES Status	Status	Return CLI command implementation result string

11h	Timestamp Set	Control	Request the enclosure service processor to initialize the timestamp.
	Timestamp Get	Status	Request the enclosure service processor to return the value of the timestamp.
12h	VPD Control	Control	Request the specified component replace the contents of its associated VPD in non-volatile storage with the given data. Or specify the offset and length to fetch the VPD data.
	VPD Status	Status	Request the VPD of the specified component to be retrieved.
13h	Log Control	Control	Request to clear Log Repository. Or specify the Start Entry and Entry Numbers to fetch Log Repository.
	Log Status	Status	Request the Log Repository to be retrieved.
14h	PHY Control	Control	Request to control each PHY's status
	PHY Status	Status	Request to report each PHY's status.
15h	Error Injection Control	Control	Request to configure an error injection entry or control the error injection process
	Error injection Status	Status	Request to get error injection status
16h	State Preservation Control	Control	Request to trigger a state preservation action
	State Preservation Status	Status	Request to get state preservation content

4.2.1 Supported Diagnostic Pages Diagnostic Page (00h)

Description

This page contains a list of all diagnostic page codes implemented by the enclosure services process in ascending order beginning with diagnostic page code 00h

Pages Contents

Table 39 Supported Diagnostic Page Diagnostic Page

Supported Diagnostic Pages diagnostic page								
Bit Byte	7	6	5	4	3	2	1	0
Page Header								
0	PAGE CODE (00h)							
1	Reserved							
2	PAGE LENGTH (0Fh)							
3	(MSB)							(LSB)
Supported Pages								
4	Supported Diagnostic Pages diagnostic page (00h)							
5	Configuration diagnostic page (01h)							
6	Enclosure Control / Status diagnostic page (02h)							
7	String Out / In diagnostic page (04h)							
8	Threshold Out / In diagnostic page (05h)							
9	Element Descriptor diagnostic page (07h)							
10	Additional Element Status diagnostic page (0Ah)							
11	Download Microcode Control / Status diagnostic page (0Eh)							
12	CLI Over SES Control / Status diagnostic page (10h)							
13	Timestamp Control / Status diagnostic page (11h)							
14	VPD Control / Status diagnostic page (12h)							
15	Log Control / Status diagnostic page (13h)							
16	PHY Control / Status diagnostic page (14h)							
17	Error Injection Control / Status diagnostic page (15h)							
18	State Preservation Control / Status diagnostic page (16h)							

4.2.2 Configuration Diagnostic Page (01h)

Description

The Configuration diagnostic page returns information about the enclosure, including the list of elements in the enclosure. The element list includes all elements with defined element status or controls in the enclosure. The Configuration diagnostic page provides enclosure descriptor information and parameters as well as descriptive text identifying element types in more detail.

Pages Contents

Table 40 Configuration Diagnostic Page

Configuration diagnostic page									
Bit	7	6	5	4	3	2	1	0	
Byte									
Page Header									
0	PAGE CODE (01h)								
1	NUMBER OF SECONDARY SUBENCLOSURES (00h)								
2	(MSB)	PAGE LENGTH (n-3)							(LSB)
3									
4	GENERATION CODE								
7									
Enclosure Descriptor List									
8	Enclosure descriptor(s) (one per subenclosure)								
Type Descriptor Header List									
	Type descriptor header(s) (one per element type)								
Type Descriptor Text List									
	Type descriptor text(s) (one per type descriptor header)								
n									

Please see the following subsections for more detailed information of Enclosure Descriptor List, Type Descriptor Header List and Type Descriptor Text List.

4.2.2.1 Enclosure Descriptor

The Enclosure Descriptor provides identification information of the target enclosure.

Table 41 Enclosure Descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
0	Reserved	RELATIVE ENCLOSURE SERVICES PROCESS IDENTIFIER (001b or 010b)			Reserved	NUMBER OF ENCLOSURE SERVICES PROCESSES(010b)		
1	SUBENCLOSURE IDENTIFIER							
2	NUMBER OF TYPE DESCRIPTOR HEADERS							
3	ENCLOSURE DESCRIPTOR LENGTH							
4	ENCLOSURE LOGICAL IDENTIFIER							
...								
11								
12	ENCLOSURE VENDOR IDENTIFIER							
...								
19								

20	PRODUCT IDENTIFICATION
...	
35	
36	PRODUCT REVISION LEVEL
...	
39	
40	Vendor-specific enclosure information (32 Bytes Reserved as 00h)
m	

NUMBER OF ENCLOSURE SERVICES PROCESSES

This field specifies the number of enclosure services processes in the subenclosure. A value of 0h indicates the number is not known.

RELATIVE ENCLOSURE SERVICES PROCESS IDENTIFIER

This field specifies the enclosure services process relative to other enclosure services processes in the subenclosure. A value of 0h is reserved.

SUBENCLOSURE IDENTIFIER

This field specifies the subenclosure described by this enclosure descriptor

The NUMBER OF TYPE DESCRIPTOR HEADERS

This field specifies the number of type descriptor headers in the Configuration diagnostic page with this subenclosure identifier

ENCLOSURE DESCRIPTOR LENGTH

This field specifies the number of bytes that follow in the enclosure descriptor.

ENCLOSURE LOGICAL IDENTIFIER

This field contains a unique logical identifier for the subenclosure. It shall use an 8-byte NAA identifier, the format of which is defined in SPC-4 vital product data.

ENCLOSURE VENDOR IDENTIFIER

This field contains the identification string for the vendor of the subenclosure in the same format as specified for the VENDOR IDENTIFICATION field of the standard INQUIRY data. The ENCLOSURE VENDOR IDENTIFICATION field may contain a different value than the vendor identification of the logical unit providing the enclosure services.

PRODUCT IDENTIFICATION

This field contains the product identification string for the subenclosure in the same format as specified for the PRODUCT IDENTIFICATION field of the standard INQUIRY data.

PRODUCT REVISION LEVEL

This field contains the product revision level string for the subenclosure in the same format as specified for the PRODUCT REVISION LEVEL field of the standard INQUIRY data.

VENDOR SPECIFIC ENCLOSURE INFORMATION

This field is reserved as 00h

4.2.2.2 Type Descriptor

The Type Descriptor Header List contains a 4-byte descriptor header for each type of element that is implemented in the system. Its format is defined as follow:

Table 42 Type Descriptor Header

Bit	7	6	5	4	3	2	1	0
0	ELEMENT TYPE							
1	NUMBER OF POSSIBIE ELEMENTS							
2	SUBENCLOSURE IDENTIFIER							
3	TYPE DESCRIPTOR TEXT LENGTH							

The Type Descriptor Text List contains type descriptor texts in the same order as the type descriptor headers.

For CLS SES firmware, the data of the Type Descriptor Header List and the Type Descriptor Text List is defined as below:

Table 43 CLS SES firmwareType Descriptor Values

ELEMENT TYPE	NUMBER OF POSSIBIE ELEMENTS	SUBENCLOSURE IDENTIFIER	TYPE DESCRIPTOR TEXT LENGTH	TYPE DESCRIPTOR TEXT (ASCII String)
17h	N/A *	00h	11h	Array Device Slot
02h	N/A *	00h	0Ch	Power Supply
03h	N/A *	00h	07h	Cooling
04h	N/A *	00h	12h	Temperature Sensor
07h	N/A *	00h	10h	ESCE
0Eh	N/A *	00h	11h	Enclosure
12h	N/A *	00h	0Eh	Voltage Sensor
13h	N/A *	00h	0Eh	Current Sensor
18h	N/A *	00h	0Ch	SAS Expander
19h	N/A *	00h	0Dh	SAS Connector

* : NUMBER OF POSSIBLE ELEMENTS is platform-specific data, each platform will have its own configuration

4.2.3 Enclosure Control Diagnostic Page (02h)

Description

The Enclosure Control diagnostic page provides access to the control elements identified by the Configuration diagnostic page.

Pages Contents

Table 44 Enclosure Control Diagnostic Page

Enclosure Control diagnostic page								
Bit	7	6	5	4	3	2	1	0
Byte								
Page Header								
0	PAGE CODE (02h)							
1	Reserved				INFO	NON-CRIT	CRIT	UNRECOV
2	(MSB) PAGE LENGTH (n-3) (LSB)							
3								
4	EXPECTED GENERATION CODE							
7								
Control descriptor list								
8	Control descriptor (first)							
							
	Control descriptor (last)							
n								

The INFO, NON-CRIT, CRIT, and UNRECOV bit are each mandatory and may be set to one in the enclosure by the application client when one or more of the elements are detected not operating normally. Please see the following subsections for more detailed information of Control Descriptor List.

4.2.3.1 Control Descriptor

The control descriptor list contains a control descriptor for each type descriptor header in the Configuration diagnostic page. The format of control descriptor is defined as follow:

Table 45 Control Descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
0	Overall Control Element							
3								
Individual Control Element List								
4	Individual control element (first)							
7								
							
m - 3	Individual control element (last)							
m								

The overall control element provides control for all the elements corresponding to the type descriptor header. The individual control element list contains an individual control element for each of the possible elements identified by the NUMBER OF POSSIBLE ELEMENTS field in the corresponding

type descriptor header. Each individual control element contains control information for one specific element.

4.2.3.2 Control Element

The general format for the control element is defined as follow:

Table 46 Control Element Format

Bit	7	6	5	4	3	2	1	0
Byte 0	COMMON CONTROL							
	SELECT	PRDFAIL	DISABLE	RST SWAP	Reserved			
1	Element type specific control information							
2								
3								

SELECT

This bit specifies whether or not the enclosure services process should perform the control functions defined by the other bits in the control element.

PRDFAIL

This bit is not supported.

DISABLE

This bit is not supported.

RST SWAP

This bit is not supported.

The element type specific control information is defined separately for each element type. Please refer to 4.3 Element Definitions for more information.

4.2.4 Enclosure Status Diagnostic Page (02h)

Description

The Enclosure Status diagnostic page provides access to the status elements identified by the Configuration diagnostic page.

Pages Contents

Table 47 Enclosure Status Diagnostic Page

Enclosure Status diagnostic page								
Bit	7	6	5	4	3	2	1	0
Byte								
Page Header								
0	PAGE CODE (02h)							
1	Reserved		INVOP	INFO	NON-CRIT	CRIT	UNRECOV	
2	(MSB) PAGE LENGTH (n-3) (LSB)							
3								
4	GENERATION CODE							
7								
Status descriptor list								
8	Status descriptor (first)							
							
	Status descriptor (last)							
n								

The INVOP, INFO, NON-CRIT, CRIT, and UNRECOV bit are each mandatory and have the following meanings:

INVOP	invalid operation requested
INFO	information conditions exist
NON-CRIT	non-critical conditions exist
CRIT	critical conditions exist
UNRECOV	unrecoverable conditions exist

The bits may be read with an allocation length greater than one and may be examined by an enclosure polling procedure to determine if events have occurred that require reading the complete page. The bits may be set by either the enclosure services process or with the Enclosure Control diagnostic page.

Please see the following subsections for more detailed information of Status Descriptor List.

4.2.4.1 Status Descriptor

The status descriptor list contains a status descriptor for each type descriptor header in the Configuration diagnostic page. The format of status descriptor is defined as follow:

Table 48 Status Descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
0	Overall Status Element							
3								
Individual Status Element List								

4	Individual status element (first)
7	

m - 3	Individual status element (last)
m	

The overall status element provides summary status for all the elements described by the type descriptor header. The individual status element list contains an individual status element for each of the possible elements identified by the NUMBER OF POSSIBLE ELEMENTS field in the corresponding type descriptor header. Each individual status element contains status information for one specific element.

4.2.4.2 Status Element

The general format for the status element is defined as follow:

Table 49 Status Element Format

Bit Byte	7	6	5	4	3	2	1	0
0	COMMON STATUS							
	Reserved	PRDFAIL	DISABLED	SWAP	ELEMENT STATUS CODE			
1	Element type specific status information							
2								
3								

PRDFAIL

This predicted failure bit is used to indicate that a failure has been predicted, this bit is not supported and always reports zero(0b).

DISABLED

This bit indicates that the element has been disabled, this bit is not supported and always reports a zero (0b).

SWAP

This swap bit is not supported and always reports a zero (0b).

ELEMENT STATUS CODE

For the overall status element, this field will report the combined common status from all the individual status. Each individual element status element reports its own status via this field.

The status priority for individual and overall common status is defined as below

Table 50 Status Priority for individual and Overall Common Status

Priority	Code	Name
1(highest)	2	Critical
2	3	Noncritical
3	7	Not Available
4	6	Unknown
5	5	Not Installed
6(lowest)	1	OK

The element type specific status information is defined separately for each element type. Please refer to 4.3 Element Definitions for more information.

4.2.5 String Out Diagnostic Page (04h)

Description

The String Out diagnostic page transmits an enclosure dependent binary string from the application client to the enclosure services process of the enclosure. The format of the binary string is vendor specific.

Pages Contents

Table 51 String Out Diagnostic Page

String Out Diagnostic Page								
Bit	7	6	5	4	3	2	1	0
Byte								
Page Header								
0	PAGE CODE (04h)							
1	Obsolete (00h)							
2	PAGE LENGTH (n-3)							
3								
Vendor Specific Binary String Out Data								
4	COMMAND CODE							
5	USER DATA							
n								

CLS SES firmware utilizes the specific function definitions of String Out diagnostic page. The table below is the summary of COMMAND CODE and USER DATA supported by String Out diagnostic page.

Table 52 String Out Diagnostic Commands

Command Code	Function	User Data
0x01	Download Firmware	Firmware image binary data
0x02~0xff	Reserved	Reserved

4.2.6 String In Diagnostic Page (04h)

Description

The String In diagnostic page transmits an enclosure dependent binary string from the enclosure services process of the enclosure to the application client. The format of the binary string is vendor specific.

Pages Contents

Table 53 String In Diagnostic Page

String In Diagnostic Page								
Bit	7	6	5	4	3	2	1	0
Byte								
Page Header								
0	PAGE CODE (04h)							
1	Obsolete (00h)							
2	PAGE LENGTH (00 EEh)							
3								
Vendor Specific Binary String In Data								
4	FW Download Status							
5	Reserved							
241								

Table 54 Firmware Download Status

FW Download Status	Comments
0x00	Firmware Download Ready
0x01	Firmware Download In Progress
0x02	Firmware Download Header Incorrect
0x03	Firmware Download Offset Incorrect
0x04	Firmware Download CRC Incorrect
0x05	Firmware Download Length Incorrect
0x06	Firmware Download Hardware Error
0x07	Firmware Download Complete
0x08	Firmware Download Complete Image Pending Active
0x09	Firmware Download Complete Date Pending Active

4.2.7 Threshold Out Diagnostic Page (05h)

Description

The Threshold Out diagnostic page is transmitted to the enclosure services process to establish threshold values for those elements that have limited sensing capability.

Pages Contents

Table 55 Threshold Out Diagnostic Page

Threshold Out Diagnostic Page								
Bit	7	6	5	4	3	2	1	0
Byte								
Page Header								
0	PAGE CODE (05h)							
1	Reserved (00h)							
2	(MSB) PAGE LENGTH (n-3) (LSB)							
3								
4	EXPECTED GENERATION CODE							
7								
Threshold control descriptor list								
8	Threshold control descriptor (first)							
							
n	Threshold control descriptor (last)							

Please see the following subsections for more detailed information of Threshold Control Descriptor List.

4.2.7.1 Threshold Control Descriptor

The threshold control descriptor list contains a threshold control descriptor for each type descriptor header in the Configuration diagnostic page. The format of threshold control descriptor is defined as follow:

Table 56 Threshold Control Descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
0	Overall Threshold Control Element							
3								
Individual Threshold Control Element List								
4	Individual threshold control element (first)							
7								
							
m - 3	Individual threshold control element (last)							
m								

The overall threshold control element provides shared threshold control for all the elements described by the type descriptor header. The individual threshold control element list contains an individual threshold control element for each of the possible elements identified by the NUMBER OF POSSIBLE ELEMENTS field in the corresponding type descriptor header. Each individual threshold control element contains threshold control information for one specific element.

4.2.7.2 Threshold Control Element

The general format for the threshold control element is defined as follow:

Table 57 Threshold Control Element Format

Bit Byte	7	6	5	4	3	2	1	0
0	REQUESTED HIGH CRITICAL THRESHOLD (UC)							
1	REQUESTED HIGH WARNING THRESHOLD (UW)							
2	REQUESTED LOW WARNING THRESHOLD (LW)							
3	REQUESTED LOW CRITICAL THRESHOLD (LC)							

The threshold values must be specified in proper order otherwise firmware will ignore the contents of all the requested threshold fields.

Threshold field format is defined separately for each threshold-based element type, their threshold field definitions are defined as below:

- Temperature sensors: REQUESTED THRESHOLD fields are in degrees Celsius, offset by +20 degrees. The range of the value expresses a temperature threshold between -19 and +235 degrees Celsius. A value of 00h is reserved.
- Voltage sensor: REQUESTED THRESHOLD fields are in percentages of the nominal voltage in units of 0.5 %.
- Current sensor: HIGH CRITICAL and HIGH WARNING are in percentages of the nominal current in units of 0.5 %, LOW WARNING and LOW CRITICAL are ignored.

4.2.8 Threshold In Diagnostic Page (05h)

Description

The Threshold In diagnostic page is transmitted from the enclosure services process to the application client to report the actual threshold values for those elements that have limited sensing capability.

Pages Contents

Table 58 Threshold In Diagnostic Page

Threshold In Diagnostic Page									
Bit	7	6	5	4	3	2	1	0	
Byte									
Page Header									
0	PAGE CODE (05h)								
1	Reserved			INVOP	Reserved				
2	(MSB) PAGE LENGTH (n-3) (LSB)								
3									
4	GENERATION CODE								
7									
Threshold status descriptor list									
8	Threshold status descriptor (first)								
	...								
n	Threshold status descriptor (last)								

Please see the following subsections for more detailed information of Threshold Status Descriptor List.

INVOP

The “invalid operation” bit shall be set to one if a Threshold Out diagnostic page with an invalid format has previously been transmitted to the enclosure services process and an application client has not already been informed of the error.

4.2.8.1 Threshold Status Descriptor

The threshold status descriptor list contains a threshold status descriptor for each type descriptor header in the Configuration diagnostic page. The format of threshold status descriptor is defined as follow:

Table 59 Threshold Status Descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
0	Overall Threshold Status Element							
3								
Individual Threshold Status Element List								
4	Individual threshold status element (first)							
7								
	...							
m - 3	Individual threshold status element (last)							
m								

The overall threshold status element provides shared threshold status for all the elements described by the type descriptor header. The individual threshold status element list contains an individual threshold status element for each of the possible elements identified by the NUMBER OF POSSIBLE ELEMENTS field in the corresponding type descriptor header. Each individual threshold status element contains threshold status information for one specific element.

4.2.8.2 Threshold Status Element

The general format for the threshold status element is defined as follow:

Table 60 Threshold Status Element Format

Bit Byte	7	6	5	4	3	2	1	0
0	HIGH CRITICAL THRESHOLD (UC)							
1	HIGH WARNING THRESHOLD (UW)							
2	LOW WARNING THRESHOLD (LW)							
3	LOW CRITICAL THRESHOLD (LC)							

The threshold fields indicate the thresholds that the enclosure is using at the time the Threshold In diagnostic page is returned.

Threshold field format is defined separately for each threshold-based element type. Their threshold field definitions are as follow:

- Temperature sensors: THRESHOLD fields are in degrees Celsius, offset by +20 degrees. The range of the value expresses a temperature threshold between -19 and +235 degrees Celsius. A value of 00h is reserved.
- Voltage sensor: THRESHOLD fields are in percentages of the nominal voltage in units of 0.5 %.
- Current sensor: HIGH CRITICAL and HIGH WARNING are in percentages of the nominal current in units of 0.5 %, LOW WARNING and LOW CRITICAL are reserved.

4.2.9 Element Descriptor Diagnostic Page (07h)

Description

The Element Descriptor diagnostic page returns a list of vendor-specific, variable-length ASCII strings, one for each element in the Enclosure Status diagnostic page.

Pages Contents

Table 61 Element Descriptor Diagnostic Page

Element Descriptor Diagnostic Page								
Bit	7	6	5	4	3	2	1	0
Byte								
Page Header								
0	PAGE CODE (07h)							
1	Reserved (00h)							
2	(MSB) PAGE LENGTH (n-3) (LSB)							
3								
4	GENERATION CODE							
7								
Element descriptor by type list								
8	Element descriptor by type descriptor (first element type)							
							
	Element descriptor by type descriptor (last element type)							
n								

4.2.9.1 Element Descriptor by Type Descriptor

The element type descriptor list contains an element descriptor by type descriptor for each element type. The format of element descriptor by type descriptor is defined as follow:

Table 62 Element Descriptor by Type Descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
0	Overall element descriptor							
...	Individual element descriptor (first element)							
							
	Individual element descriptor (last element)							
X								

The overall descriptor contains any descriptor information applying to all elements of the type or describing elements that have no individual descriptor information. Following the overall descriptor, there shall be one element descriptor for each of the possible elements identified by the NUMBER OF POSSIBLE ELEMENTS field in the corresponding type descriptor header in the Configuration diagnostic page. Each element descriptor contains the descriptive information for the element.

4.2.9.2 Element Descriptor

The general format for the overall descriptor and the element descriptor is defined as follow:

Table 63 Element Descriptor Format

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved							
1	Reserved							
2	(MSB) DESCRIPTOR LENGTH (m-3) (LSB)							
3								
4	DESCRIPTOR ASCII STRING							
m	DESCRIPTOR ASCII STRING							

For CLS SES firmware, the Descriptor ASCII String data of the Element Descriptor List of each element type is defined as below:

Table 64 Element Descriptor ASCII String

Element Type Code	Overall Element Descriptor Length	Overall Element Descriptor	Number of Possible Elements	Individual Element Descriptor		
				Filed Name	Field Length	Comment
17h	17	Array Device Slot	N/A *	SAS ADDRESS	8	Disk SAS address in individual element descriptors is collected by firmware .
02h	12	Power Supply	N/A *	PS SERIAL NUMBER	16	PS inventory information in individual element descriptors is collected by firmware through reading PS VPD
				PS FW REVISION	4	
03h	7	Cooling	N/A *	Associated element descriptor	Associated element descriptor length	Associated element descriptor.
04h	18	Temperature Sensor	N/A *	Associated element descriptor	Associated element descriptor length	Associated element descriptor.
07h	12	ESCE	N/A *	SAS ADDRESS	8	Canister inventory information in individual element descriptors is collected by firmware through reading Canister VPD contents.
0Eh	15	Enclosure	N/A *	None	0	None
12h	14	Voltage Sensor	N/A *	Associated element descriptor	Associated element descriptor length	Associated element descriptor
13h	14	Current Sensor	N/A *	Associated element descriptor	Associated element descriptor length	Associated element descriptor
18h	12	SAS Expander	N/A *	None	0	None

19h	13	SAS Connector	N/A *	Associated element descriptor	Associated element descriptor length	Associated element descriptor
-----	----	---------------	-------	-------------------------------	--------------------------------------	-------------------------------

*: NUMBER OF POSSIBLE ELEMENTS is platform-specific data, each platform will have its own configuration

4.2.10 Additional Element Status Diagnostic Page (0Ah)

Description

In the CLS SES firmware implementation, the Additional Element Status diagnostic page provides additional information about device slot element.

Pages Contents

Table 65 Additional Element Status Diagnostic Page

Additional Element Status Diagnostic Page								
Bit	7	6	5	4	3	2	1	0
Byte								
Page Header								
0	PAGE CODE (0Ah)							
1	Reserved (00h)							
2	(MSB) PAGE LENGTH (n-3) (LSB)							
3								
4	GENERATION CODE							
7								
Additional Element Status descriptor list								
8	Additional Element Status descriptor (first)							
							
	Additional Element Status descriptor (last)							
n								

The format the additional element status descriptor conforms to SES-3 Spec. Please refer to SES-3 Spec, section 6.1.13.3.2 Additional Element Status descriptor protocol-specific information for Device Slot elements and Array Device Slot elements for SAS for detailed format of the additional element status descriptor.

4.2.10.1 Additional Element Status Descriptor

The additional element status descriptor list contains an additional element status descriptor for each element for which the enclosure services process provides additional information.

Table 66 Additional Element Status descriptor with the EIP set to one

Bit	7	6	5	4	3	2	1	0
Byte								
0	INVALID	Reserved		EIP (1b)	PROTOCOL IDENTIFIER			
1	ADDITIONAL ELEMENT STATUS DESCRIPTOR LENGTH (x - 1)							
2	Reserved							EIIOE

3	ELEMENT INDEX
4	Protocol-specific information
x	

INVALID

INVALID bit one specifies that the contents of the protocol-specific information are invalid. An INVALID bit set to zero specifies that the contents of the protocol-specific information are valid.

EIP

EIP (element index present) bit set to one specifies that there is ‘element index’ in the Additional Element Status descriptor.

PROTOCOL IDENTIFIER

This field is defined in SPC-4 and specifies the protocol of the device being described by the Additional Element Status descriptor.

ADDITIONAL ELEMENT STATUS DESCRIPTOR LENGTH

This field specifies the number of bytes that follow in the Additional Element Status descriptor.

EIIOE

This field bit set to one indicates that the ELEMENT INDEX field is based on the position in the status descriptor list of the Enclosure Status diagnostic page including overall status elements (i.e., is the same as the CONNECTOR ELEMENT INDEX fields and the OTHER ELEMENT INDEX An EIIOE). This bit set to zero indicates that the ELEMENT INDEX field is based on the position in the status descriptor list of the Enclosure Status diagnostic page excluding overall status elements.

ELEMENT INDEX

This field specifies the index of the status element that this descriptor is describing.

Protocol-specific information bytes

These bytes contain information defined based on the PROTOCOL IDENTIFIER field. (See below)

4.2.10.2 Protocol-specific Information

The Protocol-specific information fields define the Additional Element Status descriptor protocol-specific information for Array Device Slot elements.

Table 67 Additional Element Status descriptor protocol-specific information for Array Device Slot elements for SAS with the EIP bit set to one

Bit	7	6	5	4	3	2	1	0
Byte								
0	NUMBER OF PHY DESCRIPTORS							
1	DESCRIPTOR TYPE (00b)		Reserved					NOT ALL PHYS
2	Reserved							
3	DEVICE SLOT NUMBER							
Phy descriptor list								
4	Phy descriptor (first)(see table)							
31								

x - 27	Phy descriptor (last)(see table)
x	

NUMBER OF PHY DESCRIPTORS

This field specifies how many PHY descriptors are in the PHY descriptor list.

DESCRIPTOR TYPE

This field is set to 00b

NOT ALL PHYS

The bit set to one specifies that all phys in the SAS device or SATA device may or may not be described. A NOT ALL PHYS bit set to zero specifies that all phys in the SAS device or SATA device are described.

DEVICE SLOT NUMBER

This field specifies the number of the device slot represented by the element.

4.2.10.3 PHY Descriptor

The PHY descriptor list contains a PHY descriptor for each PHY counted in the NUMBER OF PHY DESCRIPTORS filed.

Table 68 PHY descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
0	Reserved	DEVICE TYPE			Reserved			
1	Reserved							
2	Reserved				SSP INITIATOR PORT	STP INITIATOR PORT	SMP INITIATOR PORT	Reserved
3	SATA PORT SELECTOR	Reserved			SSP TARGET PORT	STP TARGET PORT	SMP TARGET PORT	SATA DEVICE
4	ATTACHED SAS ADDRESS							
11								
12								
19	SAS ADDRESS							
20	PHY IDENTIFIER							
21	Reserved							
27								

For a SATA drive in the device slot:

DEVICE TYPE, SSP INITIATOR PORT, STP INITIATOR PORT, SMP INITIATOR PORT, SSP TARGET PORT, STP TARGET PORT, SMP TARGET PORT is set to zero.

SATA PORT SELECTOR

This bit is set to one.

SATA DEVICE

This bit is set to one.

SAS ADDRESS

This field is set to the SAS address of the STP target port of the STP/SATA bridge.

PHY IDENTIFIER

This field is set to 00h or 01h.

ATTACHED SAS ADDRESS

This field contains the SAS address of the attached expander PHY.

4.2.11 Download Microcode Control Diagnostic Page (0Eh)²

Description

CLS SES firmware utilizes the functional definitions of Download Microcode Control diagnostic page to do firmware upgrade

Pages Contents

Table 69 Download Microcode Control Diagnostic Page

Download Microcode Control diagnostic page								
Bit	7	6	5	4	3	2	1	0
Byte								
Page Header								
0	PAGE CODE (0Eh)							
1	SUBENCLOSURE IDENTIFIER (00h)							
2	(MSB) PAGE LENGTH (n - 3) (LSB)							
3								
4	EXPECTED GENERATION CODE							
7								
Download microcode control data								
8	DOWNLOAD MICROCODE MODE							
9	Reserved							
10								
11	BUFFER ID							
12	(MSB) BUFFER OFFSET (LSB)							
...								
15								
16	(MSB) MICROCODE IMAGE LENGTH (LSB)							
...								
19								
20	(MSB) MICROCODE DATA LENGTH (m - 23) (LSB)							
...								
23								
24								
...	MICROCODE DATA							

² This feature is dependent on hardware, if there is no SRAM in hardware, this feature can't be supported, please contact the manufacturer to ensure whether the hardware has this dependency

m	
m+1	PAD (if needed)
n	

DOWNLOAD MICROCODE MODE

The following three (3) download microcode modes are supported:

- Mode 0x07: Download firmware with offset, save, and activate.
- Mode 0x0E: Download firmware with offset, save, and defer activation.
- Mode 0x0F: Activate deferred microcode.

BUFFER ID

This field should always be a 00h.

BUFFER OFFSET

This field specifies the current offset in bytes within the firmware image.

MICROCODE IMAGE LENGTH

This field specifies the total number of bytes in the firmware image.

MICROCODE DATA LENGTH

This field specifies the number of bytes in the MICROCODE DATA field.

MICROCODE DATA

This field specifies the data in the firmware image of this transaction.

4.2.12 Download Microcode Status Diagnostic Page (0Eh)³

Description

CLS SES firmware utilizes the functional definitions of Download Microcode Status diagnostic page to report firmware upgrade status.

Pages Contents

Table 70 Download Microcode Status Diagnostic Page

Download Microcode Status diagnostic page								
Bit	7	6	5	4	3	2	1	0
Byte								
Page Header								
0	PAGE CODE (0Eh)							
1	NUMBER OF SECONDARY SUBENCLOSURES (00h)							
2	(MSB) PAGE LENGTH (n - 3) (LSB)							
3								
4	GENERATION CODE							
7								
Download microcode status descriptor								
8	Reserved (00h)							
9	SUBENCLOSURE IDENTIFIER (00h)							

³This feature is dependent on hardware, if there is no SRAM in hardware, this feature can't be supported, please contact the manufacturer to ensure whether the hardware has this dependency

Page Header	
0	PAGE CODE (10h)
1	Reserved (00h)
2	(MSB) PAGE LENGTH (n-3) (LSB)
3	
Command Data	
4	(MSB) Sequence ID (LSB)
5	
6	(MSB) CLI Command (LSB)
7	

Sequence ID

This field specifies the command sequence id, which is used to track the response data by host, the value is decided by host, host can generate this Sequence ID by ascending order for each command, for example, Sequence ID = 0 is for cmd 1, Sequence ID = 1 is for cmd 2, ...

CLI Command

This field specifies CLI command string.

4.2.14 CLI Over SES Status Diagnostic Page (0x10h)

Description

The CLI Over SES Status Diagnostic Page is vendor specific page and be used to return command result from given offset with given length specified by the latest CLI Over SES Control Diagnostic Page.

Pages Contents

Table 72 CLI Over SES Status Diagnostic Page

CLI Over SES Status Diagnostic Page (0x10)								
Bit	7	6	5	4	3	2	1	0
Byte								
Page Header								
0	PAGE CODE (10h)							
1	Reserved (00h)							
2	(MSB) PAGE LENGTH (n-3) (LSB)							
3								
Raw Data								
4	Reserved (00h)						Data Transfer Timeout	Data Transfer Complete

5	Reserved (00h)
6	(MSB) Sequenced ID (LSB)
7	
8	(MSB) Command Response Offset (LSB)
9	
10	
11	
12	(MSB) Data Size (LSB)
13	
14	(MSB) Response Data from Expander Command Server (LSB)
n	

Date Transfer Timeout

This field specifies whether the transfer for the response data has been timeout. If it is set to one, it indicates this data transfer is invalid, timeout happens. If it is set to zero, it indicates this data transfer is valid, no timeout happens.

Data Transfer Complete

This field specifies whether the whole transfer for the response data has been completed. If it is set to one, it indicates this data transfer has been completed. If it is set to zero, it indicates this data transfer has not been completed, further status diagnostic page required to fetch response data.

Since some commands have long response data, which can't be completed by one-time transfer, it need multi status diagnostic page to fetch the following data

Please pay attention, if need further status diagnostic page, please sending the following status diagnostic page in 5 seconds, otherwise the following data will be dropped.

Sequence ID

This field specifies the command sequence id of the latest CLI Over SES Control Diagnostic Page

Command Response Offset.

This filed specifies the offset of this return data of the whole response data

Date Size

This field specifies the length of the field of "Response data from Expander cmdsvr"

Response data from Expander cmdsvr

This field specifies the response data

4.2.15 Timestamp Set Diagnostic Page (11h)

Description

The Timestamp Set Diagnostic Page requests the enclosure services processor to initialize the timestamp.

Pages Contents

Table 73 Timestamp Set Diagnostic Page

Timestamp Set Diagnostic Page									
Bit	7	6	5	4	3	2	1	0	
Byte									
Page Header									
0	PAGE CODE (11h)								
1	Reserved								
2	(MSB)	PAGE LENGTH (0Ah)							
3								(LSB)	
Timestamp Control Field									
4	(MSB)	Timestamp							
11								(LSB)	
12	Reserved								
13									

Timestamp

This field specifies the initial value of the timestamp. The timestamp should be the number of milliseconds synchronized from host. If the three high order bytes of the Timestamp field are greater than 0000F0h, the command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

On successful completion of a Timestamp Set Diagnostic Page, the enclosure services processor shall establish a unit attention condition for the initiator port associated with every I_T nexus except the I_T nexus on which the Timestamp Set Diagnostic Page was received, with the additional sense code set to Timestamp Changed.

4.2.16 Timestamp Get Diagnostic Page (11h)

Description

The Timestamp Get Diagnostic Page requests that the enclosure services processor returns the value of the timestamp.

Pages Contents

Table 74 Timestamp Get Diagnostic Page

Timestamp Get Diagnostic Page									
Bit	7	6	5	4	3	2	1	0	
Byte									
Page Header									
0	PAGE CODE (11h)								
1	Reserved								
2	(MSB)								

3	PAGE LENGTH (0Ah)		(MSB)
Timestamp Status Field			
4	Reserved (00000b)	Timestamp Origin	
5	Reserved		
6	(MSB)	Timestamp	
13			(LSB)

Timestamp Origin

This field specifies the origin of the timestamp.

000b: Timestamp initialized to zero at power-on or as the result of a hard reset.

010b: Timestamp initialized by the last Timestamp Set Diagnostic Page.

Other values are to be considered reserved.

Timestamp

This field specifies the current value of timestamp. The timestamp shall increment by one for every millisecond that has elapsed since the timestamp was set. It shall remain in effect until a hard reset occurs or a Timestamp Set Diagnostic Page is processed.

4.2.17 VPD Control Diagnostic Page (12h)

Description

The VPD Control Diagnostic Page requests that the specified VPD content. The VPD Control Diagnostic Page is issued by the SEND DIAGNOSTIC command.

Pages Contents

Table 75 VPD Control Diagnostic Page

VPD Control Diagnostic Page									
Bit	7	6	5	4	3	2	1	0	
Byte									
Page Header									
0	PAGE CODE (12h)								
1	Reserved								
2	(MSB)	PAGE LENGTH (n - 3)							
3								(LSB)	
VPD Control Field									
4	Control Cmd								
n	Control Cmd Descriptor								

VPD Control Field

Table 76

Control Cmd	Comments	Control Cmd Descriptor
0x00	Read VPD	Read VPD Control Descriptor

Table 77 - VPD Control Field

Read VPD Control Descriptor

Table 78 Read VPD Control Descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
0	Control Cmd (0x00)							
1	VPD Type							
2	VPD ID							

VPD Type

Multiple combinations of VPD Type and VPD ID have been allocated to specify the component where the target VPD resides. The enclosure services processor assigns vendor-specific VPD Type to be used as to locate VPD as follows:

- 0Eh: Assigned for VPD located in Midplane
- 07h: Assigned for VPD located in Canister
- 02h: Assigned for VPD located in Power Supply
- FFh: Assigned for all the VPDs in Enclosure

VPD ID

This field specifies the VPD of a given type.

For Midplane VPD, this field is always 0

For Canister VPD, this field is 0 for Canister A VPD , 1 for Canister B VPD

For Power Supply VPD, this field is 0 for PS A VPD, 1 for PS B VPD

For All VPD, this field is always 0

4.2.18 VPD Status Diagnostic Page (12h)

Description

This function requests that the VPD of the specified component is retrieved followed by the SEND DIAGNOSTIC command with a Read VPD Control Diagnostic Page for a specific offset and length . A RECEIVE DIAGNOSTIC RESULT command is sent to retrieve the data.

Pages Contents

Table 79 VPD Status Diagnostic Page

VPD Status Diagnostic Page									
Bit	7	6	5	4	3	2	1	0	
Byte									
Page Header									
0	PAGE CODE (12h)								
1	Reserved								
2	(MSB)	PAGE LENGTH (n - 3)							(LSB)
3									
VPD Status Field									
4	Completion Code								
n	VPD Status Descriptor								

VPD Type, VPD ID are defined in Read VPD Control Descriptor

VPD Status Field

Table 80 VPD Status Field

Completion Code	Comments	VPD Status Descriptor
0x00	Read VPD Successfully	Read VPD Status Descriptor
0x01	Read VPD Failed	

Read VPD Status Descriptor

Table 81 Read VPD Status Descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
0	VPD Type							
1	VPD ID							
n	VPD Data							

Midplane VPD Data Format

Table 82 Midplane VPD Data Format

Field Name	Field Size (byte)	Field Description
Board Product Name	20	This field contains the Board Product Name
Board Part Number	20	This field contains the Board Part Number
Board Serial Number	20	This field contains the Board Serial Number
Board Hardware EC Level	8	This field contains the Board HardwareEC Level
Product_Name	20	This field contains the Product Name
Product_Part_Number	16	This field contains the Product Part Number
Product_Serial_Number	16	This field contains the Product Serial Number
Product Version	4	This field contains the Product Version

Canister VPD Data Format

Table 83 Canister VPD Data Format

Field Name	Field Size (byte)	Field Description
Board Product Name	20	This field contains the Board Product Name
Board Part Number	20	This field contains the Board Part Number
Board Serial Number	20	This field contains the Board Serial Number
Board Hardware EC Level	4	This field contains the Board HardwareEC Level

PSU VPD Data Format

Table 84 PSU VPD Data Format

Field Name	Field Size (byte)	Field Description
Manufacture Name	16	This field contains the Manufacturer Name
Manufacture PN	12	This field contains the Manufacturer Part Number
Manufacture SN	14	This field contains the Manufacturer Serial Number
Manufacture Hardware Revision	4	This field contains the 4 bytes left-aligned ASCII of Manufacturer Hardware Revision

4.2.19 Log Control Diagnostic Page (13h)

Description

Log Control Diagnostic Page is sent to Control Log Repository. The Log Control Diagnostic Page is issued by SEND DIAGNOSTIC command.

Pages Contents

Table 85 Log Control Diagnostic Page

Log Control Diagnostic Page									
Bit	7	6	5	4	3	2	1	0	
Byte									
Page Header									
0	PAGE CODE (13h)								
1	Reserved								
2	(MSB)	PAGE LENGTH (n-3)							
3								(LSB)	
Log Control Field									
4	Log Control Cmd								
5	Log Control Descriptor								
n									

Log Control Cmd

This field specifies the log control command of Log Control Diagnostic Page.

Table 86 Log Control Field

Log Control Cmd	Log Control Action	Log Control Descriptor
0x00	Get log info	Log Info Descriptor
0x01	Log Misc Control	Log Misc Control Descriptor
0x02	Get log entry	Get Log Entry Descriptor

4.2.19.1 Log Info Descriptor

Table 87 Log Info Descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
0	LOG Repository ID							

LOG Repository ID⁴

This field specifies the ID of log repository
 0x00: the log in ESCE A
 0x01: the log in ESCE B

4.2.19.2 Log Misc Control Descriptor

Table 88 Log Misc Control Descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
0	LOG Repository ID							
1	Misc Control Data							

LOG Repository ID

This field has been defined in Log Info Descriptor

Misc Control Data

Table 89 Misc Control Data

Misc Control Data	Control Action
0x00	Check new log availability
0x01	Set all log entry to be read
0x02	Set all log entry to be unread
0x03	Clear log

4.2.19.3 Get Log Entry Descriptor

Table 90 Get Log Entry Descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
0	LOG Repository ID							
1	(MSB)	Start Entry						
2								(LSB)
3	(MSB)							

⁴ This feature is dependent on hardware, if there is no SRAM in hardware, this feature will only support local log operations, all peer log operations will not be supported and return invalid data, please contact the manufacturer to ensure whether the hardware has this dependency

	Entries Number
4	(LSB)

LOG Repository ID

This field has been defined in Log Info Descriptor

Start Entry

This field specifies the first log entry requested.

Entries Number

This field specifies the total number of log entries requested.

If both Start Entry and Entries Number are 0xffff, CLS SES firmware will do Log entry read by increasingly

CLS SES firmware is responsible for checking the boundary of Log Repository. If the combination of Start Entry and Entries number is invalid, the command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

4.2.20 Log Status Diagnostic Page (13h)

Description

This function requests that the entries of Log Repository are retrieved. A RECEIVE DIAGNOSTIC RESULT command is sent to retrieve the entries of Log Repository.

Pages Contents

Table 91 Log Status Diagnostic Page

Log Status Diagnostic Page								
Bit	7	6	5	4	3	2	1	0
Byte								
Page Header								
0	PAGE CODE (13h)							
1	Reserved							
2	(MSB) PAGE LENGTH (n - 3) (LSB)							
3								
Log Entry Descriptor List								
4	Completion Code							
5	Log Status Descriptor							
n								

Completion Code

Table 92 Completion Code and Status Descriptor

Completion Code	Operation Status	Log Status Descriptor
0x00	Get log info successfully	Log Info Status Descriptor

0x01	Get log info failed	
0x02	Control Log successfully	Log Misc Control Status Descriptor
0x03	Control Log failed	
0x04	Get Log Entry successfully	Get Log Entry Status Descriptor
0x05	Get Log Entry failed	

Log Status Descriptor

4.2.20.1 Log Info Status Descriptor

Table 93 Log Info Status Descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
0	LOG Repository ID							
1	nv log level							
2	(MSB)	Current entry number						(LSB)
3								
4	(MSB)	Available entry number						(LSB)
5								
6	(MSB)	Current Critical log number						(LSB)
7								
8	(MSB)	Current Warning log number						(LSB)
9								
10	(MSB)	Current Info log number						(LSB)
11								
12	(MSB)	Event log number						(LSB)
13								
14	(MSB)	System Operation log number						(LSB)
15								
16	(MSB)	Read out log entry number						(LSB)
17								

LOG Repository ID

This field has been defined in Log Info Descriptor

4.2.20.2 Log Misc Control Status Descriptor

Table 94 Log Misc Control Status Descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
0	LOG Repository ID							
1	Completion Code							
2	Additional Completion Code							

3	
---	--

LOG Repository ID

This field has been defined in Log Info Descriptor

Table 95 Completion Code and Additional Completion Code

Completion Code	Log Misc Control Cmd	Additional Completion Code
0x00	Check new log availability successfully	0x0000: no adding log 0x0001~0xffff: adding log number
0x01	Check new log availability failed	
0x02	Set all log entry to be read successfully	Reserved
0x03	Set all log entry to be read failed	
0x04	Set all log entry to be unread successfully	
0x05	Set all log entry to be unread failed	
0x06	Clear log successfully	Reserved
0x07	Clear log failed	

4.2.20.3 Get Log Entry Status Descriptor

Table 96 Get Log Entry Status Descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
0	LOG Repository ID							
1	(MSB)							
	Start Entry							
2								(LSB)
3	(MSB)							
	Entries Number							
4								(LSB)
5	Requested Entry Number							
6								
7	(MSB)							
...	Log Entry Descriptor 1							
22								(LSB)
m-15	(MSB)							
...	Log Entry Descriptor N							
m								(LSB)

LOG Repository ID

This field has been defined in Log Info Descriptor

Start Entry

This field specifies the start entry returned by Log Status Diagnostic Page

Entries Number

This field specifies the number of log entry returned by Log Status Diagnostic Page.

Requested Entry Number

This field specifies the number of log entry sent by Log Control Diagnostic Page

Please see the following subsections for more detailed information of Log Entry Descriptor.

4.2.20.3.1 Log Entry Descriptor

The Log Entry Descriptor contains a log entry descriptor for each log entry in Log Repository. The format of Log Entry Descriptor is defined as follow:

Table 97 Log Entry Descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
0	(MSB) Log Entry ID (LSB)							
1								
2	Log Entry Version (10h)							
3	Log Type							
4	(MSB) Timestamp (LSB)							
5								
6								
7								
8	Reserved							
9	Element Type							
10	Element ID							
11	Event Type							
12	Event Attributes							
13	(MSB) Event Data (LSB)							
14								
15								

Log Entry ID

An index value that's used for accessing log entries.

Log Entry Version

Version of log entry format, 10 h for this specification.

Log Type

Type of this log entry.
 01h: Element event log
 02h: System operation log

Timestamp

Firmware local running time (in second) when this entry was logged.

Element Type

Element Type Code, defined in 4.3 Element Definitions

Element ID

Unique number identifies an element of a given type.

Event Type

This field specifies the event type.

Event Attributes

See to following subsection for more detailed information of Event Attributes.

Event Data

Three (3) bytes data field describe additional information of an event.

4.2.20.3.1.1 Event Attributes

Event Attributes of Log Entry Descriptor is defined as follow:

Table 98 Event Attributes

Bit	7	6	5	4	3	2	1	0
Byte								
Field	Event Direction		Out of Range Type		Cleared Event Severity		Event Severity	

Event Direction

00b: Assertion/Insertion/On
11b: De-Assertion/Removal/Off
Other values are reserved.

Out of Range Type

00b: Not applicable
01b: Over high threshold.
10b: Under low threshold.
Other values are reserved.

Cleared Event Severity

For sensors' de-assertion events.
00b: Not applicable
01b: Warning event cleared
10b: Critical event cleared.
Other values are reserved.

Event Severity

00b: Info
01b: Warning
10: Critical
Other values are reserved.

4.2.21 PHY Control Diagnostic Page (14h)

Description

The PHY Control Diagnostic Page is sent to enclosure services processor to control the specified PHY. The PHY Control Diagnostic Page is issued by SEND DIAGNOSTIC command.

Pages Contents

Table 99 PHY Control Diagnostic Page

PHY Control Diagnostic Page									
Bit	7	6	5	4	3	2	1	0	
Byte									
Page Header									
0	PAGE CODE (14h)								
1	Reserved								
2	(MSB)	PAGE LENGTH (n-3h)							
3								(LSB)	
PHY Control Descriptor list									
4	Total PHY Number								
5	PHY Control Descriptor 1								
...									
8									
n-3	PHY Control Descriptor N								
...									
n									

Total PHY Number

This field specifies the total number of phy in expander

CLS SES firmware is responsible for checking the boundary of target expander PHYs. If total phy number is invalid, the command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

PHY Control Descriptor is defined as below:

Table 100 PHY Control Descriptor

0	PHY Identifier
1	Select
2	PHY Control Command
3	PHY Control Data

Select

This bit specifies whether or not the enclosure services process should perform the control functions defined by the other bits in the PHY Control Descriptor

This bit set to one specifies enclosure services process should perform the control functions defined by the other bits in the PHY Control Descriptor. This bit set to zero specifies enclosure services process should not perform the control functions defined by the other bits in the PHY Control Descriptor

PHY Identifier

This field specifies the PHY of the target expander which PHY Control Diagnostic Page will control

CLS SES firmware is responsible for checking the boundary of target expander PHYs. If the PHY Identifier is invalid, the command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

PHY Control Command

This field specifies the control command for the specified PHY

- 0x00 PHY Status Control
- 0x01 PHY Information Get

PHY Control Data

this field specifies the control data which is used by control command

Table 101 PHY Control Command and Control Data

PHY Control Command	PHY Control Data	Descriptions
0x00	0x00: Disable	Disable the specified phy, stop the transaction on this phy
	0x01: Enable	Enable the specified phy, resume the transaction on this phy
0x01	Reserved	

4.2.22 PHY Status Diagnostic Page (14h)

Description

The PHY Status Diagnostic Page is returned by enclosure services processor to report the status of the specified phy. The PHY Status Diagnostic Page is returned by RECEIVE DIAGNOSTIC RESULT command.

Pages Contents

Table 102 PHY Status Diagnostic Page

PHY Status Diagnostic Page									
Bit	7	6	5	4	3	2	1	0	
Byte									
Page Header									
0	PAGE CODE (14h)								
1	Reserved								
2	(MSB)	PAGE LENGTH (n-3h)							(LSB)
3									
PHY Status Descriptor list									

4	Total PHY Number
5	PHY Status Descriptor 1
...	
...	
	PHY Status Descriptor N
...	
n	

Total PHY Number

This field specifies the total number of phy in expander

PHY Status Descriptor is defined as below:

Table 103 PHY Status Descriptor

0	PHY Identifier
1	PHY Status Format
2	PHY Status Data
N	

PHY Identifier

This field specifies the PHY of the target expander which PHY Status Diagnostic Page will report

PHY Status Format

This field specifies the format of the follow PHY Status Descriptor

Table 104 PHY Status Format

PHY Status Descriptor Format	PHY Status Descriptor Format Description
0x00	PHY Status Descriptor
0x01	PHY Information Descriptor
0xFF	Reserved Status Descriptor

4.2.22.1 PHY Status Descriptor

The PHY Status Descriptor List contains PHY Status Descriptors for each PHY of the target expander. The format of the PHY Status Descriptor is defined as follow:

Table 105 PHY Power Status Descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
0	PHY Status							

PHY Status

00h: Disabled.

01h: Enabled

4.2.22.2 PHY Information Descriptor

Table 106 PHY Information Descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
0	(MSB) PHY Status (LSB)							
1								
2	Link Speed							
3	Reserved							
4	(MSB) Invalid Dword Count (LSB)							
5								
6								
7								
8	(MSB) Running Disparity Error Count (LSB)							
9								
10								
11								
12	(MSB) Loss of Dword Synchronization Count (LSB)							
13								
14								
15								
16	(MSB) PHY Reset Problem Count (LSB)							
17								
18								
19								

PHY Status

Table 107 PHY Status

PHY Status Code	Comments
0x00	PHY not ready
0x01	PHY ready

Link Speed

Table 108 Link Speed

Link Speed Code	Comments
0x00	1.5 Gb
0x01	3 Gb
0x02	6 Gb
0x03	12 Gb

Invalid Dword Count

This field specifies the number of invalid dwords that have been received outside of phy reset sequences. The count shall stop at the maximum value. The Invalid Dword Count field is set to 0 after power on.

Running Disparity Error Count

This field indicates the number of dwords containing running disparity errors that have been received outside of phy reset sequences. The count shall stop at the maximum value. The Running Disparity Error Count field is set to 0 after power on.

Loss of Dword Synchronization Count

This field indicates the number of times the phy has restarted the link reset sequence because it lost dword synchronization. The count shall stop at the maximum value. The Loss of Dword Synchronization Count field is set to 0 after power on.

PHY Reset Problem Count

This field indicates the number of times a phy reset problem occurred. The count shall stop at the maximum value. The PHY Reset Problem Count field is set to 0 after power on.

4.2.22.3 Reserved Status Descriptor

Table 109 Reserved Status Descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
0	PHY Identifier							
1	0xFF							

0xFF indicates this PHY is not selected in the corresponding Control Descriptor

4.2.23 Error Injection Control Diagnostic Page (15h)

Description

The Error Injection Control Diagnostic Page is sent to enclosure services processor to control the error injection. The Error injection Control Diagnostic Page is issued with SEND DIAGNOSTIC command.

The following table defines the page content of Error Injection Control Diagnostic Page

Table 110 Error Injection Control Diagnostic Page

Error Injection Control Diagnostic Page								
Bit	7	6	5	4	3	2	1	0
Byte								
Page Header								
0	PAGE CODE (15h)							
1	Reserved							
2	(MSB)							

3	PAGE LENGTH (n - 3) (LSB)
Error Injection Control Descriptor	
4	Error Injection Control Cmd
n	Error Injection Control Cmd Descriptor

The following table defines the relationship between Control Cmd and the relative Control Cmd Descriptor

Table 111 Error Injection Control Cmd and Control Cmd Descriptor

Error Injection Control Cmd	Error Injection Control Cmd Descriptor	Comments
0x00	Configuration Descriptor	This cmd is used to get error injection configuration in Enclosure
0x01	Control Descriptor List	This cmd is used to inject error types into the elements defined by Table 124

Configuration Descriptor

The following table defines the format of Configuration Descriptor

Table 112 Configuration Descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
0	Reserved							

Control Descriptor List

The following table defines the format of Control Descriptor List

Table 113 Control Descriptor List

Bit	7	6	5	4	3	2	1	0
Byte								
0	Control Descriptor1							
...	...							
M	Control Descriptor N							

The Control Descriptor List contains control descriptors for each element described in the Configuration Status Descriptor defined by Table 123

The following table defines the format of Control Descriptor

Table 114 Control Descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
0	Overall Control Descriptor							
3	Overall Control Descriptor							

4	Individual Control Descriptor 1
7	
...	...
M-3	Individual Control Descriptor N
M	

The overall control descriptor provides control for all the elements corresponding to the element type define in Table 124. The general format for the overall control descriptor is defined by Table 115.

The individual control descriptor contains an individual control for each of the possible elements identified by the ELEMENT NUMBERS field in the corresponding Configuration Status Descriptor by Table 122.

For example, if the ELEMENT NUMBERS field for one element is 4, the number of individual descriptor for this element shall be 4.

The individual control descriptors for the specific element shall be listed in the same order as ones in Enclosure Control diagnostic page.

Each control descriptor contains control information for the element. Table 115 defines the general format for the individual control element.

Table 115 Overall and Individual Control Descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
0	COMMON CONTROL							
	Select	Trigger	Reserved					
1	Error Type Control Descriptor							
2								
3								

The COMMON CONTROL field contains Select and Trigger bit that can be used by any control element

Select

A SELECT bit set to one specifies that the firmware should perform the control functions defined by the other bits in the control descriptor. A SELECT bit set to zero specifies that the firmware shall ignore all other bits in the control descriptor.

Trigger

A Trigger bit set to one specifies that the error types whose bits are set to one, defined in Error Type Control Descriptor, should be triggered on. A Trigger bit set to zero specifies that the error types whose bits are set to one, defined in Error Type Control Descriptor, should be triggered off.

Error Type Control Descriptor

The Error Type Control Descriptor is defined separately for each element type in Table 124 this field specifies the error types for this element should be carried out by this error injection control or not.

The bit in Error Type Control Descriptor set to one specifies that the corresponding error type shall be carried out by this error injection control. The bit in Error Type Control Descriptor set to zero has no effect

The following table defines the Power Supply Error Type Control Descriptor

Table 116 Power Supply Error Type Control Descriptor

Bit	7	6	5	4	3	2	1	0
0	COMMON CONTROL							
1	RQST DC Over Voltage	RQST DC Under Voltage	RQST DC Over Current	RQST AC Fail	RQST DC Fail	Reserved		
2	Reserved							
3	Reserved							

The following table defines the Cooling Error Type Control Descriptor

Table 117 Cooling Error Type Control Descriptor

Bit	7	6	5	4	3	2	1	0
0	COMMON CONTROL							
1	RQST Fail	Reserved						
2	Reserved							
3	Reserved							

The following table defines the Temperature Error Type Control Descriptor

Table 118 Temperature Error Type Control Descriptor

Bit	7	6	5	4	3	2	1	0
0	COMMON CONTROL							
1	RQST Over Temperature Fail	RQST Over Temperature Warning	RQST Under Temperature Fail	RQST Under Temperature Warning	Reserved			
2	Reserved							
3	Reserved							

The following table defines the Voltage Error Type Control Descriptor

Table 119 Voltage Error Type Control Descriptor

Bit	7	6	5	4	3	2	1	0
0	COMMON CONTROL							
1	RQST Over Voltage Fail	RQST Over Voltage Warning	RQST Under Voltage Fail	RQST Under Voltage Warning	Reserved			
2	Reserved							
3	Reserved							

The following table defines the Current Error Type Control Descriptor

Table 120 Current Error Type Control Descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
0	COMMON CONTROL							
1	RQST Over Current Fail	RQST Over Current Warning	Reserved					
2	Reserved							
3	Reserved							

4.2.24 Error Injection Status Diagnostic Page (15h)

Description

The Error Injection Status Diagnostic Page is sent to enclosure services processor to get error injection status. The Error Injection Status Diagnostic Page is issued with RECEIVE DIAGNOSTIC RESULT command.

The following table defines the page content of the Error Injection Status Diagnostic Page

Table 121 Error Injection Status Diagnostic Page

Error Injection Status Diagnostic Page									
Bit	7	6	5	4	3	2	1	0	
Byte									
Page Header									
0	PAGE CODE (15h)								
1	Reserved								
2	(MSB)	PAGE LENGTH (n - 3)							
3								(LSB)	
Error Injection Status Descriptor									
4	Error Injection Completion Code								
n	Error Injection Status Descriptor								

The following table defines the relationship between Completion Code and Status Descriptor

Table 122 Error Injection Completion Code and Status Descriptor

Completion Code	Comments	Status Descriptor
0x00	Get Configuration Status successfully	Configuration Status Descriptor
0x01	Get Configuration Status failed	
0x02	Error Injection Control successfully	Status Descriptor List
0x03	Error Injection Control failed	

Configuration Status Descriptor

The following table defines the format of Configuration Status Descriptor

Table 123 Configuration Status Descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
0	Element Type 1							
1	Element Numbers							
...	...							
N-1	Element Type N							
N	Element Numbers							

Element Type

The Element Type field specifies the element type being described in the Configuration Status Descriptor. The following table defines the detailed element type information.

Table 124 Element Type List

Element Type Code	Element Type Name
0x02	Power Supply
0x03	Cooling
0x04	Temperature
0x12	Voltage
0x13	Current

Element Numbers

The Element Numbers field specifies the number of elements for the element type described in Element Type field.

Status Descriptor List

The following table defines the format of Status Descriptor List

Table 125 Status Descriptor List

Bit	7	6	5	4	3	2	1	0
Byte								
0	Status Descriptor 1							
...	...							
M	Status Descriptor N							

The Status Descriptor List contains status descriptors for each element described in the Configuration Status Descriptor defined by Table 123.

The following table defines the format of Status Descriptor

Table 126 Status Descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
0	Overall Status Descriptor							

3	
4	Individual Status Descriptor 1
7	
...	...
X-3	Individual Status Descriptor N
X	

The overall status descriptor provides summary status for all the elements corresponding to the element type defined in Table 124.

The following table defines the general format for the overall status element.

Table 127 Overall Status Descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
0	Common Status							
	Status				Reserved			
1	Reserved							
2	Reserved							
3	Reserved							

The COMMON STATUS field contains Status bit that shall be returned by any status descriptor.

Status

The status field specifies the summary error injection status for the elements described in this descriptor.

The following table defines the Status field.

Table 128 Status Definition

Status Code	Status Description
0x00	Error Injection not Running
0x01	Error Injection Running

The individual status descriptor contains an individual status element for each elements identified by the ELEMENT NUMBERS field in the corresponding Error Injection Configuration Status Descriptor by Table 124.

For example, if the ELEMENT NUMBERS field for one element is 4, the number of individual descriptor for this element shall be 4,

The individual status descriptors for the specific element shall be listed in the same order as ones in Enclosure Status diagnostic page.

Each individual status descriptor contains status information for the element.

The following table defines the general format for the individual status element.

Table 129 Individual Status Descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
0	COMMON STATUS							

	Status	Reserved
1	Error Type Status Descriptor	
2		
3		

The COMMON STATUS field contains Status bit that shall be returned by any status descriptor.

Status

The status field specifies the error injection status for the element described in this descriptor, which is defined in Table 124

Error Type Status Descriptor

The Error Type Status Descriptor is defined separately for each element type in Table 124 this field specifies the status of error types for this element.

The bit in Error Type Status Descriptor set to one specifies that the corresponding error type has been carried out by firmware. The bit in Error Type Status Descriptor set to zero specifies that the corresponding error type hasn't been carried out by firmware.

The following table defines the Power Supply Error Type Status Descriptor

Table 130 Power Supply Error Type Status Descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
0	COMMON STATUS							
1	DC Over Voltage	DC Under Voltage	DC Over Current	AC Fail	DC Fail	Reserved		
2	Reserved							
3	Reserved							

The following table defines the Cooling Error Type Status Descriptor

Table 131 Cooling Error Type Status Descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
0	COMMON STATUS							
1	Fail	Reserved						
2	Reserved							
3	Reserved							

The following table defines the Temperature Error Type Status Descriptor

Table 132 Temperature Error Type Status Descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
0	COMMON STATUS							
1	Over Temperature Fail	Over Temperature Warning	Under Temperature Fail	Under Temperature Warning	Reserved			
2	Reserved							

3	Reserved
----------	----------

The following table defines the Voltage Error Type Status Descriptor

Table 133 Voltage Error Type Status Descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
0	COMMON STATUS							
1	Over Voltage Fail	Over Voltage Warning	Under Voltage Fail	Under Voltage Warning	Reserved			
2	Reserved							
3	Reserved							

The following table defines the Current Error Type Status Descriptor

Table 134 Current Error Type Status Descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
0	COMMON STATUS							
1	Over Current Fail	Over Current Warning	Reserved					
2	Reserved							
3	Reserved							

4.2.25 State Preservation Control Diagnostic Page (16h)

Description

The State Preservation Control Diagnostic Page is sent to enclosure services process to request performing Stave Save, getting saved content from a specific flash buffer, getting information of State Preservation and clearing the saved content in a specific flash buffer. The State Preservation Control Diagnostic Page is issued with SEND DIAGNOSTIC command.

Pages Contents

Table 135 State Preservation Control Diagnostic Page

State Preservation Control Diagnostic Page								
Bit	7	6	5	4	3	2	1	0
Byte								
Page Header								
0	PAGE CODE (16h)							
1	Reserved							
2	(MSB)	PAGE LENGTH (n - 3)						(LSB)
3								
State Preservation Control Descriptor								
4	State Preservation Cmd							
5	State Preservation Control Descriptor							
n								

State Preservation Cmd

Table 136 State Preservation Cmd and Control Descriptor

State Preservation Cmd	Action	Control Descriptor
0x00	Perform State Preservation	Perform State Preservation Control Descriptor
0x01	Get saved content of State Preservation from a specific flash buffer	Get State Preservation Content Control Descriptor
0x02	Get information of State Preservation	Get State Preservation Info Control Descriptor
0x03	Clear saved content of State Preservation in a specific flash buffer	Clear State Preservation Content Control Descriptor

Control Descriptor

Perform State Preservation Control Descriptor

Table 137 Perform State Preservation Control Descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
0	Reserved							

Please note the State Preservation will not be performed if no free flash buffer available. It's application client's responsibility to maintain the availability of flash buffer.

Get State Preservation Content Control Descriptor

Table 138 Get State Preservation Content Control Descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
0	Buffer ID							
1	(MSB)							
2	Buffer Offset							
3	(LSB)							
4								
5	(MSB)							
6	Length							
7	(LSB)							
8								

Buffer ID

This field specifies the flash buffer ID from which the saved content will be retrieved. Now it supports 3 buffers which value shall be 0~2.

Buffer Offset

This field specifies the byte offset within the specified flash buffer, which is the beginning data shall be returned to application client side.

Buffer Length

This field specifies the number of bytes will be returned to application client side via the Data-In Buffer. The amount of data that will be transferred shall not exceed this length or cross-border the end of the valid State Preservation size which is indicated by the Buffer N Valid Length within Get State Preservation Info Description, whichever comes firstly.

Get State Preservation Info Control Descriptor

Table 139 Get State Preservation Info Control Descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
0	Reserved							

Clear State Preservation Content Control Descriptor

Table 140 Clear State Preservation Content Control Descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
0	Buffer ID							

Buffer ID

This field is defined as the specific flash buffer 0~2.

CLS SES firmware is responsible for checking the boundary of target expander Buffer ID and Buffer Offset. If they are invalid, the command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST

4.2.26 State Preservation Status Diagnostic Page (16h)

Description

The State Preservation Status Diagnostic Page is sent to enclosure services process to get the information of Stave Save, content saved by Stave Save function and the result of the Send Diagnostic command for Stave Save page code. The State Preservation Status Diagnostic Page is issued with RECEIVE DIAGNOSTIC RESULTS command.

Pages Contents

Table 141 State Preservation Status Diagnostic Page

State Preservation Status Diagnostic Page								
Bit	7	6	5	4	3	2	1	0
Byte								
Page Header								
0	PAGE CODE (16h)							
1	Reserved							
2	(MSB)	PAGE LENGTH (n - 3)						(LSB)
3								
State Preservation Descriptor								
4	Completion Code							
5	State Preservation Status Descriptor							
n								

Completion Code

Table 142 Completion Code and Status Descriptor

Completion Code	State Preservation Cmd Status	State Preservation Status Descriptor
0x00	Perform State Preservation successfully	Perform State Preservation Status Descriptor
0x01	Perform State Preservation failed	
0x02	Get content of State Preservation successfully	Get State Preservation Content Staus Descriptor
0x03	Get content of State Preservation failed	
0x04	Get information of State Preservation successfully	Get State Preservation Information Staus Descriptor
0x05	Get information of State Preservation failed	
0x06	Clear content of State Preservation successfully	Clear State Preservation Staus Content Descriptor

0x07	Clear content of State Preservation failed	
------	--	--

Perform State Preservation Status Descriptor

Table 143 Perform State Preservation Status Descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
0	Reserved							

Get State Preservation Content Status Descriptor

Table 144 Get State Preservation Content Status Descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
0	Buffer ID							
1	(MSB)							
2	Buffer Offset (LSB)							
3								
4								
5								
6	Returned Length (LSB)							
7								
8								
9								
10	Requested Length (LSB)							
11								
12								
13								
N								

Get State Preservation Info Status Descriptor

Table 145 Get State Preservation Info Status Descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
0	(MSB)							
1	Total Buffer Number (LSB)							
2								
3								
4								
5	Buffer 0 Size							

6		(LSB)
7		
8	(MSB)	
9		Buffer 0 Start Address
10		(LSB)
11		
12	(MSB)	
13		Buffer 0 Valid Length
14		(LSB)
15		
16	(MSB)	
17		Buffer 0 Status
18		(LSB)
19		
...	(MSB)	
		Buuffer N Size
		(LSB)
	(MSB)	
		Buffer N Start Address
		(LSB)
	(MSB)	
		Buffer N Valid Length
		(LSB)
	(MSB)	
		Buffer N Status
		(LSB)
n		

Total Buffer Number

This field specifies the total number of the flash buffers.

Buffer Size

This field specifies the total size of each flash buffer. Each, flash buffer has the same size.

Buffer N Status

This field specifies the status of buffer N. The value 0 indicates the buffer is empty, in which the content is invalid. The value 1 indicates the content in the buffer is valid.

Buffer N Start Address

This field specifies the start address of buffer N.

Buffer N Valid Length

This field specifies the valid length of the content in buffer N.

Clear State Preservation Status Descriptor

Table 146 Clear State Preservation Status Descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
0	Reserved							

4.3 Element Definitions

The table below is a list of SES element types that are designed in CLS SES firmware implementation:

Table 147 SES Element Types Summary

Element Type Code	Element Name	Threshold	Number of Possible Elements
17h	Array Device Slot	none	N/A *
02h	Power Supply	none	N/A *
03h	Cooling	none	N/A *
04h	Temperature Sensor	temperature	N/A *
07h	ESCE	none	N/A *
0Eh	Enclosure	none	N/A *
12h	Voltage Sensor	% voltage	N/A *
13h	Current Sensor	% current	N/A *
18h	SAS Expander	none	N/A *
19h	SAS Connectors	none	N/A *

* : NUMBER OF POSSIBLE ELEMENTS is platform-specific data, each platform will have its own configuration

Please refer to SES-3 spec section 7.2 for field format definitions common to all element types. Please refer to SES-3 spec section 7.3 for field format definitions that differ for different element types.

4.3.1 COMMON CONTROL Element Format

Table 148 Common Control Element Format

Bit	7	6	5	4	3	2	1	0
Byte								

0	COMMON CONTROL				
	SELECT	PRDFAIL	DISABLE	RST SWAP	Reserved
1	Element Type specific control information				
2					
3					

SELECT

A SELECT bit set to one specifies that the enclosure services process should perform the control functions defined by the other bits in the control element. A SELECT bit set to zero specifies that the enclosure services process shall ignore all other bits in the control element.

4.3.2 COMMON STATUS Element format

Table 149 Common Status

Bit	7	6	5	4	3	2	1	0
Byte								
0	COMMON STATUS							
	Reserved	PRDFAIL	DISABLED	SWAP	ELEMENT STATUS CODE			
1	Element type specific status information							
2								
3								

The ELEMENT STATUS CODE field is defined in the following table.

Table 150 Element Status Code

Status Code	Name	Condition
1h	Ok	Element is installed and no error conditions are known
2h	Critical	Element Critical condition is detected
3h	Noncritical	Element Noncritical condition is detected
5h	Not installed	Element is not installed
6h	Unknown	Element status is not available
7h	Not available	Element installed, no known errors, but the element has not been turned on or set into operation

4.3.3 Array Device Slot Element (17h)

The Array Device Slot element manages a device slot (e.g., containing a SCSI device such as a disk drive) in the enclosure.

4.3.3.1 Array Device Slot Control Element

The Array Device Slot control element is defined as follow:

Table 151 Array Device Slot Control Element

Array Device Slot Control Element
--

Bit Byte	7	6	5	4	3	2	1	0
0	COMMON CONTROL							
1	RQST OK	RQST RSVD DEVICE	RQST HOT SPARE	RQST CONS CHECK	RQST IN CRIT ARRAY	RQST IN FAILED ARRAY	RQST REBUILD / REMAP	RQST R / R ABORT
2	RQST ACTIVE	DO NOT REMOVE	Reserved	RQST MISSING	RQST INSERT	RQST REMOVE	RQST IDENT	Reserved
3	Reserved		RQST FAULT	DEVICE OFF	ENABLE BYP A	ENABLE BYP B	Reserved	

RQST IDENT

A RQST IDENT (request identify) bit set to one specifies that the device slot be identified by a visual indication. A RQST IDENT bit set to zero specifies that the device slot not identified by a visual indication.

RQST FAULT

A RQST FAULT bit set to one specifies that the device slot be identified by a visual indication that a fault is present in the device. A RQST FAULT bit set to zero specifies that the fault indication shall be cleared if the indication is not also being set by the device or the enclosure services process.

DEVICE OFF

A DEVICE OFF bit set to one specifies that the device slot be turned off. A DEVICE OFF bit set to zero specifies that the device slot may be turned on if all other prerequisites are met

Other fields are not supported.

It should be noted that when zoning is enabled, if the SELECT bit in COMMON CONTROL byte is set to one for any device attached to the PHY for which the SAS initiator port performing the SEND DIAGNOSTIC command does not have access according to the zone permission table, then the SEND DIAGNOSTIC command will be terminated with a CHECK CONDITION status. The sense key is set to ILLEGAL REQUEST, and the additional sense code is set to INVALID FIELD IN PARAMETER LIST.

4.3.3.2 Array Device Slot Status Element

The Array Device Slot status element is defined as follow:

Table 152 Array Device Slot Status Element

Array Device Slot Status Element								
Bit	7	6	5	4	3	2	1	0
Byte								
0	COMMON STATUS							
1	OK	RSVD DEVICE	HOT SPARE	CONS CHK	IN CRIT ARRAY	IN FAILED ARRAY	REBUILD / REMAP	R / R ABORT
2	APP CLIENT BYPASSED A	DO NOT REMOVE	ENCLOSURE BYPASSED A	ENCLOSURE BYPASSED B	READY TO INSERT	RMV	IDENT	REPORT
3	APP CLIENT BYPASSED B	FAULT SENSED	FAULT REQSTD	DEVICE OFF	BYPASSED A	BYPASSED B	DEVICE BYPASSED A	DEVICE BYPASSED B

IDENT

A IDENT bit set to one indicate that the RQST IDENT control bit is set and the device is providing a visual indication of its location. The IDENT bit is cleared when the RQST IDENT control bit is cleared.

FAULT REQSTD

A FAULT REQSTD bit is set to one indicate that the RQST FAULT control bit has requested that the device slot be identified by a visual fault indication. The FAULT REQSTD bit is cleared when the RQST FAULT control bit is cleared.

DEVICE OFF

A DEVICE OFF bit is set to one indicate that the device is turned off. This bit is cleared to indicate that the device is turned on.

Table 153 ELEMENT STATUS CODE for Device Slot

Status Code	Name	Condition
1h	Ok	Drive is installed and no error conditions are known
2h	Critical	Drive over temperature is detected
5h	Not installed	Drive is not installed
6h	Unknown	Drive is not accessible (PHY disabled)
7h	Not available	Drive is installed but PHYRDY lost
8h	No Access Allowed	Zoning related, access deny

Other fields are not used.

It should be noted that when zoning is enabled on an expander device, the enclosure services process sets the ELEMENT STATUS CODE field to 8h (i.e., No Access Allowed) for each element that represents a device attached to the expander PHY for which the SAS initiator port performing the RECEIVE DIAGNOSTIC RESULTS command does not have access according to the zone permission table.

4.3.4 Power Supply Element (02h)

The Power Supply element manages a power supply in the enclosure.

4.3.4.1 Power Supply Control Element

The Power Supply control element is defined as follow:

Table 154 Power Supply Control Element

Power Supply Control Element								
Bit	7	6	5	4	3	2	1	0
0	COMMON CONTROL							
1	RQST IDENT	Reserved						
2	Reserved							
3	Reserved	RQST FAIL	RQST ON	Reserved				

RQST IDENT

This bit set to one specifies that the enclosure services process identify the PSU by a visual indication. A RQST IDENT bit set to zero specifies that the enclosure services process not identify the PSU by a visual indication

RQST FAIL

This bit set to one will turn on the selected PS fault LED. This bit set to zero will turn off the selected PS fault LED unless the enclosure services process is itself detecting a failure in the PS.

RQST ON

This bit set to one specifies that the selected PS be turned on or remain on. When the RQST ON bit is set to zero, the power supply is requested to turn off or remain off.

4.3.4.2 Power Supply Status Element

The Power Supply status element is defined as follow:

Table 155 Power Supply Status Element

Power Supply Status Element									
Bit	7	6	5	4	3	2	1	0	
0	COMMON STATUS								
1	IDENT	Reserved							
2	Reserved				DC OVER VOLTAGE	DC UNDER VOLTAGE	DC OVER CURRENT	Reserved	
3	HOT SWAP	FAIL	RQSTED ON	OFF	OVERTMP FAIL	TEMP WARN	AC FAIL	DC FAIL	

IDENT

An IDENT bit set to one indicates that the enclosure services process is identifying the PSU by a visual indication because the RQST IDENT bit was set to one in the control element. An IDENT bit set to zero indicates that the enclosure services process is not identifying the PSU by a visual indication based on the RQST IDENT bit in the control element.

DC OVER VOLTAGE

A DC OVERVOLTAGE bit set to one indicates an overvoltage condition has been detected at the power supply output. A DC OVERVOLTAGE bit set to zero indicates that the RQST FAIL control bit has been set to one and then set to zero or that a power on has occurred.

DC UNDER VOLTAGE

A DC UNDERVOLTAGE bit set to one indicates an under voltage condition has been detected at the power supply output. A DC UNDERVOLTAGE bit set to zero indicates that the RQST FAIL control bit has been set to one and then set to zero or that a power on has occurred.

DC OVERCURRENT

A DC OVERCURRENT bit set to one indicates an over current condition has been detected at the power supply output. The DC OVERCURRENT bit set to zero indicates that the RQST FAIL control bit has been set to one and then set to zero or that a power on has occurred.

HOT SWAP

This bit set to one indicates that the element may be replaced without removing power from the enclosure that contains the element.

FAIL

A FAIL bit set to one indicates that the enclosure services process is identifying the element with a visual failure indication based on the RQST FAIL bit in the control element or its own detection of a failure. When this bit set to zero indicated the enclosure services process is not identifying the element with a visual failure indication based on the RQST FAIL bit in the control element or its own detection of a failure. In CLS SES firmware implementation, this bit reflects the current state of PS Fault LED.

RQSTED ON

This bit set to one indicates that the power supply has been manually turned on or has been requested to turn on by setting the RQST ON control bit to one. A RQSTED ON bit set to zero indicates that the RQST ON control bit has been set to zero.

OFF

An OFF bit set to zero indicates the power supply is providing its specified output.

OVERTMP FAIL

This over temperature failure bit set to one indicates the power supply has detected a temperature above the safe operating temperature range.

TEMP WARN

This over temperature warning bit set to one indicates the power supply has detected a temperature within the safe operating temperature range, but above the normal operating temperature range.

AC FAIL

This bit set to one indicates that the power supply is not receiving the specified AC power. This bit set to zero indicates that normal AC power is being received.

DC FAIL

This bit set to one indicates that the power supply is unable to supply the specified DC power. This bit set to zero indicates that normal DC power is being provided.

ELEMENT STATUS CODE In COMMON STATUS, this field is used to indicate PS element presence and failure status, defined as follow:

Table 156 ELEMENT STATUS CODE for PS

Status Code	Name	Condition
1h	Ok	PS is installed and no error conditions are known
2h	Critical	All the PS Alert/failure conditions except "TEMP WARN" and "AC FAIL"
3h	Non-critical	TEMP WARN or AC FAIL
5h	Not installed	PS is not installed
6h	Unknown	PS is not accessible (I2C access error)

4.3.5 Cooling Element (03h)

The Cooling element manages a fan, blower, or other cooling mechanism.

4.3.5.1 Cooling Control Element

The Cooling control element is defined as follow:

Table 157 Cooling Control Element

Cooling Control Element								
Bit	7	6	5	4	3	2	1	0
0	COMMON CONTROL							
1	RQST IDENT	Reserved						
2	Reserved							
3	Reserved	RQST FAIL	RQST ON	Reserved	RQST MANUAL	REQUESTED SPEED CODE		

RQST MANUAL

This bit set to one specifies that the cooling control mode be set to external mode in which fan speed is controlled by host. When this bit set to zero specifies that the cooling control mode be set to internal mode in which fan speed is controlled by CLS SES firmware.

REQUESTED SPEED CODE

This field specifies the requested speed or rate of cooling fans. 000b means leave fan at current speed while 001b to 111b correspond to 7 fan speed levels. If cooling control mode is in internal mode at the time of receiving this element and RQST CTRL bit of this element is not set to one, then CLS SES firmware ignores the request and the INVOP bit is set.

4.3.5.2 Cooling Status Element

The Cooling status element is defined as follow:

Table 158 Cooling Status Element

Cooling Status Element								
Bit	7	6	5	4	3	2	1	0
0	COMMON STATUS							
1	IDENT	Reserved				(MSB)		
2	ACTUAL FAN SPEED (LSB)							
3	HOT SWAP	FAIL	RQSTED ON	OFF	FAN MODE	ACTUAL SPEED CODE		

ACTUAL FAN SPEED

An ACTUAL FAN SPEED field indicates the actual fan speed in revolutions per minute (rpm) when multiplied by a factor of 10 (e.g., 000h indicates 0 rpm and 7FFh indicates 20 470 rpm).

FAIL

A FAIL bit set to one indicates that the enclosure services process is identifying the element with a visual failure indication based on its own detection of a failure. When this bit set to zero indicated the enclosure services process is not identifying the element with a visual failure indication based on its own detection of a failure.

FAN MODE

This bit indicates current cooling control mode, an one indicates it is in external control mode while a zero indicates it is in internal control mode.

ACTUAL SPEED CODE

This field indicates the actual speed or rate of cooling of the cooling mechanism, 000b indicates cooling fans are stopped while 001b to 111b correspond to 7 fan speed levels.

ELEMENT STATUS CODE

In COMMON STATUS, this field is used to indicate Cooling element presence and failure status, defined as follow:

Table 159 ELEMENT STATUS CODE for Cooling

Status Code	Name	Condition
1h	Ok	The fan is installed and no error conditions are known
2h	Critical	Multiple fan failure
3h	Non-critical	Single fan failure
5h	Not installed	The PS is not installed
6h	Unknown	The fan is not accessible (I2C access error)

4.3.6 Temperature Sensor Element (04h)

The Temperature Sensor element manages a temperature sensor.

4.3.6.1 Temperature Sensor Control Element

The Temperature Sensor control element is defined as follow:

Table 160 Temperature Sensor Control Element

Temperature Sensor Control Element								
Bit	7	6	5	4	3	2	1	0
0	COMMON CONTROL							
1	RQST IDENT	RQST FAIL	Reserved					
2	Reserved							
3								

4.3.6.2 Temperature Sensor Status Element

The Temperature Sensor status element is defined as follow:

Table 161 Temperature Sensor Status Element

Temperature Sensor Status Element								
Bit	7	6	5	4	3	2	1	0
0	COMMON STATUS							
1	IDENT	FAIL	Reserved					
2	TEMPERATURE							
3	Reserved				OT FAILURE	OT WARNING	UT FAILURE	UT WARNING

TEMPERATURE

This field indicates the temperature at the sensor in degrees Celsius, offset by +20 degrees. The range of the value expresses a temperature between -19 and +235 degrees Celsius. A value of 00h is reserved.

OT FAILURE

This bit set to one indicates that the temperature is above the safe operating temperature range or higher than the value indicated by the high critical threshold.

OT WARNING

This bit set to one indicates that the temperature is above the normal operating temperature range or higher than the value indicated by the high warning threshold.

UT FAILURE

This bit set to one indicates that the temperature is below the safe operating temperature range or lowers than the value indicated by the low critical threshold.

UT WARNING

This bit set to one indicates that the temperature is below the normal operating temperature

range or lowers than the value indicated by the low warning threshold.

ELEMENT STATUS CODE In COMMON STATUS, this field is used to indicate Temperature Sensor element presence and failure status, defined as follow:

Table 162 ELEMENT STATUS CODE for Temperature Sensor

Status Code	Name	Condition
1h	Ok	The sensor is installed and no error conditions are known
2h	Critical	OT or UT failure condition is detected
3h	Non-critical	OT or UT warning condition is detected
5h	Not installed	The sensor is not installed
6h	Unknown	The sensor is not accessible (I2C access error)

Other fields are not used.

4.3.7 Enclosure Services Controller Electronics Element (07h)

The Enclosure Services Controller Electronics (ESCE) element manages the processor circuitry used by the enclosure services process, as known as the SES firmware.

4.3.7.1 ESCE Control Element

The ESCE control element is defined as follow:

Table 163 ESCE Control Element

Enclosure Services Controller Electronics Control Element								
Bit	7	6	5	4	3	2	1	0
Byte								
0	COMMON CONTROL							
1	RQST IDENT	RQST FAIL	Reserved					
2	Reserved							SELECT
								ELEMENT
3	Reserved							

RQST IDENT

This bit set to one specifies that the enclosure services process turn on Canister Identify LED.
This bit set to zero specifies that the enclosure services process turn off Canister Identify LED.

RQST FAIL

This bit set to one specifies that the enclosure services process turn on Canister Fault LED. This bit set to zero specifies that the enclosure services process turn off Canister Fault LED unless the enclosure services process is itself detecting a failure in the Canister.

4.3.7.2 ESCE Status Element

The ESCE status element is defined as follow:

Table 164 ESCE Status Element

Enclosure Services Controller Electronics Status Element								
Bit	7	6	5	4	3	2	1	0
Byte								
0	COMMON STATUS							
1	IDENT	FAIL	Reserved					
2	Reserved							REPORT
3	HOT SWAP	Reserved						

IDENT

An IDENT bit is set to indicate that the RQST IDENT control bit is set and the device is providing a visual indication of its location. An IDENT bit is cleared when the RQST IDENT control bit is cleared.

FAIL

A FAIL bit set to one indicates that the enclosure services process is identifying the element with a visual failure indication based on the RQST FAIL bit in the control element. A FAIL bit set to zero indicated the enclosure services process is not identifying the element with a visual failure indication based on the RQST FAIL bit in the control element.

HOT SWAP

A HOT SWAP bit set to one indicates that ESCE may be replaced without removing power from the subenclosure that contains it. A HOT SWAP bit set to zero indicates that the ESCE is not a replaceable element or power is required to be removed from the subenclosure before it is replaced.

ELEMENT STATUS CODE In COMMON STATUS, this field is used to indicate ESCE element presence and failure status, defined as follow:

Table 165 ELEMENT STATUS CODE for ESCE

Status Code	Name	Condition
1h	Ok	Canister is installed and no error conditions are known
2h	Critical	Critical condition is detected
3h	Non-critical	Non-critical condition is detected
5h	Not installed	Canister is not installed
6h	Unknown	Peer communication lost
7h	Not Available	MIPSRDY lost

Other fields are not used.

4.3.8 Enclosure Element (0Eh)

The Enclosure element manages the enclosure itself.

4.3.8.1 Enclosure Control Element

The Enclosure control element is defined as follow:

Table 166 Enclosure Control Element

Enclosure Control Element									
Bit	7	6	5	4	3	2	1	0	
0	COMMON CONTROL								
1	RQST IDENT	Reserved							
2	POWER CYCLE REQUEST		POWER CYCLE DELAY						
3	POWER OFF DURATION					RQST FAILURE	RQST WARNING		

RQST IDENT

This bit set to one specifies that the enclosure services process turn on Enclosure Identify LED.
This bit set to zero specifies that the enclosure services process turn off Enclosure Identify LED.

RQST FAILURE

This bit set to one specifies that the enclosure services process turn on Enclosure Fault LED.
This bit set to zero specifies that the enclosure services process turn off Enclosure Fault LED unless the enclosure services process is itself detecting a failure in the enclosure.

RQST WARNING

This bit set to one specifies that the enclosure services process turn on Enclosure Warning LED.
This bit set to zero specifies that the enclosure services process turn off Enclosure Warning LED unless the enclosure services process is itself detecting a warning in the enclosure.

Other fields are not used.

4.3.8.2 Enclosure Status Element

The Enclosure status element is defined as follow:

Table 167 Enclosure Status Element

Enclosure Status Element									
Bit	7	6	5	4	3	2	1	0	
0	COMMON STATUS								
1	IDENT	Reserved							
2	TIME UNTIL POWER CYCLE					FAILURE LED	WARNING LED		
3	REQUESTED POWER OFF DURATION					FAILURE RQSTED	WARNING RQSTED		

IDENT

This bit is set to indicate that the RQST IDENT control bit is set and the device is providing a visual indication of its location. The IDENT bit is cleared when the RQST IDENT control bit is cleared.

FAILURE LED

This bit set to one indicates that a failed condition was detected by the enclosure services process and that the Enclosure Fault LED is turned on.

WARNING LED

This bit set to one indicates that a warning condition was detected by the enclosure services process and that the Enclosure Warning LED is turned on.

FAILURE RQSTED

This bit set to one indicates that a failed condition has been requested by an application client with the Enclosure Control diagnostic page and that the Enclosure Fault LED is turned on. This bit set to zero indicates that a failed condition has not been requested by an application client.

WARNING RQSTED

This bit set to one indicates that a warning condition has been requested by an application client with the Enclosure Control diagnostic page and that the Enclosure Warning LED is turned on. This bit set to zero indicates that a warning condition has not been requested by an application client.

ELEMENT STATUS CODE In COMMON STATUS, this field is used to indicate Enclosure element status, defined as follow:

Table 168 ELEMENT STATUS CODE for Enclosure

Status Code	Name	Condition
1h	Ok	No error conditions are known in the enclosure
2h	Critical	Critical condition is detected
3h	Non-critical	Non-critical condition is detected
6h	Unknown	Enclosure is not accessible (Enter LOCK DOWN mode)

Other fields are not used.

4.3.9 Voltage Sensor Element (12h)

The Voltage Sensor element manages a voltage sensor.

4.3.9.1 Voltage Sensor Control Element

The Voltage Sensor control element is defined as follow:

Table 169 Voltage Sensor Control Element

Voltage Sensor Control Element								
Bit	7	6	5	4	3	2	1	0
0	COMMON CONTROL							
1	RQST IDENT	RQST FAIL	Reserved					
2	Reserved							
3								

4.3.9.2 Voltage Sensor Status Element

The Voltage Sensor status element is defined as follow:

Table 170 Voltage Sensor Status Element

Voltage Sensor Status Element								
Bit	7	6	5	4	3	2	1	0
0	COMMON STATUS							
1	IDENT	FAIL	Reserved		WARN OVER	WARN UNDER	CRIT OVER	CRIT UNDER
2	(MSB) VOLTAGE (LSB)							
3								

WARN OVER

This bit set to one indicates that the voltage indicated by the VOLTAGE field is above the high warning threshold. This bit set to zero indicates that the voltage indicated by the VOLTAGE field is below the high warning threshold.

WARN UNDER

This bit set to one indicates that the voltage indicated by the VOLTAGE field is below the low warning threshold. This bit set to zero indicates that the voltage indicated by the VOLTAGE field is above the low warning threshold.

CRIT OVER

This bit set to one indicates that the voltage indicated by the VOLTAGE field is above the high critical threshold. This bit set to zero indicates that the voltage indicated by the VOLTAGE field is below the high critical threshold.

CRIT UNDER

This bit set to one indicates that the voltage indicated by the VOLTAGE field is below the low critical threshold. This bit set to zero indicates that the voltage indicated by the VOLTAGE field is above the low critical threshold.

VOLTAGE

This field indicates the voltage detected by the voltage sensor, measured in units of 10mV.

ELEMENT STATUS CODE In COMMON STATUS, this field is used to indicate Voltage Sensor element presence and failure status, defined as follow:

Table 171 ELEMENT STATUS CODE for Voltage Sensor

Status Code	Name	Condition
1h	Ok	The sensor is installed and no error conditions are known
2h	Critical	OV or UV critical condition is detected
3h	Non-critical	OV or UV warning condition is detected
5h	Not installed	The sensor is not installed
6h	Unknown	The sensor is not accessible (I2C access error)

Other fields are not used.

4.3.10 Current Element (13h)

The Current element manages a current sensor

4.3.10.1 Current Control Element

The Current control element is defined as follow

Table 172 Current Control Element

Current Control Element								
Bit	7	6	5	4	3	2	1	0
Byte								
0	COMMON CONTROL							
1	RQST IDENT	RQST FAIL	Reserved					
2	Reserved							
3	Reserved							

4.3.10.2 Current Status Element

The Current status element is defined as follow

Table 173 Current Status Element

Current Status Element								
Bit	7	6	5	4	3	2	1	0
Byte								
0	COMMON STATUS							
1	IDENT	FAIL	Reserved		WARN OVER	Reserved	CRIT OVER	Reserved
2	(MSB)							

	CURRENT
3	(LSB)

WARN OVER

A WARN OVER (over current warning) bit set to one indicates that the current indicated by the CURRENT field is above the high warning threshold. A WARN OVER bit set to zero indicates that the current indicated by the CURRENT field is below the high warning threshold.

CRIT OVER

A CRIT OVER (over current critical) bit set to one indicates that the current indicated by the CURRENT field is above the high critical threshold. A CRIT OVER bit set to zero indicates that the current indicated by the CURRENT field is below the high critical threshold.

CURRENT

A CURRENT field indicates the current detected by the current sensor, measured in units of 10 mA. A.C. currents are measured in amperes A.C., RMS. The value is expressed as a 16-bit number using two's complement notation to indicate negative numbers. The largest positive current that is able to be expressed is 327.67 A and the largest negative current that is able to be expressed is -327.67 A.

4.3.11 SAS Expander Element (18h)

The SAS Expander element manages a SAS expander device.

4.3.11.1 SAS Expander Control Element

The SAS Expander control element is defined as follow:

Table 174 SAS Expander Control Element

SAS Expander Control Element								
Bit	7	6	5	4	3	2	1	0
Byte 0	COMMON CONTROL							
1	RQST IDENT	RQST FAIL	Reserved					
2	Reserved							
3								

4.3.11.2 SAS Expander Status Element

The SAS Expander status element is defined as follow:

Table 175 SAS Expander Status Element

SAS Expander Status Element								
Bit	7	6	5	4	3	2	1	0
Byte 0	COMMON STATUS							
1	IDENT	FAIL	Reserved					
2	Reserved							
3								

ELEMENT STATUS CODE In COMMON STATUS, this field is used to indicate SAS Expander element status, defined as follow:

Table 176 ELEMENT STATUS CODE for SAS Expander

Status Code	Name	Condition
1h	Ok	Element is installed and no error conditions are known
5h	Not installed	Element is not installed
6h	Unknown	SAS Expander is not accessible (Enter LOCK DOWN mode)

Other fields are not used.

4.3.12 SAS Connector Element (19h)

The SAS Connector element manages a SAS connector or a portion of a SAS connector.

4.3.12.1 SAS Connector Control Element

The SAS Connector control element is defined as follow:

Table 177 SAS Connector Control Element

SAS Connector Control Element								
Bit	7	6	5	4	3	2	1	0
0	COMMON CONTROL							
1	RQST IDENT	Reserved						
2	Reserved							
3	Reserved	RQST FAIL	Reserved					

This element has no effect.

4.3.12.2 SAS Connector Status Element

The SAS Connector status element is defined as follow:

Table 178 SAS Connector Status Element

SAS Connector Status Element								
Bit	7	6	5	4	3	2	1	0
0	COMMON STATUS							
1	IDENT	CONNECTOR TYPE						
2	CONNECTOR PHYSICAL LINK							
3	Reserved	FAIL	Reserved					

CONNECTOR TYPE

This field indicates the type of connector.

CONNECTOR PHYSICAL LINK

This field indicates the physical link in the connector represented by this element.

ELEMENT STATUS CODE

In COMMON STATUS, this field is used to indicate SAS Connector element status, defined as follow:

Table 179 ELEMENT STATUS CODE for SAS Expander

Status Code	Name	Condition
1h	Ok	Element is installed and no error conditions are known
5h	Not installed	Element is not installed

6h	Unknown	SAS connector is not accessible (Enter LOCK DOWN mode)
----	---------	--

Other fields are not used.

Command Line Interface

The Command Line Interface (CLI) is provided as an alternative interface for users to monitor and control the enclosure management processes. This section provides detailed definitions of CLI commands.

4.4 Access Interfaces

This CLI can be accessed via back plate serial console port. The setting parameters for serial port are listed as below:

Table 180 Command Line Interface Setting Parameters

Setting Item	Value
Baud Rate	115200
Date	8 bit
Parity	No
Stop	1 bit
Flow Control	No

4.5 Commands summary

The table below shows the list of commands:

Table 181 CLI commands list

Command	Description
help	Display CLI command list
about	Display firmware version and copyright information
drv	Show array device slot element status
esm	Show enclosure service control electronics element status
fan	Show/Control working mode and speed of cooling fans
fru	Display/Change system inventory information of FRUs and enclosure
log	Display /Clear system event and operation log
port	SAS Expander port status display
power	Display power status of FRU and Voltage Sensors. Change power status of FRU
reset	Reset local canister
temp	Display temperature sensors reading value.
threshold	Display/Set threshold values for various sensors
checklist	Display Compatibility Check Table. Set Compatibility Matrix.
mode	Display canister current state.
config	Display/Reset user configuration.
debug	Toggle system debug information on/off switch
errlog	Display firmware application error log.
led	Show/Set status of various LED indicators
spin	Drive spin up/down control
vpd	Display/Program various VPD
phy	Implement enable, disable and reset on given PHY.

4.6 Command Keywords

All CLI commands are in lower case and are case sensitive.

All numbers used at CLI are decimal by default. To use hexadecimal data type “0x” before numbers.
The general syntax for commands is as follow:

```
command <sub_cmd_1 | sub_cmd_2> [option] [{parameter_1} | {parameter_2}]
```

```
<>    embraces mandatory parameters  
[]    embraces optional parameters  
{ }   embraces variables  
|     separates options of a parameter
```

The following abbreviations may be used in CLI commands:

```
db = drive board  
ps = Power Supply  
sys = System  
encl = Enclosure  
t = Temperature sensor  
v = Voltage sensor  
drv = Hard disk drive  
led = LED indicator  
flt = Fault  
id = Identify
```

4.7 Prompt

Firmware should use the element descriptor that represents the local canister as the CLI prompt string.

4.8 Error and Status Messages

Below is the list of error and status messages that should be used by the CLI when returning command execution results:

- Access device failure
- Bad parameter specified
- Bad status returned
- Invalid command
- FRU not installed
- Drive not installed
- This function is not supported by hardware
- Target device absent

4.9 Command Definitions

This section provides a complete list of all commands supported by the CLI. Note that values shown in this section are examples and are not necessarily match the real system display.

4.9.1 help

Description

This command displays a short summary of the available commands...

Syntax

```
help [<command>]
```

4.9.2 about

Description

This command displays CLS SES firmware revision and copyright information.

Syntax

```
about
```

4.9.3 drv

Descriptor

This command displays the information and status of drives in each device slot.

Syntax

```
drv <get> [{slot_id}]
```

Sub_cmd:

get: display the list of drive disk status and slot virtual indicator status.

Options:

none.

Parameter:

slot_id: drive slot id.

4.9.4 esm

Descriptor

This command displays reading value and status of each elements located in each esce..

Syntax

Usage:

```
esm <get> [{esm_slot_id}]
```

Sub_cmd:

get: display the information and status of each Enclosure Service Module.

Option:

none.

Parameter:

esm_slot_id: physical slot ID of ESM, 0 = ESM A, 1 = ESM B.

4.9.5 fan

Description

This command is used to monitor and control the cooling fans.

Syntax

```
fan <get | set> [-l | --level | -m | --mode | -p | -pwm]
                [{speed_level} | {control_mode} | {pwm_value}]
```

Sub_cmd:

get: display fan working mode, speed and status pwm value.
set: change fan working mode or speed or pwm value.

Options:

--level: fan speed level
-l: abbreviation of --level.
--mode: cooling control mode. Internal - fan speed is controlled by enclosure management firmware. External - fan speed is controlled by CLI or SES page.
-m: abbreviation of --mode.
--pwm: fan PWM setting in percentage, 100 means full speed.
-p: abbreviation of --pwm.

Parameter:

speed_level: 0-7, must be specified with option --level or -l.
control_mode: i(internal) or e(external), must be specified with option -
mode or -m.
pwm_value: 0-100, must be specified with option --pwm or -p.

4.9.6 fru

Description

This command is used to display inventory information of various elements, including PS, Canister and Enclosure. This command also supports to change dynamic inventory information.

Syntax

Usage:

```
fru <get | set> [-e | --enclosure | -c | --can | -p | --ps]
```

sub_cmd:

get: display enclosure and FRUs information.
set: set settable information of FRUs.

Options:

*--enclosure: set enclosure information.
-e: abbreviation of --enclosure.
--can: set canister information.
-c: abbreviation of --can
--ps: set power supply information.
-p: abbreviation of --ps.*

Parameter:

none.

4.9.7 log

Description

This command is used to display and clear local or peer log repository.

Syntax

Usage:

*log <get> [-s | --severity] [i | w | c] [p]
log <clear> [p]
log <filter> <get|set> <-s | --severity> [0 | 1 | 2]*

Sub_cmd:

*get: display event log entries.
clear: clear all event log entries.*

Option:

*--severity: event display filters.
-s: abbreviation of --severity.*

Parameter:

*i: info.
w: warning.
c: critical.
severity must be specified with option --severity or -s.
p: peer log repository*

4.9.8 port

Description

This command is used to display each port status of SAS expander.

Syntax

Usage:

port <get>

Sub_cmd:

get: display port number of this expander and each port information.

Option:
none.

Parameter:
none.

4.9.9 power

Descriptor

This command is used to display power supply status, voltage sensors reading value and power failure conditions.

This command also supports to power on/off specified power supply and do power margin operations.

Syntax

Usage:

```
power <get | set> [-m | --margin] [{ps_id} | {can_id}] [on | up | down | off]
```

Sub_cmd:

get: display power status of PS and voltage sensor.

set: change power state of PS or do power margin on voltage sensors located in given canister

Option:

--margin: implement power margin to voltage sensors located in given canister.

-m: abbreviation of *--margin*.

Parameter:

ps_id: power supply id for power supply, use format like this: "ps" + number, for example ps0, ps1.

can_id: canister id for canister, use format like this: "CAN" + number, for example CAN0, CAN1.

can_id must be specified with option *--margin* or *-m*

up: power margin up on all the voltage sensors located in given canister.

down: power margin down on all the voltage sensors located in given canister.

off: power margin off on all the voltage sensors located in given canister

on: power on ps.

off: power off ps

Must be specified with "power set" command and parameters "ps_id"

4.9.10 reset

Description

This command is used to reset local canister.

Syntax

```
reset
```

4.9.11 temp

Descriptor

This command shall display the temperature sensors reading and temperature failure conditions..

Syntax

```
temp <get>
```

4.9.12 threshold

Descriptor

This command supports to display or change threshold values of an element.

Syntax

Usage:

```
threshold <get | set> [{sensor_id}] [{lc}][{lw}][{uw}][{uc}]
```

Sub_cmd:

```
get: display current threshold values.  
set: change threshold values.
```

Option:

```
none.
```

Parameter:

```
sensor_id: identifier number of a sensor. Use command "threshold  
get" to display and find out sensor_id for a specific sensor. Must  
be specified with "threshold set" command. If not specified with  
"threshold get" command, it will display threshold values of all  
sensors.
```

Threshold types:

```
uc: Upper Critical  
uw: Upper Warning  
lw: Lower Warning  
lc: Lower Critical
```

```
Must be specified in the following sequence: lc <= lw <= uw <=  
uc..
```

4.9.13 checklist

Description

This command is used to get Compatibility Check Table. This command also supports to set Compatibility Matrix (Enable or Disable Compatibility Check items) or reset it to default value. If an item is enabled in Compatibility Check Table, it will be checked during system initialization.

Syntax

Usage:

```
checklist <get | set | reset> [-r | --range] [{first last} |  
{check_item_index}] [on | off].
```

Sub_cmd:

```
get: display the list of compatibility check items and current status.  
set: enable/disable the compatibility check items.  
reset: reset to factory default checklist setting.
```

Option:

```
--range: set a group of checklist items.  
-r: abbreviation of --range.
```

Parameter :

```
first: index of the first item in the group.  
last: index of the last item in the group.  
first and last must be specified with option -r or --range.  
check_item_index: index of an item in check list. Use command "checklist  
get" to display and find out check_item_index for a specific checking  
item.  
on: enable item, all enabled items will be checked in compatibility  
checking process.  
off: disable item, all disabled items will not be checked in  
compatibility  
checking process.
```

4.9.14 mode

Description

This command is used to display local canister current state. This command also supports to force local canister to change from LOCK DOWN state to Compatibility Check mode to recover from LOCK DOWN mode.

Syntax

Usage:

```
mode <get | set> [{state_id}]
```

Sub_cmd:

```
get: display this canister's current power state.  
set: user forced state change.
```

Option:

```
none.
```

Parameter:

state_id: defined power state, must be specified with "mode set"

<i>State ID</i>	<i>Description</i>
-----------------	--------------------

<i>A</i>	<i>No Power</i>
<i>B</i>	<i>Compatibility Check</i>
<i>C</i>	<i>Lock Down</i>
<i>D</i>	<i>Single Mode</i>
<i>E</i>	<i>Shared Mode</i>

"mode set" command only supports the following operations: This canister is in state C: Lock Down. User is allowed to issue "mode set B" command to force this canister to return from Lock Down.

4.9.15 config

Description

This command displays user configuration and reset user configuration to factory default.

Syntax

Usage:

```
config <get | reset>
```

Sub_cmd:

get: display user configuration stored in EEPROM.
reset: reset to factory default user configuration.

Option:

none.

Parameter:

none.

4.9.16 debug

Description

This command is used to turn on/off system debug information and change the debug message verbose level.

Syntax

```
debug [on | off] [-l | --level {severity_level}]
```

4.9.17 errlog

Description

This command is used to display error log. This command also supports to turn on/off error log or setting the severity level of firmware application error log.

Syntax

Usage:

```
errlog <get | set> [-l | --level] [on | off] [{severity_level}]
```

Sub_cmd:

```
get: display current errlog, errlog status and errlog severity level.  
set: change status of error log switch and log severity.
```

Option:

```
--level: optional flag, indicate that a severity_level parameter is  
provided.  
-l: abbreviation of --level.
```

Parameter:

```
on: turn on firmware logger.  
off: turn off firmware logger.
```

```
severity_level: severity level of firmware log filter, from 1 to 3.
```

```
1 = Info  
2 = Warning  
3 = Critical
```

```
Must be specified with option --level or -l.
```

4.9.18 led

Description

This command supports directly control to physical LEDs.

Syntax

Usage:

```
led <get | set> [{led_id}] [on | off | fast | slow]
```

Sub_cmd:

```
get: display LED indicators current status.  
set: change LED indicators status.
```

Option:

```
none.
```

Parameter:

```
led_id: indicates which led to set or get. Must specified with "led set"
```

```
on: turn on LED.  
off: turn off LED.  
fast: turn on LED to blink fast.  
slow: turn on LED to blink slow.
```

```
An action must be specified when use "led set" command.
```

4.9.19 spin

Description

This command supports to spin up or spin down a drive or a group of drives.

Syntax

Usage:

```
spin [-g | --group] <up | down> <{drv_slot_id} | {first_slot_id  
last_slot_id}>
```

Sub_cmd:

none.

Options:

--group: spin up/down a group of drives.
-g: abbreviation of --group.

Parameter:

up: spin up one or a group of drive(s)
down: spin down one or a group of drive(s)

drv_slot_id: physical slot ID of drive.

first_drv_slot_id: the first drive slot id of this group of drives.

last_drv_slot_id: the last drive slot id of this group of drives.

4.9.20 vpd

Description

This command supports to display, program and reset VPD content of Midplane, Canister and Power Supply.

Syntax

Usage:

```
vpd <get | set> <-m | -- Midplane | -c | --can | -p | --ps>  
<{mp_vpd_id} | {esm_slot_id} | {ps_slot_id}> [{offset}] [{length}]
```

Sub_cmd:

get: display vpd content.
set: update vpd content.

Option:

-- Midplane: select content of Midplane vpd to be shown.
-m: abbreviation of -- Midplane.
--can: select content of canister vpd to be shown.
-c: abbreviation of --can.
--ps: select content of power supply vpd to be shown.
-p: abbreviation of --ps.

Parameter:

mp vpd id: ID of Midplane vpd, 0 = Midplane vpd 0, 1 = Midplane vpd 1

```
can_slot_id: physical slot ID of canister, 0 = canister A, 1 = canister B.
ps_slot_id: physical slot ID of power supply, 0 = ps slot A, 1 = ps slot B.

offset: starting address of vpd data display. This is the EEPROM internal data offset. Default is 0x0 if not specified.
length: data length of vpd data to be displayed, in bytes. Default is 0x100 if not specified.
```

4.9.21 phy

Description

This command is used to do enable, disable or reset to given PHY.

Syntax

Usage:

```
phy <enable | disable | reset> <all | {phy_id}>
phy loopback <-sys | -ext> <-t | -n> [{test_time} | {error_num}] <-p>
<{phy_id} | all>
phy cnt <-{error_cnt_type} | -all> <{phy_id} | all>
```

Sub_cmd:

```
enable: enable phy.
disable: disable phy, continuous OOB_INIT.
reset: reset phy, do link reset sequence.
loopback: loopback test
cnt: get given or all types of error count
```

Option:

```
-sys: implement system side analog loopback
-ext: implement external loopback
-t: duration for inserting PRBS patterns
-n: number of error patterns
-p: phy id
Above options are required for Sub_cmd "loopback"
-all, -code_viol, -disp, -crc, -lost_dwd_sync and -invalid_dwd: error counter type
Above options are required for Sub_cmd "cnt"
```

Parameter:

```
all: all expander phys.
phy_id: specific phy id.
```