|  |
| --- |
| **S2PH SAS Expander Specification** |

|  |  |  |
| --- | --- | --- |
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# Introduction

This document covers the implementation of the Enclosure Management Solution portion of the S2PH (LSISAS3x24R Expander) firmware. It is a high-availability and high-density SAS 3.0 storage product that enables the connection of up to 16 directly attached dual-ported SAS or SATA devices by SKU.

The main task of the SEP software provides SCSI Enclosure Service (SES) which monitors the status of FRUs (Field Replaceable Unit) and provides controls over these FRUs in the system. When FRU failures are detected or recovered, necessary adjustments are performed to maintain normal system operations. The signals to monitor and control FRUs, internal APIs and protocols for communication are listed in this document. Possible FRU events generated from monitoring the FRUs, or internal actions to take are also included.

## Reference Documents

* SCSI-3 Enclosure Services (SES2r20)
* Serial Attached SCSI-2 (SAS 2r14d)
* SCSI-4 Architecture Model (SAM 4r14)
* SCSI-4 Primary Commands (SPC 4r14)
* SATA 1.0a Specification, *Serial ATA Working Group*
* Serial ATA II: Extensions to Serial ATA 1.0a, *Serial ATA Working Group*
* I2C-bus Specification 2.1, *Philips Semiconductor*
* LSISAS3x24-R\_Expander\_Datasheet\_v2\_1, July 2013
* LSI\_12Gb\_SAS-SATA\_Expander\_SDK\_ProgGd\_v1.1, April 2013
* LSISAS3XnnRExpander\_RegPG\_Rev2.2, August 213

## Glossary

|  |  |  |
| --- | --- | --- |
| **DAE** | - | **D**isk **A**rray **E**nclosure. Cabinet containing disk drives inter-connect paths, cooling elements, configuration management electronics and power supplies. |
| **Enclosure address** | - | Address to be used by the storage processor to map the topology of the storage system, and aid in locating faults; may also be called Enclosure Identifier. |
| **SEP** | - | **S**torage **E**nclosure **P**rocessor. A processor that monitors and controls the internal environment of an enclosure. |
| **FRU** | - | **F**ield **R**eplaceable **U**nit. Refers to any component in a DAE that is replaceable, including firmware. |
| **HA** | - | **H**igh **A**vailability. Increasing the availability of the product through robust design and redundant components for failover. |
| **JBOD** | - | **J**ust a **B**unch **O**f **D**isks. A term describing an enclosure providing raw storage without a built-in RAID controller. |
| **SIM** | - | The management element of a Disk Array Enclosure. |
| **SES** | - | **S**CSI **E**nclosure **S**ervices; a means of monitoring and controlling an enclosure using the in-band SAS signal |
| **TWI** | - | **T**wo **W**ire **I**nterface. The industry decided to call it this after the patent name lapsed on I2C. |

# Firmware Operation on Enclosure Management

The functions of Enclosure management provide power, cooling, and protection for devices. Enclosure also provides external indicators about the state of the enclosure and devices. Enclosure manages all controlled elements and communicates with SCSI application client in host.

## Main tasks in SEP Firmware

After firmware initialization, SEP will do the following main tasks:

1. Handle SAS protocol such as

* Process SCSI supported commands described in chapter 1.
  + To provide the portions of SCSI Architecture Model (SAM-4) and SCSI Primary Commands (SPC-4) required supporting SES device.
* Process SES supported control/status pages described in chapter 6.
  + To provide SCSI enclosure services (SES-2)
* Process SMP supported commands described in chapter 0.
  + To provide expander management and zoning functions.
* Process discovery if broadcast change is received.
  + To find SAS network topology and configure routing table.

1. Handle Enclosure Management Application described in the following sections.

* Monitor the current status of the control elements such as drive’s presence, HDD boards, power condition, SIM condition
* Control/Set control elements such as drives, HDD board, SIM based on requests.
* Update SES status pages based on the current status of all control elements

1. Handle Command Line Interface described in chapter 3.
2. Handle hardware resources such as IIC bus, IPC bus and GPIO.

## Enclosure Management Application

EMA can monitor and report the status in the following controlled elements:

Table 1 Enclosure Element Status

|  |  |  |
| --- | --- | --- |
| Controlled Elements | Amount | Status |
| Hard Disk Drive | 16 (1U 3.5”x16 SKU) | Present, Removed, Disabled, Locator |
| Expander Module (SIM) | 1 | Present, Locator and Failed |

EMA will be based on pre-defined period to monitor the status of above controlled elements and update its current status. If controlled element is failed or out of range, EMA will set the fault LED which described in chapter 0 to notify user. If the status is changed, EMA will log the event and also update SES status pages to notify the host. If control request is from host, EMA will set the controlled element based on the request.

### Drive Presence/Absence Detection

SEP can monitor the drive presence/absence status.

### JBOD fault status

The SEP will check all controlled elements to report JBOD’s status (OK, non-critical, critical or not installed) in SES page as the following table:

Table 2 Supported Status Code

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Element** | **Individual Element Status Code** | | | |
| **OK** | **non-critical** | **critical** | **uninstalled** |
| Disk | OK | NA | NA | not installed |
| SAS Connectors | OK | NA | NA | not installed |
| SAS Expanders | OK | NA | NA | NA |
| JBOD | Based on above elements | | | NA |

### Monitor the speed of SAS connector

The SEP will detect the speed of SAS connector such as 1.5G, 3G, 6G, or 12G. The connector type is external mini-SAS (SFF-8088) or internal SAS Drive receptacle (SFF-8482).

Each drive and SAS port has been assigned one connector index as following layout:

# Command Line Interface

S2PH provides a basic command line interface (CLI) as an alternative for users to configure their S2PH. In order to use the CLI, users can use the UART to communicate with S2PH. The baud rate should be set **115200bps**. We support the following control, status and diagnostic commands to S2PH

================================================================================

Test Command

================================================================================

Display/Reset all phy counters phycnt reset(optional) <address>

Display FRU information fru

Display Status for all disks disks

Display System Status status

Display Status for all ports port

Display FW versions ver

Diag Each Item diag

File download fdl <BufferID(H)> <Offset(H)> <Erase(\*)>

Display Info for all phys phyinfo [help|edfb|power|cable](opt)

Display expander SAS address sasaddr

Show POST info showpost

Show firmware rev rev

CLI Help help command

================================================================================

## CLI commands

### Display/Reset all PHY counters

**This command is used to display the error counters of PHYs and reset the error counters of PHYs.**

|  |  |
| --- | --- |
| **Syntax** |  |
| **phycnt reset(optional) <address>** | |

**Syntax Description**

**reset: Use this parameter to reset all PHY error counters.**

**address: The SAS address of JBF you want to access. If no address input, then get the local PHY error count.**

**Display Message**

**InvWrdCnt: Refer to section 3.1.5.**

**DispErrCnt: Refer to section 3.1.5.**

**LossSyncCnt: Refer to section 3.1.5.**

**RstSeqFailCnt: Refer to section 3.1.5.**

**Phy xxx: The PHY number xxx.**

**Related Commands**

**counters**

**Examples**

D51PH-1ULH >phycnt

Phy Layer Error Counters========================================================

================InvWrdCnt ======DispErrCnt =====LossSyncCnt ====RstSeqFailCnt===

================================================================================

Phy 000 0x00000000 0x00000000 0x00000000 0x00000000

Phy 001 0x00000000 0x00000000 0x00000000 0x00000000

Phy 002 0x00000000 0x00000000 0x00000000 0x00000000

Phy 003 0x00000000 0x00000000 0x00000000 0x00000000

Phy 004 0x00000000 0x00000000 0x00000000 0x00000000

Phy 005 0x00000000 0x00000000 0x00000000 0x00000000

Phy 006 0x00000000 0x00000000 0x00000000 0x00000000

Phy 007 0x00000000 0x00000000 0x00000000 0x00000000

Phy 008 0x00000000 0x00000000 0x00000000 0x00000000

Phy 009 0x00000000 0x00000000 0x00000000 0x00000000

Phy 010 0x00000000 0x00000000 0x00000000 0x00000000

Phy 011 0x00000000 0x00000000 0x00000000 0x00000000

Phy 012 0x00000000 0x00000000 0x00000000 0x00000000

Phy 013 0x00000000 0x00000000 0x00000000 0x00000000

Phy 014 0x00000000 0x00000000 0x00000000 0x00000000

Phy 015 0x00000000 0x00000000 0x00000000 0x00000000

Phy 016 0x00000000 0x00000000 0x00000000 0x00000000

Phy 017 0x00000000 0x00000000 0x00000000 0x00000000

Phy 018 0x00000000 0x00000000 0x00000000 0x00000000

Phy 019 0x00000000 0x00000000 0x00000000 0x00000000

Phy 020 0x00000000 0x00000000 0x00000000 0x00000000

Phy 021 0x00000000 0x00000000 0x00000000 0x00000000

Phy 022 0x00000000 0x00000000 0x00000000 0x00000000

Phy 023 0x00000000 0x00000000 0x00000000 0x00000000

================================================================================

### Display FRU information

**This command is used to display FRU information of JBOD.**

|  |  |
| --- | --- |
| **Syntax** |  |
| **fru** | |

**Syntax Description**

**None**

**Display Message**

**SAS Address: The length of SAS address must be 16 digitals.**

**Serial Number: The length of SIM must be 11 digitals.**

**Related Commands**

**diag**

**Examples**

### Display status for all disks

**This command is used to display the status of all disks.**

|  |  |
| --- | --- |
| **Syntax** |  |
| **disks** | |

**Syntax Description**

**None**

**Display Message**

**Disk: Display the disk number.**

**PSNT: Display the disk is attached or not.**

**RDY: Display the disk is linking ready or not.**

**SAS: Display the attached port is SAS device or not.**

**SATA: Display the attached port is SATA device or not.**

**1.5G: 1.5 Gbit/sec link speed of attached device.**

**3.0G: 3.0 Gbit/sec link speed of attached device.**

**6.0G: 6.0 Gbit/sec link speed of attached device.**

**12.0G: 12.0 Gbit/sec link speed of attached device.**

**Disk SAS address: The SAS address of attached disk.**

**Related Commands**

**status, port, phyinfo**

**Examples**

D51PH-1ULH >disks

--------------------------------------------------------------------------------

|Disk |00|01|02|03|04|05|06|07|08|09|10|11|12|13|14|15|

--------------------------------------------------------------------------------

|PSNT | | | | | V| V| | | | | | | | | | |

--------------------------------------------------------------------------------

|RDY | | | | | V| V| | | | | | | | | | |

--------------------------------------------------------------------------------

|SAS | | | | | V| V| | | | | | | | | | |

--------------------------------------------------------------------------------

|SATA | | | | | | | | | | | | | | | | |

--------------------------------------------------------------------------------

|1.5G | | | | | | | | | | | | | | | | |

--------------------------------------------------------------------------------

|3.0G | | | | | V| | | | | | | | | | | |

--------------------------------------------------------------------------------

|6.0G | | | | | | V| | | | | | | | | | |

--------------------------------------------------------------------------------

|12.0G | | | | | | | | | | | | | | | | |

--------------------------------------------------------------------------------

Disk SAS address:

00:0000000000000000 01:0000000000000000 02:0000000000000000 03:0000000000000000

04:500000e01e823092 05:50000393c8492fca 06:0000000000000000 07:0000000000000000

08:0000000000000000 09:0000000000000000 10:0000000000000000 11:0000000000000000

12:0000000000000000 13:0000000000000000 14:0000000000000000 15:0000000000000000

### Display system status

**This command is used to display JBOD system status, there are included status of disks.**

|  |  |
| --- | --- |
| **Syntax** |  |
| **status** | |

**Syntax Description**

**None**

**Display Message**

**SIM[xx]: The SIM board xx, the value of xx must be 0.**

**DISK[xx]: The disk xx, the value of xx must be in the range of 0 to 15.**

**PORT[xx]: The port xx, the value of xx must be in the range of 0 to 7.**

**Related Commands**

**disks, port, phyinfo,**

**Examples**

D51PH-1ULH >status

==============================================================================

| D51PH-1ULH System Status |

==============================================================================

| D51PH-1ULH DISKS Modules Status |

------------------------------------------------------------------------------

Disk[00] status : [Uninstall][Disabled] SAS\_ADDR: 0x0000000000000000

Disk[01] status : [Uninstall][Disabled] SAS\_ADDR: 0x0000000000000000

Disk[02] status : [Uninstall][Disabled] SAS\_ADDR: 0x0000000000000000

Disk[03] status : [Uninstall][Disabled] SAS\_ADDR: 0x0000000000000000

Disk[04] status : [ Present ][Enabled] SAS\_ADDR: 0x500000e01e823092

Disk[05] status : [ Present ][Enabled] SAS\_ADDR: 0x50000393c8492fca

Disk[06] status : [Uninstall][Disabled] SAS\_ADDR: 0x0000000000000000

Disk[07] status : [Uninstall][Disabled] SAS\_ADDR: 0x0000000000000000

Disk[08] status : [Uninstall][Disabled] SAS\_ADDR: 0x0000000000000000

Disk[09] status : [Uninstall][Disabled] SAS\_ADDR: 0x0000000000000000

Disk[10] status : [Uninstall][Disabled] SAS\_ADDR: 0x0000000000000000

Disk[11] status : [Uninstall][Disabled] SAS\_ADDR: 0x0000000000000000

Disk[12] status : [Uninstall][Disabled] SAS\_ADDR: 0x0000000000000000

Disk[13] status : [Uninstall][Disabled] SAS\_ADDR: 0x0000000000000000

Disk[14] status : [Uninstall][Disabled] SAS\_ADDR: 0x0000000000000000

Disk[15] status : [Uninstall][Disabled] SAS\_ADDR: 0x0000000000000000

------------------------------------------------------------------------------

Rear Port SAS Address:

SIM0 :

PORT[0] ~ PORT[3] : 5001636000feee68 5001636000feee68 5001636000feee68 5001636000feee68

PORT[4] ~ PORT[7] : 5001636000feee68 5001636000feee68 5001636000feee68 5001636000feee68

Expanders SAS Address: 5001636000227780

### Display status for all ports

**This command is used to display the status of all ports.**

|  |  |
| --- | --- |
| **Syntax** |  |
| **Port** | |

**Syntax Description**

**None**

**Display Message**

**SIMx: Display the SIM board x information.**

**Port: Display the port number mapping to Physical SAS port. 0~3 is SAS port 0, 4~7 is SAS port 1.**

**Type: Display the type of port.**

**RDY: Display the port is ready or not.**

**SAS: Display the attached port is SAS device or not.**

**SATA: Display the attached port is SATA device or not.**

**1.5G: 1.5 Gbit/sec link speed of attached device.**

**3.0G: 3.0 Gbit/sec link speed of attached device.**

**6.0G: 6.0 Gbit/sec link speed of attached device.**

**12.0G: 12.0 Gbit/sec link speed of attached device.**

**Port SAS address: The SAS address of attached device.**

**Related Commands**

**status, disks, phyinfo**

**Examples**

D51PH-1ULH >port

SIM0 :

--------------------------------------------------------------------------------

|Port |00|01|02|03|04|05|06|07|

--------------------------------------------------------------------------------

|Type | SAS#0 | SAS#1 |

--------------------------------------------------------------------------------

|RDY | V| V| V| V| V| V| V| V|

--------------------------------------------------------------------------------

|SAS | | | | | | | | |

--------------------------------------------------------------------------------

|SATA | | | | | | | | |

--------------------------------------------------------------------------------

|1.5G | | | | | | | | |

--------------------------------------------------------------------------------

|3.0G | | | | | | | | |

--------------------------------------------------------------------------------

|6.0G | V| V| V| V| V| V| V| V|

--------------------------------------------------------------------------------

|12.0G | | | | | | | | |

--------------------------------------------------------------------------------

Port SAS address:

00:5001636000feee68 01:5001636000feee68 02:5001636000feee68 03:5001636000feee68

04:5001636000feee68 05:5001636000feee68 06:5001636000feee68 07:5001636000feee68

### Display firmware versions

**This command is used to display the versions of firmware.**

|  |  |
| --- | --- |
| **Syntax** |  |
| **ver** | |

**Syntax Description**

**None**

**Display Message**

**Firmware Version: The versions of S2PH firmware.**

**Build time: The build time of S2PH firmware.**

**Related Commands**

**ver**

**Examples**

D51PH-1ULH >ver

Firmware Version : 0.900

Build time : 2018/01/31 12:00:00

### Diagnostic all hardware

**This command is used to diagnostic hardware components of JBOD.**

|  |  |
| --- | --- |
| **Syntax** |  |
| **diag** | |

**Syntax Description**

**None**

**Display Message**

**FRUs Management: Manage the FRU information on boards.**

**LED Diagnostic: Use to diagnostic the LEDs on all modules.**

**SRAM Diagnostic: Use to diagnostic the function of SRAM.**

**FLASH Diagnostic: Use to diagnostic the function of FLASH.**

**Expander PHY Loopback Diagnostic: Use to diagnostic the function of PHY loopback.**

**Expander PHY Link Diagnostic: Use to diagnostic the function of PHY link status.**

**\*\* After use this diagnostic, the PHY will be abnormal. So you have to reboot the JBOD system again.**

**Related Commands**

**fru**

**Examples**

### Display information for PHYs

**This command is used to display information of PHY of SIM board.**

|  |  |
| --- | --- |
| **Syntax** |  |
| **phyinfo** | |

**Syntax Description**

**None**

**Display Message**

**PHY ID:** The phy number**.**

**DEV TYPE:** The device type of device connect to the phy.

**NLR:** Negotiate Link Rate. 0x0/1.5G/3G/6G/12G

**PHY CNG CNT:** Phy Change Count.

**SSPI:** The device connect to this port is SSPI device.

**STPI:** The device connect to this port is STPI device.

**SMPI:** The device connect to this port is SMPI device.

**SSPT:** The device connect to this port is SSPT device.

**STPT:** The device connect to this port is STPT device.

**SMPT:** The device connect to this port is SMPT device.

**SATA:** The device connect to this port is SATA device.

**ATTACHED SAS ADDR:** Attached device SAS Address.

**ROUTE TYPE:** The route type of the phy: D:Direct, T:Table, S:Substractive

**ZONE GRP:** Zone Group

**ZON CTRL BUS:** Zone Control Bus.

**CONN TYPE:** Connector Type, see SES2 7.3.26 Table 147.

**CONN ELEM INDX:** Connector Element Index is the element index into SES page 10 to obtain actual slot/bay number.

**CONN PHY LINK:** Connector Phy Link corresponds to phy number within connector.

**MAP PHY ID:** Remapped phy identifier as determined by the phy remappping config page.

**EDFB: End** Device Frame Buffering.

**ERRL:** EDFB Error Logging (logs EDFB errors to trace).

**Related Commands**

**phyinfo, disks, port**

**Examples**

D51PH-1ULH >phyinfo

SSSSSSS EE

PHY STMSTMA ZONE CONN CONN MAP DR

PHY DEV CNG PPPPPPT ROUTE ZONE CTRL CONN ELEM PHY PHY FR

ID TYPE NLR CNT IIITTTA ATTACHED SAS ADDR TYPE GRP BUS TYPE INDX LINK ID BL

00 END 12G 0x03 ---1--- 50000398\_28030D9A D 0x01 0x04 0x20 0x04 0xFF 004 --

01 END 12G 0x03 ---1--- 50000398\_28030DBA D 0x01 0x04 0x20 0x05 0xFF 005 --

02 END 12G 0x03 ---1--- 50000398\_28030D7E D 0x01 0x04 0x20 0x06 0xFF 006 --

03 END 12G 0x03 ---1--- 50000398\_280B0BAE D 0x01 0x04 0x20 0x07 0xFF 007 --

04 END 12G 0x03 ---1--- 50000398\_280B0BF2 D 0x01 0x04 0x20 0x08 0xFF 008 --

05 END 12G 0x03 ---1--- 50000398\_28030DA6 D 0x01 0x04 0x20 0x09 0xFF 009 --

06 END 12G 0x03 ---1--- 50000398\_28030DEE D 0x01 0x04 0x20 0x0A 0xFF 010 --

07 END 12G 0x03 ---1--- 50000398\_280B0C32 D 0x01 0x04 0x20 0x0B 0xFF 011 --

08 0x6 0x01 ------- D 0x01 0x04 0x20 0x0C 0xFF 012 1-

09 0x0 0x01 ------- D 0x01 0x04 0x20 0x0D 0xFF 013 1-

10 0x0 0x01 ------- D 0x01 0x04 0x20 0x0E 0xFF 014 1-

11 0x0 0x01 ------- D 0x01 0x04 0x20 0x0F 0xFF 015 1-

12 END 6G 0x03 111---- 50016360\_0175006D T 0x01 0x04 0x02 0x00 0x00 016 --

13 END 6G 0x03 111---- 50016360\_0175006D T 0x01 0x04 0x02 0x00 0x00 017 --

14 END 6G 0x03 111---- 50016360\_0175006D T 0x01 0x04 0x02 0x00 0x00 018 --

15 END 6G 0x03 111---- 50016360\_0175006D T 0x01 0x04 0x02 0x00 0x00 019 --

16 END 6G 0x03 111---- 50016360\_0175006D T 0x01 0x04 0x02 0x00 0x00 020 --

17 END 6G 0x03 111---- 50016360\_0175006D T 0x01 0x04 0x02 0x00 0x00 021 --

18 END 6G 0x03 111---- 50016360\_0175006D T 0x01 0x04 0x02 0x00 0x00 022 --

19 END 6G 0x03 111---- 50016360\_0175006D T 0x01 0x04 0x02 0x00 0x00 023 --

20 0x0 0x01 ------- D 0x01 0x04 0x20 0x00 0xFF 000 1-

21 0x0 0x01 ------- D 0x01 0x04 0x20 0x01 0xFF 001 1-

22 0x0 0x01 ------- D 0x01 0x04 0x20 0x02 0xFF 002 1-

23 0x0 0x01 ------- D 0x01 0x04 0x20 0x03 0xFF 003 1-

SXP0 END 12G 0x02 --11--- 50016360\_0004F9BD D 0x01 0x04 0x2F 0x10 0x00 024

SXP1 END 12G 0x01 1----1- 50016360\_0004F9BF D 0x01 0x04 0x2F 0x11 0x00 025

SXP2 END 12G 0x01 -1----- 50016360\_0004F9BE D 0x01 0x04 0x00 0x00 0x00 026

Expander Change Count: 003d

Zone Configuring: 0

Self Configuring: 0

Configuring: 0

### Display expander’s SAS address

**This command is used to display EXP, SXP, and STP SAS addresses.**

|  |  |
| --- | --- |
| **Syntax** |  |
| **sasaddr** | |

**Syntax Description**

**None**

**Display Message**

**SXP Port SAS Address:**

**The SXP port is a single internal SAS port comprised of four different functional clients. The clients are the following:**

1. **SMP initiator**
2. **STP Initiator**
3. **SSP Initiator**
4. **SSP Target**

**Related Commands**

**status, phyinfo, port, disks**

**Examples**

D51PH-1ULH >sasaddr

Expander SAS Addresses -

SxP Port 0 SAS Address: 0x500163600004F9BD

SxP Port 1 SAS Address: 0x500163600004F9BF

SxP Port 2 SAS Address: 0x500163600004F9BE

### POST test information

**This command is used to diagnostic expander internal function.**

|  |  |
| --- | --- |
| **Syntax** |  |
| **showpost** | |

**Syntax Description**

**None**

**Display Message**

**Smart Serial: Diagnostic the smart serial port of expander.**

**Watchdog Timer: Diagnostic the watchdog timer of expander.**

**Timer x: Diagnostic the internal timer of expander.**

**Interrupt: Diagnostic the interrupt function of expander.**

**Phy Loopback: Diagnostic the function of PHY loopback.**

**ISTWI Channel x: Diagnostic the I2C function of expander.**

**Internal RAM test: Diagnostic the RAM functions of expander.**

**Forced ECC Error Test: Diagnostic the function of ECC error check.**

**Related Commands**

**None**

**Examples**

D51PH-1ULH >showpost

POST status of expander on-chip devices

================================================================================

On-Chip Device POST Status

================================================================================

Smart Serial :PASS

Watchdog Timer :PASS

Timer 1 :PASS

Timer 2 :PASS

Timer 3 :PASS

Timer 4 :PASS

Interrupt :PASS

Phy Loopback :PASS

ISTWI Channel 00 :PASS

ISTWI Channel 01 :PASS

ISTWI Channel 02 :PASS

ISTWI Channel 03 :PASS

ISTWI Channel 04 :PASS

ISTWI Channel 05 :PASS

ISTWI Channel 06 :PASS

ISTWI Channel 07 :PASS

ISTWI Channel 08 :PASS

ISTWI Channel 09 :PASS

ISTWI Channel 10 :PASS

ISTWI Channel 11 :PASS

True Random Num Generator:PASS

Internal RAM Test :PASS

Forced ECC Error Test :PASS

SXP Port Buffers Test :PASS

================================================================================

### Show firmware revision

**This command is used to show the revisions of firmware.**

|  |  |
| --- | --- |
| **Syntax** |  |
| **rev** | |

**Syntax Description**

**None**

**Display Message**

**Vendor ID: The vendor name, it should be ‘QUANTA’.**

**Product ID: The product name, it should be ‘D51PH-1ULH’.**

**Product Revision Level: The revision number of S2PH firmware.**

**Component ID: It is provided by expander vendor.**

**Component Revision Level: It is provided by expander vendor.**

**Active Firmware: Start execution of firmware image.**

**Boot Image: The boot up image of S2PH.**

**Firmware Copy 1: The first region of S2PH firmware.**

**Firmware Copy 2: The second region of S2PH firmware.**

**SDK Revision: The version of SDK.**

**Related Commands**

**ver**

**Examples**

D51PH-1ULH >rev

================================================================================

Hardware Revision Information:-

================================================================================

Vendor ID :QUANTA

Product ID :D51PH-1ULH

Product Revision Level :Minor = 0x09, Unit = 0x00

Component Type :Cobra-R

Component ID :0x0236 (Bond Option :24)

Component Revision Level :3 (C1)

================================================================================

Firmware Revision Information:-

================================================================================

Active Firmware: Firmware Copy 2

Boot Image:

Revision: 0.1.0.0

Platform Name: 2014/12/17 10:00:00

Version Name: S2PH SAS3xFW v0.1.0 12/17/14

Firmware Family: 0 OemFamily: 0

Fast Boot: Yes Image Address: 0x10000000

Firmware Copy 1:

Revision: 0.5.2.0

Platform Name: 2016/11/09 12:00:00

Version Name: S2PH SAS3xFW v0.5.2 11/10/16

Firmware Family: 0 OemFamily: 0

Fast Boot: Yes Image Address: 0x10180000

Firmware Copy 2:

Revision: 0.9.0.0

Platform Name: 2018/01/31 12:00:00

Version Name: S2PH SAS3xFW v0.9.0 01/31/18

Firmware Family: 0 OemFamily: 0

Fast Boot: Yes Image Address: 0x10300000

================================================================================

SDK Revision:-

================================================================================

HAL Revision: 0.15.0.0

SES Revision: 0.15.0.0

SCE Revision: 0.15.0.0

================================================================================

Current Toolchain Revision:-

================================================================================

ARM RVDS v.400400

### CLI help

This command is used to display all CLI commands.

|  |  |
| --- | --- |
| **Syntax** |  |
| **help** | |

**Syntax Description**

**None**

**Display Message**

**None**

**Related Commands**

**None**

**Examples**

D51PH-1ULH >help

# LED status

JBOD FW will control the system’s LEDs according to the following conditions.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Module Name** | **LED** | **Color** | **Condition** | **Description** |
| **HDD BP** | **Locate** | Blue | BLINK | HDD Identifier |
| ON | HDD Present |
| OFF | Normal |
| **Fault** | Amber | ON | Hard Drive Fail (triggered by host ) |
| OFF | Normal |
| **SIM** | **Heartbeat** | Green | BLINK(fast) | Power On |
| Green | OFF | Power Off or system hang |

# 

# SEP SCSI Commands

## SCSI Commands Overview

One of the main functions of JBOD is to monitor and control enclosure elements. The (Storage Enclosure Processor) SEP is a target SES device in the SAS domain. The SEP monitors a number of system attributes and reports details to a SAS host. The SEP uses SSP (SAS SCSI Protocol) to convey JBOD system status to a SAS host and controls from a SAS host.

## Supported SCSI Commands

The commands supported by the SEP, per SES specification, are listed in the following table.

Table 3 Supported SCSI Commands

|  |  |  |
| --- | --- | --- |
| **SCSI CMD** | **Op code** | **CMD Categories** |
| Inquiry | 0x12 | Read CMD |
| Request Sense | 0x03 | Non Data |
| Test Unit Ready | 0x00 | Non Data |
| Report LUNs | 0xA0 | Read CMD |
| **SES CMD** | | |
| Receive Diagnostic results | 0x1C | Read CMD |
| Send Diagnostic | 0x1D | Write CMD |

The following sections, we describe the format of command describe block (CDB) for above supported SCSI commands.

### Inquiry

The INQUIRY command requests that information regarding the parameters of the target and a component logic unit to be sent to the application client. Options allow the application client to request additional information on the target/logical unit, with information on SCSI commands supported by the device.

Table 4 INQUIRY command

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bytes\Bits | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 0 | INQUIRY (0x12) | | | | | | | |
| 1 | reserved | | | | | | | *EVPD* |
| 2 | *page or operation code* | | | | | | | |
| 3~4 | *Allocation length (MSB...LSB)* | | | | | | | |
| 5 | control | | | | | | | |
| 6~15 | 0 | | | | | | | |

**EVPD, Page or Operation Code:**

1. If the EVPD bit is set to zero, the SES F/W shall return the standard INQUIRY data.
2. If the PAGE CODE field is not set to zero when the EVPD bit is set to zero, the SES F/W shall return CHECK CONDITION status with sense key set to ILLEGAL REQUEST and an additional sense code of INVALID FIELD IN CDB.
3. When the EVPD bit is set to one, the PAGE CODE field will specify which page of vital product data information the SES F/W shall return. The valid page is 0x83(Device Identification Page) and 0x00 (Supported VPD page).

**Allocation Length:** Allocation length is the number of bytes requested by the Initiator from the target.

**Control:** The control byte is not implemented by the SES F/W and shall always be set to zero.

When SES device receives the INQUIRY command, it returns the following INQUIRY data format to application client according to the content of INQUIRY command.

Table 5 INQUIRY Data for INQUIRY command

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Standard Inquiry (EVPD = 0) | | | | | | | | |
| Bytes\Bits | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 0 | PERIPHERAL QUALIFIER (0x0) | | | PERIPHERAL DEVICE TYPE (0x0D) | | | | |
| 1 | RMB | Reserved | | | | | | |
| 2 | ISO/IEC Version 0x0,  ECMA Version 0x0,  ANSI Version (SPC-3 = 0x05) | | | | | | | |
| 3 | 0 | 0 | NormACA | HiSup | RESPONSE DATA FORMAT (0x02) | | | |
| 4 | Additional Length[n-4] (81) | | | | | | | |
| 5 | SCCS | ACC | TPGS (0x0) | | 3PC | Reserved | | Protect |
| 6 | 0 | EncServ**(1)** | VS | MultiP | 0 | 0 | 0 | ADDR16 |
| 7 | 0 | 0 | WBUS | SYNC | 0 | 0 | CMDQUE(1) | VS |
| 8~15 | T10 VENDOR IDENT("QUANTA") | | | | | | | |
| 16~31 | Product IDENT("D51PH-1ULH"), | | | | | | | |
| 32~86 | *Product Revision(ex "0003")* | | | | | | | |
| Supported VPD Page (Page Code = 0x00 and EVPD = 1) | | | | | | | | |
| Bytes\Bits | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 0 | PERIPHERAL QUALIFIER (0x0) | | | PERIPHERAL DEVICE TYPE (0x0D) | | | | |
| 1 | VPD Page Code ( 0x00) | | | | | | | |
| 2 | Reserved | | | | | | | |
| 3 | Page Length[n-3] (0x03) | | | | | | | |
| 4 | Supported VPD pages (0x00) | | | | | | | |
| 5 | Device identification (0x83) | | | | | | | |
| 6 | Management network addresses (0x85) | | | | | | | |
| Device Identification Page (Page Code = 0x83 and EVPD = 1) | | | | | | | | |
| Bytes\Bits | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 0 | PERIPHERAL QUALIFIER (0x0) | | | PERIPHERAL DEVICE TYPE (0x0D) | | | | |
| 1 | VPD Page Code ( 0x83) | | | | | | | |
| 2 | Reserved | | | | | | | |
| 3 | Page Length[n-3] (24) | | | | | | | |
| 4 | Protocol Identifier (0x06) | | | | Code Set (Binary value 0x01) | | | |
| 5 | PIV 0 (Binary value 0x01) | Reserved | **Association (T port0x01)** | | DESIGNATOR TYPE (NAA 0x03) | | | |
| 6 | Reserved | | | | | | | |
| 7 | Designator Length (0x08) | | | | | | | |
| 8~15 | *Designator (SES SAS address)* | | | | | | | |
| 16 | Protocol Identifier (0x00) | | | | Code Set (Binary value 0x01) | | | |
| 17 | PIV 0 (Binary value 0x00) | Reserved | **(LUN 0x00)** | | DESIGNATOR TYPE (NAA 0x03) | | | |
| 18 | Reserved | | | | | | | |
| 19 | Designator Length (0x08) | | | | | | | |
| 20~27 | *Designator (SES SAS address)* | | | | | | | |

**Peripheral qualifier and Peripheral device type:** Peripheral qualifier and peripheral device type fields identify the device connected to the logic unit. For the SES F/W, the peripheral qualifier shall be set to zero. The peripheral device type shall be 01101b (0Dh) as defined for a SCSI processor device.

RMB: A removable medium (RMB) bit set to zero indicates that the medium is not removable.

**Version**: This shall be set to 06h indicating compliance with SPC-4.

**NormACA**: The Normal ACA supported (NormACA) bit is not supported, and shall be set to zero by the SES F/W.

**HiSup**: The Hierarchical Support bit shall be set 0 indicates the SCSI target device does not use the hierarchical addressing model to assign LUNs to logical units.

**Response Data Format**: The response data format value shall be 0010b (02h), which indicates that the data shall be in the format specified in SPC-3.

**Additional Length**: The additional length field specifies the length in bytes of the parameters. The total length of the page (except the vendor specific fields) is 36h bytes. So the additional length, which is defined as 36h-4h, shall be set to 31h.

**SCCS**: The SCC Support bit shall be set to zero.

**ACC, TPGS, 3PC:** The Access Controls Coordinator, Target Port Group Support and Third-Party Copy bits shall be set to zero.

**Protect**: A PROTECT bit set to zero indicates that the logical unit does not support protection information.

**EncServ**: An enclosure services (EncServ) bit shall be set to 1b, which indicates that the device contains an embedded enclosure services component.

**VS, MultiP, Addr16, Wbus16, Sync and CmdQue**: The multi-port (MultiP) bit shall be set 0 to indicate not multi-port device. The CMDQUE bit shall be set to one indicating that the logical unit supports the task management model. The wide SCSI address 32 (Addr32) bit, the synchronous transfer (Sync) bit, and the VS (Vendor Specified) bit are not implemented and shall be set to zero.

**Vendor Identification**: The vendor identification field contains eight bytes of ASCII data identifying the vendor of the product. This field should be reserved for OEM customers. During development phase, this field should contain “QUANTA”.

**Product Identification**: The product identification field contains sixteen bytes of ASCII data. This field should be reserved for OEM customers. During development phase, the product identification field is defined to be “D51PH-1ULH“.

**Product Revision Level**: The product revision level field contains four bytes of ASCII data. This would be the firmware revision level, which is same as that in the download image header. For the first F/W release, this value should be “0003”.

### Request Sense

The REQUEST SENSE command requests that the device server transfer parameter data containing sense data to the application client.

Table 6 Request Sense Command

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bytes\Bits | 7 | 6 | 5 | 4 | 3 | 2 | 1 | | 0 |
| 0 | REQUEST SENSE (0x03) | | | | | | | | |
| 1~3 | Reserved | | | | | | | DESC | |
| 4 | *allocation length* | | | | | | | | |
| 5 | Control | | | | | | | | |
| 6~15 | 0 | | | | | | | | |

DESC: 00 The device server shall return fixed format sense data in the parameter data.

When SES device receives the REQUEST SENSE command, it shall return parameter data containing sense data as following table and complete this command with GOOD status response frame.

Table 7 Fixed format Sense Data

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bytes\Bits | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 0 | VALID | Response Code (70h) | | | | | | |
| 1 | Reserved | | | | | | | |
| 2 | FileMark | EOM | ILI | Reserved | Sense Key | | | |
| 3~6 | Information | | | | | | | |
| 7 | Additional Sense Length [n-7] 0x0A | | | | | | | |
| 8~11 | Command-Specific Information | | | | | | | |
| 12 | Additional Sense Code | | | | | | | |
| 13 | Additional Sense Code Qualifier | | | | | | | |
| 14 | Field Replaceable Unit Code | | | | | | | |
| 15~17 | SKSV | Sense Key Specific---- | | | | | | |
| ------- Sense Key Specific | | | | | | | |
| 18~19 | PAD | | | | | | | |

### Test Unit Ready

The TEST UNIT READY command provides a means to check if the logic unit is ready. SES device just returns ‘Good Status’ response frame.

Table 8 Test Unit Ready Command

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bytes\Bits | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 0 | TEST UNIT READY (0x00) | | | | | | | |
| 1 | LUN | | | | | | Reserved | |
| 2-4 | Reserved | | | | | | | |
| 5 | Control | | | | | | | |

**Control Byte:** The control byte is not implemented by the SIM and shall always be set to zero.

The device will then return either good status or a check condition.

### Report LUN

The REPORT LUN command requests that the peripheral device logical unit inventory be sent to the application client. SES device only supports logical unit number 0.

Table 9 Report LUN Command

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bytes\Bits | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 0 | REPORT LUN (0xA0) | | | | | | | |
| 1 | Reserved | | | | | | | |
| 2 | Select Report (0x00) | | | | | | | |
| 3~5 | Reserved | | | | | | | |
| 6~9 | Allocation length (MSB...LSB) | | | | | | | |
| 10 | Reserved | | | | | | | |
| 11 | Control | | | | | | | |
| 12~16 | 0 | | | | | | | |

Table 10 Report LUN data for Report LUN command

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bytes\Bits | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 0~3 | LUN LIST LENGTH (0x08) | | | | | | | |
| 4~7 | Reserved | | | | | | | |
| 8~15 | LUN 1st LIST (0) | | | | | | | |

### Receive Diagnostic Results

The RECEIVE DIAGNOSTIC RESULTS command is used to pass SES data between an initiator and the SIM. In SES, the Page Code Valid (PCV) bit shall be set to one. More detailed information on the SES pages supported by the SIM can be found in section 6 SES Interface.

Table 11 RECEIVE DIAGNOSTIC RESULTS command

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bytes\Bits | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 0 | RECEIVE DIAG RESULT (0x1C) | | | | | | | |
| 1 | reserved | | | | | | | PCV=1 |
| 2 | ***PAGE CODE*** | | | | | | | |
| 3 | *allocation length* | | | | | | | |
| 4 |
| 5 | control | | | | | | | |
| 6~15 | 0 | | | | | | | |

**Page Code Valid**: The Page Code Valid (PCV) bit shall be set to one to indicate the SES F/W to return data based on this command and not the previous SEND DIAGNOSTICS. If this bit is zero, the SES F/W shall return a check condition with a sense key of “ILLEGAL REQUEST” and an ASC of “Invalid Field in CDB”.

**Page Code**: The page code refers to the diagnostic page to be read. Detailed information is in chapter 6.

**Allocation Length**: Allocation length refers to the number of bytes requested from the host. If the allocation length is greater than the maximum length, the target will only return the maximum that it supports. If the allocation length is shorter than the maximum, then the target will return the desired number of bytes.

**Control:** The control byte is not implemented by the SES F/W and shall always be set to zero.

**RECEIVE DIAGNOSTIC RESULTS Data**

The SES pages supported by the SIM and their return data format are detailed in chapter 6.

### Send Diagnostic

The SEND DIAGNOSTIC command is used to pass SES control information from an initiator to the SIM. In SES, the Page Format (PF) bit shall be set to one. More detailed information on the SES pages supported by the SIM can be found in chapter 6.

Table 12 SEND DIAGNOSTIC command

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bytes\Bits | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 0 | SEND DIAG (0x1D) | | | | | | | |
| 1 | Self Test Code | | | PF=1 | RES | Self Test | DEVOFFL | UNITOFFL |
| 2 | Reserved | | | | | | | |
| 3 | *parameter length (MSB…LSB)* | | | | | | | |
| 4 |
| 5 | Control | | | | | | | |
| 6~15 | 0 | | | | | | | |

**Self-Test Code**: The Self-Test Code is not supported by the SES F/W. If the Self-Test Code is non-zero, the SES F/W shall return a check condition with a sense key of “ILLEGAL REQUEST” and an ASC of “Invalid Field in CDB”.

**Page Format**: If the bit is set to one, the SES F/W will process the data as an SES data. If this bit is zero, the command is a SAF-TE self-diagnostic command. If this bit is set to zero, the SES F/W shall always return a GOOD condition.

**SelfTest, DevOfl, and UnitOfl**: The SelfTest bit, DevOfl bit and UnitOfl bit are not supported by the SES F/W. If any of the bits are not zero, the SES F/W shall return a check condition with a sense key of “ILLEGAL REQUEST” and an ASC of “Invalid Field in CDB”.

**Parameter List Length**: Parameter List length refers to the number of bytes to be written to the target.

**Control**: The control byte is not implemented by the SES F/W and shall always be set to zero.

**SEND DIAGNOSTIC Data**

The SES pages are supported by the SIM and their data formats are detailed in chapter 6.

### Write buffer

The WRITE BUFFER command is used to download microcode to SIM. Pass SES control information from an initiator to the SIM. In SES, the Page Format (PF) bit shall be set to one.

Table 13 SEND DIAGNOSTIC command

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bytes\Bits | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 0 | WRITE BUFFER (0x3B) | | | | | | | |
| 1 | Reserved | | | *Mode(02)* | | | | |
| 2 | *buffer ID* | | | | | | | |
| 3~5 | *buffer offset [MSB … LSB]* | | | | | | | |
| 6~8 | *parameter length [MSB … LSB]* | | | | | | | |
| 9 | control | | | | | | | |

**Mode**: We use Data Mode(02h) to download microcode.

**Buffer ID**: If the buffer id is selected to 0, the command will download data to FW region. If the buffer id is selected 1, the command will download data to mfg region for modified vendor identify and product identify.

**Buffer offset**: Buffer offset refer to the offset to be write to the target, the value is zero.

**Parameter Length**: Parameter length refers to the number of bytes to be written to the target.

### SCSI buffer

The SCSI BUFFER is implemented by the READ(3C)/WRITE(3B) BUFFER(Mode 0x01) command.

Table 14 Write buffer command

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bytes\Bits | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 0 | WRITE BUFFER (0x3B) | | | | | | | |
| 1 | Reserved | | | *Mode(01)* | | | | |
| 2 | *buffer ID* | | | | | | | |
| 3~5 | *buffer offset [MSB … LSB]* | | | | | | | |
| 6~8 | *parameter length [MSB … LSB]* | | | | | | | |
| 9 | control | | | | | | | |

Table 15 Read buffer command

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bytes\Bits | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 0 | READ BUFFER (0x3C) | | | | | | | |
| 1 | Reserved | | | *Mode(01)* | | | | |
| 2 | *buffer ID* | | | | | | | |
| 3~5 | *buffer offset [MSB … LSB]* | | | | | | | |
| 6~8 | *parameter length [MSB … LSB]* | | | | | | | |
| 9 | control | | | | | | | |

**Mode**: We use Data Mode(01h) to read/write parameter to expander.

**Buffer ID**: Reference the support buffer ID as bellow table.

**Buffer offset**: Buffer offset refer to the offset to be write to the target, the value is zero.

**Parameter Length**: Parameter length refers to the number of bytes to be written to the target.

## Supported SCSI Status

The SES supported SCSI statuses as following:

|  |  |  |
| --- | --- | --- |
| **Value** | **Name** | **Task Ended** |
| 00h | Good | Yes |
| 02h | Check Condition | Yes, Auto sense |
| 08h | Busy | Yes |
| 28h | Task Set Full | Yes |

## Supported Sense Data

The SES supported sense keys as following:

|  |  |
| --- | --- |
| **Sense Key** | **Description** |
| 00h | NO SENSE. Indicates that there is no specific sense data information to be reported. |
| 04h | HARDWARE ERROR: Indicates that the EMM has detected a non-recoverable hardware failure while performing the command, or during a self-test. |
| 05h | ILLEGAL REQUEST. Indicates that there is an illegal parameter in the command descriptor block, or in the additional parameters supplied as data for some commands. |
| 06h | UNIT ATTENTION. Indicates that the target has been reset. |

The SES ASC and ASCQ assignments as following:

|  |  |  |
| --- | --- | --- |
| **ASC** | **ASCQ** | **Description** |
| 04h | 00h | Logical unit not ready |
| 29h | 00h | Power on, Reset, or Bus Device Reset Occurred |
| 44h | 00h | Internal target failure |
| 20h | 00h | Invalid Command Operation Code |
| 24h | 00h | Invalid Field in CDB |
| 25h | 00h | Logical unit not support |
| 26h | 00h | Invalid Field in Parameter List |
| 35h | 01h | Unsupported Enclosure Function |
| 35h | 00h | Enclosure Service Failure |
| 2Ch | 00h | Command Sequence Error |

# SES Interface

## SES Interface Overview

The SES command set defines a standard data format, which allows a controller board to communicate with a host application. The SES data is transported ‘in-band’ to and from the application client. Within a SAS system, the data is transported via SSP using standard SCSI commands.

## SCSI Enclosure Services

All SAS Expander firmware shall provide SCSI enclosure services interface and functionalities for the host application client. The enclosure services interface is provided via the virtual SSP port on the SAS Expander chip.

### Supported SCSI Commands in SES device

For SES support, the SAS Expander firmware needs to implement the two SCSI commands: SEND DIAGNOSTIC (1Dh) and RECEIVE DIAGNOSTIC (1Ch) describing in chapter 5.2 to access the following diagnostic pages for application client.

Table 16 Supported SES diagnostic pages

|  |  |
| --- | --- |
| **SES page** | **page code** |
| Supported Diagnostic Pages | 0x00 |
| Configuration | 0x01 |
| Enclosure Status/Control | 0x02 |
| String In/Out | 0x04 |
| Element Descriptor | 0x07 |
| Additional Element Status | 0x0A |
| Supported SES Diagnostic Pages | 0x0D |
| Download Microcode | 0x0E |
| Subenclosure Nickname | 0x0F |
| Defined Extension Status/Control | 0x1B |
| Phy Error Counter Status | 0x1D |

The first byte of the SES data specifies the page code as the above table. If any other page is specified, a check condition will be returned with sense data, indicating Invalid SES SEND/RECEIVE DIAGNOSTIC command. If the command sends less data than the page length, the check condition will be returned with a sense key, indicating an Invalid SES SEND DIAGNOSTIC command. If the command sends more, it is truncated.

**Blue color** fields mean the fields are changed by S2PH SAS Expander.

**Generation Code**

The SES interface uses a 4-bytes generation code to make sure the status and control pages are consistent with the configuration page. Due to the fact that enclosure service does not support dynamic change in unit configuration, this field will have a fixed value of zero.

## RECEIVE DIAGNOSTICS RESULT Command

The enclosure service supports the following pages for RECEIVE DIAGONSTIC RESULTS command to read the enclosure information:

* Page 00h (Supported Diagnostics Pages) to find out what pages are supported.
* Page 01h (Configuration) to find out enclosure configurations.
* Page 02h (Enclosure Status) to report enclosure status..
* Page 04h (String In) to transmits a binary string to the application client.
* Page 07h (Element Descriptor) to report individual element’s description.
* Page 0Ah (Additional Element Status) to return information on each of the expander's PHYs in device slots.
* Page 0Dh (Supported SES Diagnostic Pages) is similar to supported diagnostics page
* Page 0Eh (Download Microcode Status) to report firmware download status.
* Page 0Fh (Sub Enclosure Nickname) to report the nickname of the subenclosure.
* Page 1Bh (Defined Extension Status Page) to report the status of enclosure extension control.
* Page 1Dh (Phy Error Counter Status) to report error counters of each phy.

### Supported Diagnostics Page (00h)

When the enclosure service receives a Receive Diagnostic Result SCSI command with page code of 00h, refers to the Supported Diagnostics page as following to return a list of supporting pages in the enclosure.

Table 17 Diagnostics Page (00h) Data Format (SIM Board)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bytes\Bits | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 0 | Supported Page Code (0x00) | | | | | | | |
| 1 | Reserved | | | | | | | |
| 2~3 | Page Length [n-3] (11) | | | | | | | |
| 4 | Supported Diagnostic Page (0x00) | | | | | | | |
| 5 | Configuration Page (0x01) | | | | | | | |
|  | Enclosure Control/Status Page (0x02) | | | | | | | |
|  | String In/Out Page (0x04) | | | | | | | |
|  | Element Descriptor (0x07) | | | | | | | |
|  | Additional Element Status Page (0x0A) | | | | | | | |
|  | Supported SES Diagnostic Page (0x0D) | | | | | | | |
|  | Download Microcode Page (0x0E) | | | | | | | |
|  | Subenclosure Nickname Page (0x0F) | | | | | | | |
|  | Defined Extension Control Page (0x1B) | | | | | | | |
|  | Phy Error Counter Status Page (0x1D) | | | | | | | |

### Enclosure Configuration Page (01h)

When the enclosure service receives a Receive Diagnostic Result SCSI command with page code of 01h, refers to the Enclosure Services Configuration page as following table to return a list of elements in the enclosure.

Table 18 Enclosure Configuration Diagnostics Page (01h) Format (SIM Board)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bytes\Bits | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 0 | Configuration Page Code (0x01) | | | | | | | |
| 1 | Number of secondary subenclosure (0x00) | | | | | | | |
| 2~3 | Page Length [n-3] | | | | | (129) | | |
| 4~7 | Generation Code | | | | | | | |
| 8 | Reserved | Relative ES process Id (master 0x01) | | | Reserved | Number of ES processes(0x01) | | |
| 9 | Subenclosure Identifier (0x00) | | | | | | | |
| 10 | Number of Descriptor Headers (0x05) | | | | | | | |
| 11 | Enclosure Descriptor Length [m-3] (56) | | | | | | | |
| 12~19 | *Enclosure Logical Identifier*[Note 0] | | | | | | | |
| 20~27 | *Enclosure VENDOR IDENT ("*QUANTA*")* | | | | | | | |
| 28~43 | *Product IDENT ("D51PH-1ULH")* | | | | | | | |
| 44~47 | *Product Revision ("0003")* | | | | | | | |
| 48~53 | Vendor Specified | | | | | | | |
| 54~57 | *Product Ident ("S2PH")* | | | | | | | |
| 58~59 | Reserved | | | | | | | |
| 60~63 | *Vendor Specifer: Self Product Revision ("0003")* | | | | | | | |
| 64~67 | Vendor Specifer | | | | | | | |
| 68 | Array Device Slot Element Type (0x17) | | | | | | | |
| 69 | Number Of Possible Elements (16) | | | | | | | |
| 70 | SUBENCLOSURE ID (0) | | | | | | | |
| 71 | Type Descriptor Text Length (8) | | | | | | | |
| 72 | Enclosure Services Controller Electronics Element Type (0x07) | | | | | | | |
| 73 | Number of Elements (1) | | | | | | | |
| 74 | Subenclosure Identifier (0x00) | | | | | | | |
| 75 | Type Descriptor Text Length (3) | | | | | | | |
| 76 | Enclosure Element Type (0x0E) | | | | | | | |
| 77 | Number of Elements (1) | | | | | | | |
| 78 | Subenclosure Identifier (0x00) | | | | | | | |
| 79 | Type Descriptor Text Length (9) | | | | | | | |
| 80 | SAS connector Element Type (0x19) | | | | | | | |
| 81 | Number of Elements (16) | | | | | | | |
| 82 | Subenclosure Identifier (0x00) | | | | | | | |
| 83 | Type Descriptor Text Length (13) | | | | | | | |
| 84 | SAS expander (0x18) | | | | | | | |
| 85 | Number of Elements (1) | | | | | | | |
| 86 | Subenclosure Identifier (0x00) | | | | | | | |
| 87 | Type Descriptor Text Length (12) | | | | | | | |
| 88-95 | Element type descriptor (“SAS DISK”) | | | | | | | |
| 96~98 | Element type descriptor ("EMM") | | | | | | | |
| 99~107 | Element type descriptor ("Enclosure") | | | | | | | |
| 108~120 | Element type descriptor ("SAS Connector") | | | | | | | |
| 121~132 | Element type descriptor ("SAS Expander") | | | | | | | |

**Note0:** Enclosure Logical Identifier is SAS ADDRESS or 0x3D

In this SES device, SAS expander firmware reports the following supported element types in enclosure:

Table 19 Supported element types

|  |  |  |
| --- | --- | --- |
| **Support Element Type** | **Element Code** | **A number Of Control Items** |
| ARRAY DEVICE SLOT | 17h | 16 |
| ENCLOSURE SERVICES CONTROLLER ELECTRONICS | 07h | 1 |
| ENCLOSURE | 0Eh | 1 |
| SAS CONNECTOR | 19h | 16 |
| SAS EXPANDER | 18h | 1 |

The elements listed on the following page of an enclosure shall be listed in the same order in

1. the type descriptor header list in configuration page
2. the type descriptor text in configuration page
3. the Enclosure Status diagnostic page
4. Additional element status diagnostic page

### Enclosure Status Page (02h)

When the enclosure service receives a Receive Diagnostic Result SCSI command with page code of 02h, refers to the Enclosure Status page as following table to return a list of Enclosure element status.

Table 20 For 1U 3.5”x16 SKU - Enclosure Status Diagnostics Page (02h) Format (SIM Board)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bytes\Bits | | | | | 7 | 6 | | | | | | | 5 | | 4 | | | | | | | | | | 3 | 2 | | 1 | | | 0 |
| 0 | | | | | Status Page Code (0x02) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | | | | | Reserved | | | | | | | | | | INVOP | | | | | | | | | | INFO | Non-Crit | | Crit | | | Unrecov |
| 2~3 | | | | | Page Length [n-3] (164) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4~7 | | | | | Generation code | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Array Device Slot | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 ~ 75 | | | | 0 | Reserved | PRDFAIL | | | | | | | DISABLED | | SWAP | | | | | | | | | | Element Status Code | | | | | | |
| 1~3 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Individual\*16 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | Reserved | | | | | PRDFAIL | | | DISABLED | | | SWAP | | | | | | | | Element Status Code | | | | | | | |
| 1 | OK | | | | | RSVD Device | | | Hot Spare | | | CONS CHK | | | | | | | | IN CRIT | | IN FAILED | | Rebuild/Remap | | | R/R Abort |
| 2 | App  Client  Bypassed A | | | | | Don’t RMV | | | Enc. Bypassed A | | | Enc. By Passed 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 |
| Enclosure Services Controller Electronics | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 76 ~  83 | | | | 0 | Reserved | | | PRDFAIL | | | | | DISABLED | | | SWAP | | | | | | | | Element Status Code | | | | | | | |
| 1~3 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Individual\*1 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | Reserved | | | PRDFAIL | | | | | | DISABLED | | | SWAP | | | | | | | Element Status Code | | | | | | | |
| 1 | IDENT | | | | FAIL | | | | | Reserved | | | | | | | | | | | | | | | | | |
| 2 | Reserved | | | | | | | | | | | | | | | | | | | | | | | | | Report | |
| 3 | Hot Swap | | | | Reserved | | | | | | | | | | | | | | | | | | | | | | |
| Enclosure | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 84 ~91 | | | 0 | | Reserved | | | PRDFAIL | | | | | DISABLED | | | | | | | | SWAP | | Element Status Code | | | | | | | | |
| 1~3 | | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Individual\*1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | | Reserved | | | PRDFAIL | | | | | DISABLED | | | | | | | | SWAP | | Element Status code | | | | | | | | |
| 1 | | IDENT | | | Reserved | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | | TIME UNIT POWER CYCLE | | | | | | | | | | | | | | | | | | | | | | Fail Indic | | Warn Indic | | |
| 3 | | REQUEST POWER OFF DURATION | | | | | | | | | | | | | | | | | | | | | | Fail REQSED | | Warn REQSED | | |
| SAS Connector | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 92 ~ 159 | 0 | | | | Reserved | | | PRDFAIL | | | | DISABLED | | | | | | | | SWAP | | Element Status Code | | | | | | | | | |
| 1~3 | | | | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Individual\*16 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | | | | Reserved | | PRDFAIL | | | | | DISABLED | | | | | | | | SWAP | | Element Status code | | | | | | | | | |
| 1 | | | | IDENT | | Connector Type (12' SAS Drive receptacle 0x20 ; 2' min-SAS 0x02) | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | | | | Connector Physical Link (0x00) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | | | | Reserved | | FAIL | | | | Reserved | | | | | | | | | | | | | | | | | | | | |
| SAS Expander | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 160 ~ 167 | | 0 | | | Reserved | | | PRDFAIL | | | | DISABLED | | | | | | | SWAP | | | Element status Code | | | | | | | | | |
| 1~3 | | | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Individual\*1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | | | Reserved | | PRDFAIL | | | | | DISABLED | | | | | | SWAP | | | | Element Status Code | | | | | | | | | |
| 1 | | | IDENT | | FAIL | | | | | Reserved | | | | | | | | | | | | | | | | | | | |
| 2~3 | | | Reserved | | | | | | | | | | | | | | | | | | | | | | | | | | |

#### Health Status (HS) Fields

Table 21 HS fields for Enclosure Status Diagnostic Page

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Byte\Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 0 | Reserved | | | IVOP | INFO | NCRT | CRIT | UNRC |

The INFO, NON-CRIT and CRIT bits are mandatory and may be set to one in the enclosure by the application client when the application client has detected that one or more of the elements in the enclosure are not operating normally.

An **INFO** (informational condition) bit set to one specifies that the application client is detecting an as NO AC power from power supply or one of elements is not installed. An INFO bit set to zero has no effect.

A **NON-CRIT** (noncritical condition) bit set to one specifies that the application client is detecting a noncritical condition. A NON-CRIT bit set to zero specifies that the application client is not detecting a noncritical condition. If the enclosure services process has independently determined that a noncritical condition is present, a request from the application client to set the NON-CRIT bit to zero shall be ignored by the enclosure services process.

A **CRIT** (critical condition) bit set to one specifies that the application client is detecting a critical condition. A CRIT bit set to zero specifies that the application client is not detecting a critical condition. If the enclosure services process has independently determined that a critical condition is present, a request from the application client to set the CRIT bit to zero shall be ignored by the enclosure services process.

#### Format for all status fields

Table 22 ELEMENT STATUS and OVERALL STATUS fields

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Byte\Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 0 | Common Status | | | | | | | |
| Rsvd | PRDFAIL | DISABLED | SWAP | ELEMENT STATUS CODE | | | |
| 1 | Element-type-specific status information | | | | | | | |
| 2 |
| 3 |

The **COMMON STATUS** field contains those bits that may be returned by any OVERALL STATUS field or ELEMENT STATUS field. The bits of the COMMON STATUS field (i.e., the PRDFAIL, DISABLED, SWAP, and ELEMENT STATUS CODE fields) are defined below.

A **PRDFAIL** (predicted failure) bit set to one indicates that the element has the capability of predicting failure and that a failure has been predicted. The “predicted failure state” indicator may additionally be set by the PRDFAIL bit in the corresponding control field. A PRDFAIL bit set to zero indicates that the “predicted failure state” indicator is turned off or is not implemented.

A **DISABLED** bit set to one indicates that the element has been disabled because the DISABLE bit was set to one in the control field. A DISABLED bit set to zero indicates that the element has not been disabled or that the disable function is not implemented.

A **SWAP** bit set to one indicates that an element has been removed and the same or another element has been inserted in the same location since the last time the RST SWAP control bit was set to one in the corresponding COMMON CONTROL field. The SWAP bit is set to zero when the RST SWAP control bit is set in the control field and remains set to zero until a device has been both removed and inserted in the device slot. The SWAP bit provides an indication that an element’s properties may have been changed without any change of configuration.

The **ELEMENT STATUS CODE** field is defined in table 60. The ELEMENT STATUS CODE values apply to ELEMENT STATUS fields. The OVERALL STATUS fields shall have an ELEMENT STATUS CODE of 0h (i.e., unsupported).

Table 23 Element Status Code

|  |  |  |
| --- | --- | --- |
| **Code** | **Name** | **Condition** |
| 0h | Unsupported | Status detection is not implemented for this element. |
| 1h | OK | Element is installed and no error conditions are known. |
| 2h | Critical | Critical condition is detected. |
| 3h | Noncritical | Noncritical condition is detected. |
| 5h | Not installed | Element is not installed in enclosure. |
| 7h | Not Available | Element installed, no known errors, but the element has not been turned on or set into operation. |
| 8h | Not Access Allowed | The initiator port from which the RECEIVE DIAGNOSTIC RESULT command was received does not have access to this element. |

#### Overall Array Device Slot Status (OSDS) Fields

Table 24 Overall Array Device Slot status fields for Enclosure Status diagnostic page

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 0 | Reserved | PRDFAIL | DISABLED | SWAP | Element Status Code |
| 1~3 | Reserved (0) | | | | |

Common Status field will have the following values depending on the specific condition:

* 00h (Unsupported)

#### Array Device Slot Status Fields

Table 25 Individual Array Device Slot fields for Enclosure Status diagnostic page

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | Reserved | PRDFAIL | *DISABLED* | SWAP | Element Status Code | | | |
| 1 | OK | RSVD Device | *Hot SPARE* | *CONS CHK* | IN CRIT | IN FAILED | REBUILD/REMAP | R/R Abort |
|
| 2 | App Client  Bypassed A | Don't RMV | Enc. Bypassed A | Enc. By Passed B | Ready To Insert | RMV | *Reqed IDENT* | REPORT |
|
| 3 | App Client  Bypassed B | *Fault Sensed* | Fault REQSTD | Device Off | Bypassed A | Bypassed B | Device Bypassed A | Device Bypassed B |
|

Common Status field will have the following values depending on the specific condition:

* 01h (OK): HDD Module status is OK.
* 05h (Not Installed): HDD is not installed.

The following status bits are supported in array device slot:

* Hot SPARE bit set to one indicates that in DIAG Control page (0x02) the RQST Hot SPARE control bit has set to one, specifyin that the “hot spare” indicator is turned on.
* CONS CHK bit set to one indicates that in DIAG Control page (0x02) the RQST CONS CHECK control bit has set to one, specifying that the “consistency check in progress” indicator is turned on, showing that the device is participating in an array consistency check activity.
* REBUILD/REMAP bit set to one indicates that in DIAG Control page (0x02) the RQST REBUILD/REMAP control bit has set to one, specifying that the “rebuild/remap” indicator is turned on, showing that the device is participating in a rebuild or remap of the array contents.
* FAULT SENSED bit set to one indicates that the enclosure or device has detected a fault condition and may be displaying a visual indication of the fault condition. A FAULT SENSED bit set to zero indicates that there is no fault condition detected by the device or enclosure.
* IDENT: When set, this bit indicates that the drive LED’s are currently in the ‘identify’ state.

### String In Page (04h)

The String In diagnostic page transmits a subenclosure dependent binary string from the enclosure services process of the primary subenclosure to the application client. The binary string may contain bits describing keyboard states, switch states, or the content of other information provided by the primary subenclosure to the application client.

Table 26 String In Page (04h) Data Format

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bytes\Bits | | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 0 | | String In (0x04) | | | | | | | |
| 1 | | Reserved | | | | | | | |
| 2~3 | | Page Length [n-3] (316) | | | | | | | |
| 4 | | Start (0x0) | | | | | | | |
| 5 | | Reserved | | | | | | | |
| 6~7 | | FRU Description Length [n-3] (195) | | | | | | | |
| SIM0 | | | | | | | | | |
| 8 | 0~3 | Identify Name "SIM0" | | | | | | | |
| ~ | 4~18 | *N/A* | | | | | | | |
| 46 | 19~38 | *Serial Number* | | | | | | | |
| SIM1 | | | | | | | | | |
| 47 | 0~3 | Identify Name "SIM1" | | | | | | | |
| ~ | 4~18 | *N/A* | | | | | | | |
| 85 | 19~38 | *N/A* | | | | | | | |
| MID | | | | | | | | | |
| 86 | 0~3 | Identify Name "MID" | | | | | | | |
| ~ | 4~18 | *N/A* | | | | | | | |
| 124 | 19~38 | *N/A* | | | | | | | |
| ISIM1 | | | | | | | | | |
| 125 | 0~3 | *Identify Name "ISM1"* | | | | | | | |
| ~ | 4~18 | *N/A* | | | | | | | |
| 163 | 19~38 | *N/A* | | | | | | | |
| ISIM2 | | | | | | | | | |
| 164 | 0~3 | *Identify Name "ISM2"* | | | | | | | |
| ~ | 4~18 | *N/A* | | | | | | | |
| 202 | 19~38 | *N/A* | | | | | | | |
| 203~319 | | Reserved | | | | | | | |

### Element Descriptor Status Page (07h)

The Element Descriptor diagnostic page returns a list of ASCII strings (description as following page), one for each element in the Enclosure Status diagnostic page

Table 27 For 1U 3.5”x16 SKU - Element Descriptor Status Page (07h) (SIM Board)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bytes\Bits | | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 0 | | Element Descriptor (0x07) | | | | | | | |
| 1 | | Reserved | | | | | | | |
| 2~3 | | Page Length [n-3] | | | | | (595) | | |
| 4~7 | | Generation Code | | | | | | | |
| Array Device Slot | | | | | | | | | |
| 8 | 0~1 | Reserved | | | | | | | |
| 2~3 | Descriptor Length (MSB .. LSB) (8) | | | | | | | |
| ~ | 4~11 | "SCSI Device" (“SAS DISK”) | | | | | | | |
| Individual \* | | | | | 16 | | | |
| 179 | 0~1 | Reserved | | | | | | | |
| 2~3 | Descriptor Length (MSB .. LSB) (6) | | | | | | | |
| 4~9 | "DISKXX" | | | | | | | |
| Enclosure Services Controller Electronics | | | | | | | | | |
| 180 | 0~1 | Reserved | | | | | | | |
| 2~3 | Descriptor Length (MSB .. LSB) (3) | | | | | | | |
| ~ | 4~6 | "EMM" | | | | | | | |
| Individual \* | | | | | 1 | | | |
| 197 | 0~1 | Reserved | | | | | | | |
| 2~3 | Descriptor Length (MSB .. LSB) (6) | | | | | | | |
| 4~9 | "SIM 00" | | | | | | | |
| Enclosure | | | | | | | | | |
| 198 | 0~1 | Reserved | | | | | | | |
| 2~3 | Descriptor Length (MSB .. LSB) (9) | | | | | | | |
| ~ | 4~12 | "Enclosure" | | | | | | | |
| Individual \* | | | | | 1 | | | |
| 224 | 0~1 | Reserved | | | | | | | |
| 2~3 | Descriptor Length (MSB .. LSB) (9) | | | | | | | |
| 4~12 | "Enclosure 00" | | | | | | | |
| SAS Connector | | | | | | | | | |
| 225 | 0~1 | Reserved | | | | | | | |
| 2~3 | Descriptor Length (MSB .. LSB) (13) | | | | | | | |
| ~ | 4~16 | "SAS Connector" | | | | | | | |
| Individual \* | | | | | 16 | | | |
| 561 | 0~1 | Reserved | | | | | | | |
| 2~3 | Descriptor Length (MSB .. LSB) (16) | | | | | | | |
| 4~19 | "SAS Connector XX" | | | | | | | |
| SAS Expander | | | | | | | | | |
| 562 | 0~1 | Reserved | | | | | | | |
| 2~3 | Descriptor Length (MSB .. LSB) (12) | | | | | | | |
| ~ | 4~15 | "SAS Expander" | | | | | | | |
| Individual \* | | | | | 1 | | | |
| 597 | 0~1 | Reserved | | | | | | | |
| 2~3 | Descriptor Length (MSB .. LSB) (15) | | | | | | | |
| 4~18 | "SAS Expander XX" | | | | | | | |

**XX:** element index starting from 00

### SAS Additional Element Status Page (0Ah)

Read Diagnostic Command with Page 0Ah will retrieve the additional information about array device, enclosure service controller electrics and SAS expander. The frame definition on this page is shown in the table below.

Table 28 For 1U 3.5”x16 SKU - SAS Additional Element Status Page (0Ah) (SIM Board)

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bytes\Bits | | 7 | 6 | 5 | 4 | 3 | | 2 | | 1 | | 0 |
| 0 | | Additional Element Status (0x0A) | | | | | | | | | | |
| 1 | | Reserved | | | INVOP | Reserved | | | | | | |
| 2~3 | | Page Length [n-3] | | | | | | (664) | | | | |
| 4~7 | | Generation Code | | | | | | | | | | |
| Array Device Slot \* 16 | | | | | | | | | | | | |
| 8 | 0 | INVALID(0) | Reserved | | EIP (1) | Protocol Identifier (SAS=0x06) | | | | | | |
| 1 | Additional Element Status Descriptor Length [x-1] | | | | | | | | (34) | | |
| 2 | Reserved | | | | | | | | | | |
| 3 | *Element Index (start from 0 to 15)* | | | | | | | | | | |
| 4 | Number of Phy Descriptors (0x01) | | | | | | | | | | |
| 5 | Descriptor Type (0x00) | | Reserved | | | | | | | | Not All Phys (1) |
| 6 | Reserved | | | | | | | | | | |
| ~ | 7 | *Device Slot Number (start from 0* to 15) | | | | | | | | | | |
| 8 | Reserved | *Device Type*  *None (0)*  *End device (1)* | | | | Reserved | | | | | |
| 583 | 9 | Reserved | | | | | | | | | | |
| 10 | Reserved | | | | | SSP-I  (0) | | STP-I  (0) | | SMP-I  (0) | Reserved |
| 11 | SATA port Selector  (0) | Reserved | | | | *SSP-T*  *SAS Disk (1)*  *Others (0)* | | STP-T  (0) | | SMP-T  (0) | SATA disk  (0) |
|
| 12~19 | *expander SAS address* | | | | | | | | | | |
| 20~27 | *device SAS Address* | | | | | | | | | | |
| 28 | *device Phy Identifier* | | | | | | | | | | |
| 29~35 | Reserved | | | | | | | | | | |
| Enclosure Services Controller Electronics \* 1 | | | | | | | | | | | | |
| 584 | 0 | *INVALID* | Reserved | | EIP (1) | Protocol Identifier (SAS=0x06) | | | | | | |
| 1 | Additional Element Status Descriptor Length [y-1] | | | | | | | | 18 | | |
| 2 | Reserved | | | | | | | | | | |
| 3 | *Element Index (16)* | | | | | | | | | | |
| 4 | Number of Phy Descriptors (1) | | | | | | | | | | |
| ~ | 5 | Descriptor Type (0x01) | | Reserved | | | | | | | | |
| 6~7 | Reserved | | | | | | | | | | |
| PHY descriptor List | | | | | | | | | | | |
| 603 | 0 | PHY Identifier(24) | | | | | | | | | | |
| 1 | Reserved | | | | | | | | | | |
| 2 | CONNECTOR ELEMENT INDEX (FF) | | | | | | | | | | |
| 3 | OTHER ELEMENT INDEX (FF) | | | | | | | | | | |
| 4~11 | *SES SAS address* | | | | | | | | | | |
| SAS Expander \* 1 | | | | | | | | | | | | |
| 604 | 0 | *INVALID* | Reserved | | EIP (1) | Protocol Identifier (SAS=0x06) | | | | | | |
| 1 | Additional Element Status Descriptor Length [z-1] | | | | | | | | 62 | | |
| 2 | Reserved | | | | | | | | | | |
| ~ | 3 | *Element Index (38)* | | | | | | | | | | |
| 4 | Number of Phy Descriptors (24) | | | | | | | | | | |
| 5 | Descriptor Type (0x01) | | Reserved | | | | | | | | |
| 667 | 6~7 | Reserved | | | | | | | | | | |
| 8~15 | *expander SAS address* | | | | | | | | | | |
| PHY descriptor List \* 24 | | | | | | | | | | | |
| 0 | *CONNECTOR ELEMENT INDEX* | | | | | | | | | | |
| 1 | OTHER ELEMENT INDEX (FF) | | | | | | | | | | |

**Note:** Do not directly attach SATA disk to the slot. SATA disk should be connected with SAS Bridge.

**INVALID:**

In array device list, if the device is zoned out, the invalid is set 1.

In enclosure service control electric and SAS expander, if the peer SIM board is disabled or empty, the invalid is set 1.

**CONNECTOR ELEMENT INDEX:**

SAS driver receptacle connector element index is from **0** to **12** for **12** disks, from **0** to **16** for **16** disks. Others are 0xFF.

### Supported SES Diagnostics Page (0Dh)

When the enclosure service receives a Receive Diagnostic Result SCSI command with page code of 0Dh, refers to the Supported SES Diagnostics pages (from 0x01 to 0x2F) as following to return a list of supporting pages in the enclosure.

Table 29 Diagnostics Page (0Dh) Data Format

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bytes\Bits | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 0 | Supported Page Code (0x0D) | | | | | | | |
| 1 | Reserved | | | | | | | |
| 2~3 | Page Length [n-3] (12) | | | | | | | |
| 4 | Configuration Page (0x01) | | | | | | | |
| 5 | Enclosure Control/Status Page (0x02) | | | | | | | |
| 6 | String In/Out Page (0x04) | | | | | | | |
| 7 | Element Descriptor (0x07) | | | | | | | |
| 8 | Additional Element Status Page (0x0A) | | | | | | | |
| 9 | Supported SES Page (0x0D) | | | | | | | |
| 10 | Download Microcode Ctrl/St (0x0E) | | | | | | | |
| 11 | Subenclosure Nickname Ctrl/St Page (0x0F) | | | | | | | |
| 12 | Defined Extension Control Page (0x1B) | | | | | | | |
| 13 | Phy Error Counter Status Page (0x1D) | | | | | | | |
| 14-15 | Reserved | | | | | | | |

### Download Microcode Status Page (0Eh)

The Download Microcode Status page transmits information on the status of one or more download microcode operation to the application client. In SAS JBOD, it will show the status on Firmware Download that was set in the static global by the Send Diagnostic (Download Microcode Control Page, 0Eh) command.

Table 30 Download Microcode Status Page (0Eh) Format

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bytes\Bits | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 0 | Download Microcode Status(0x0E) | | | | | | | |
| 1 | Reserved | | | | | | | |
| 2~3 | Page Length [n-3] (20) | | | | | | | |
| 4~7 | Generation Code | | | | | | | |
| 8 | Reserved | | | | | | | |
| 9 | Subenclosure Identifier (0x00) | | | | | | | |
| 10 | *Download Status* | | | | | | | |
| 11 | *Download Additional Status* | | | | | | | |
| 12~15 | *Download Microcode Maximum Size* | | | | | | | |
| 16~18 | Reserved | | | | | | | |
| 19 | Expected Buffer ID (0x0, 0x01) | | | | | | | |
| 20~23 | *Expected Buffer Offset* | | | | | | | |

Download Status field indicates the status of download microcode operation for the sub-enclosure.

* 00h: No download microcode operation in progress
* 01h: Download microcode operation in progress
* 10h: Download microcode operation complete 1 without error
* 80h/81h: Error in one or more of Download Microcode Control page fields, new microcode is discarded. The Download Additional Status field will give more detailed information on the error.

Download Additional Status field indicates the additional status on microcode download.

* 00h: None
* 03h: Page Length error
* 07h: Download mode error
* 0Ah: Buffer ID error
* 0Eh: Buffer offset error
* 12h: Image length error
* 16h: Data length error

Download Microcode Maximum Size field indicates the maximum size in bytes of the microcode image that the enclosure services controller accepts.

Expected Buffer ID field should be set to 0 or 1.

Expected Buffer Offset field indicates next buffer offset expected to come down.

### Subenclosure Nickname Status Page (0Fh)

The Subenclosure Nickname Status diagnostic page transmits the nickname of each subenclosure to the application client.

Table 31 Subenclosure Nickname Status Page (0Fh) Format

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bytes\  Bits | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 0 | Subenclosure Nickname Status(0x0F) | | | | | | | |
| 1 | Number of Secondary SubEnclosure (0x00) | | | | | | | |
| 2~3 | Page Length [n-3] (44) | | | | | | | |
| 4~7 | *Generation Code* | | | | | | | |
| 8 | Reserved | | | | | | | |
| 9 | Subenclosure Identifier (0x00) | | | | | | | |
| 10 | *Subenclosure Nickname Status*  *0x00 (OK), 0x80(field error), 0x81(data destroy error), 0x82(no change error)* | | | | | | | |
| 11 | *Subenclosure Nickname Additional Status Error field in ID(1), Length(2), Generation Code(4), Name(8)* | | | | | | | |
| 12~13 | Reserved | | | | | | | |
| 14~15 | Language Code (0x0000 ASCII code) | | | | | | | |
| 16~47 | *Nickname* | | | | | | | |

### Defined Extension Status Page (1Bh)

The Defined Extension Status Page indicates the status of enclosure extension control.

**This page only for QDEM tool only.**

Table 32 Defined Extension Status Page (1Bh) Data Format

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bytes\Bits | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 0 | Defined Extension Status Page Code (0x1B) | | | | | | | |
| 1 | Reserved | | | | | | | |
| 2~3 | Page Length (2) | | | | | | | |
| 4~5 | Extension Code (0x1) | | | | | | | |

### Phy Error Counter Status (1Dh)

The Phy Error Counter Status Page report each phy error counter and link rate.

**This page only for QDEM tool only.**

Table 33 For 1U 3.5”x16 SKU - Phy Error Counter Status (1Dh) Data Format

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bytes\Bits | | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 0 | | Phy Error Counter Status (0x1D) | | | | | | | |
| 1 | | Reserved | | | | | | | |
| 2~3 | | Page Length [n-3] (412) | | | | | | | |
| 4 | | Number of Phy (24) | | | | | | | |
| 5 | | Number of Error Counter Type (4) | | | | | | | |
| 6~7 | | Reserved | | | | | | | |
| Phy Error Counter \* 24 | | | | | | | | | |
| 8 | 0~3 | *InvDwordCnt* | | | | | | | |
| ~ | 4~7 | *DispErrorCnt* | | | | | | | |
| 391 | 8~11 | *LossOfSyncCnt* | | | | | | | |
|  | 12~15 | *ResetProblemCnt* | | | | | | | |
| Disk Link Rate \* 24 | | | | | | | | | |
| 392  ~  415 | 0 | *Disk Link Rate*  12Gbps (0x4), 6Gbps (0x3), 3Gbps (0x2), 1.5Gbps (0x1), Uninstalled (0x0) | | | | | | | |

## SEND DIAGNOSTIC Command

The enclosure service supports the following pages for SEND DIAGONSTIC command in order to write the information:

* Page 02h (Enclosure Control) to control the enclosure functions
* Page 04h (String Out) to transmits a binary string to to the enclosure services process.
* Page 0Eh (Download Firmware Control) to perform firmware download
* Page 0Fh (Subenclosure Nickname Control) to set the nickname of subenclosure
* Page 1Bh (Defined Extension Control Page) to control enclosure extension.

### Enclosure Control Page (02h)

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

Table 34 For 1U 3.5”x16 SKU - Enclosure Control Page (02h) Format (SIM Board)

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bytes\Bits | | 7 | 6 | 5 | 4 | 3 | 2 | | 1 | 0 |
| 0 | | Status Page Code (0x02) | | | | | | | | |
| 1 | | Reserved | | | *INVOP* | INFO | NON-CRIT | | CRIT | UNRECOV |
| 2~3 | | Page Length [n-3] (164) | | | | | | | | |
| 4~7 | | Generation Code | | | | | | | | |
| Array Device Slot | | | | | | | | | | |
| 8 | 0 | Select | PRDFAIL | DISABLED | SWAP | Reserved | | | | |
| 1~3 | don't care | | | | | | | | |
| Individual \* | | | | | 16 | | | | |
| ~ | 0 | *Select* | *PRDFAIL* | *DISABLED* | SWAP | Reserved | | | | |
| 75 | 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 | Don't RMV | Reserved | RQST Missing | RQST Insert | *RQST REMOVE* | | *RQST Ident* | Reserved |
|
| 3 | Reserved | | *RQST FAULT* | Device Off | Enable Bypassed A | Enable Bypassed B | | Reserved | |
| Enclosure Services Controller Electronics | | | | | | | | | | |
| 76 | 0 | Select | PRDFAIL | DISABLED | SWAP | Reserved | | | | |
| 1~3 | don't care | | | | | | | | |
| Individual \* | | | | | 1 | | | | |
| ~ | 0 | *Select* | PRDFAIL | *DISABLED* | SWAP | Reserved | | | | |
| 83 | 1 | *RQST Ident* | RQST Fail | Reserved | | | | | | |
| 2 | Reserved | | | | | | | | S Element |
| 3 | Reserved | | | | | | | | |
| Enclosure | | | | | | | | | | |
| 84 | 0 | Select | PRDFAIL | DISABLED | SWAP | Reserved | | | | |
| 1~3 | don't care | | | | | | | | |
| Individual \* | | | | | 1 | | | | |
| ~ | 0 | *Select* | PRDFAIL | DISABLED | SWAP | *Element Status Code* | | | | |
| 91 | 1 | *RQST Ident* | Reserved | | | | | | | |
| 2 | Power Cycle RQST | | Power Cycle Delay | | | | | | |
| 3 | Power Off Duration | | | | | | RQST Fail | | RQST Warn |
| SAS Connector | | | | | | | | | | |
| 92 | 0 | Select | PRDFAIL | DISABLED | SWAP | Reserved | | | | |
| 1~3 | don't care | | | | | | | | |
| Individual \* | | | | | 16 | | | | |
| ~ | 0 | Select | PRDFAIL | DISABLED | SWAP | Reserved | | | | |
| 159 | 1 | RQST Ident | RQST Fail | Reserved | | | | | | |
| 2~3 | Reserved | | | | | | | | |
| SAS Expander | | | | | | | | | | |
| 160 | 0 | Select | PRDFAIL | DISABLED | SWAP | Reserved | | | | |
| 1~3 | don't care | | | | | | | | |
| Individual \* | | | | | 1 | | | | |
| ~ | 0 | *Select* | PRDFAIL | DISABLED | SWAP | Reserved | | | | |
| 167 | 1 | *RQST Ident* | RQST Fail | Reserved | | | | | | |
| 2~3 | Reserved | | | | | | | | |

#### Format for all control fields

Table 35 ELEMENT CONTROL and OVERALL CONTROL fields

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Byte\Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 0 | Common Control | | | | | | | |
| SELECT | PRDFAIL | DISABLED | RST SWAP | Reserved | | | |
| 1 | Element-type-specific status information | | | | | | | |
| 2 |
| 3 |

The **COMMON CONTROL** field contains those bits that may be used by any OVERALL CONTROL or ELEMENT CONTROL field. The bits of the COMMON CONTROL field, SELECT, PRDFAIL, DISABLE, and RST SWAP, are defined below.

A **SELECT** bit set to one specifies that the enclosure services process should perform the control functions defined by the other bits in the OVERALL CONTROL or ELEMENT CONTROL field. A SELECT bit set to zero specifies that the enclosure services process shall ignore all other bits in the OVERALL CONTROL or ELEMENT CONTROL field. The SELECT bit allows specific individual elements to be selected for control operations.

A **PRDFAIL** (predicted failure) bit set to one specifies that the enclosure services process turn on the “predicted failure state” indicator for the element. A PRDFAIL bit set to zero specifies that the enclosure services process turn off the “predicted failure state” indicator for the element. The element is not required to implement the PRDFAIL bit or the “predicted failure state” indicator.

A **DISABLE** bit set to one specifies that the enclosure services process disable the element. A DISABLE bit set to zero specifies that the enclosure services shall allow normal operation of the element to resume. The interpretation of the disabled state is specific to the element.

A **RST SWAP** (reset swap) bit set to one specifies that the enclosure services process set the SWAP bit to zero in the status field one time, if the SWAP bit is set to one. A RST SWAP bit set to zero specifies that the enclosure services process shall not change the SWAP bit.

The element-type-specific control information is defined separately for each element type.

#### Overall Control Fields for all element types

Table 36 Overall control fields for Enclosure Control diagnostic page

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 0 | Select | PRDFAIL | DISABLED | SWAP | Reserved |
| 1~3 | don't care | | | | |

No any effect in overall control field in all element types.

#### SCSI Array Device Control (SADCx) Fields

Table 37 Individual SCSI device control field for Enclosure Control diagnostic page

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | *Select* | *PRDFAIL* | *DISABLED* | SWAP | Reserved | | | |
| 1 | RQST OK | RQST RSVD device | RQST HOT SPARE | RQST CONS Check | RQST IN CRIT Array | RQST IN FAILED Array | RQST REBUID/REMAP | RQST R/R ABORT |
|
| 2 | RQST Active | Don't RMV | Reserved | RQST Missing | RQST Insert | *RQST REMOVE* | RQST Ident | Reserved |
|
| 3 | Reserved | | *RQST FAULT* | Device Off | Enable Bypassed A | Enable Bypassed B | Reserved | |
|

The following status bits are supported:

* DISABLED: When set, the Disk will be power on.
* Select: If this bit is set to 0, this control word will be ignored. If this is set to 1 for overall element, the action described below for element controls is performed for each element for which the element control does not have selected bit on. If this is set to 1 for non-overall element, the action described below for element controls is performed. If this bit is set to 0, this status word will be ignored.
* Rqst RMV: When set, the removal indicator is activated to indicate the drive is in “ready to remove” state, and the RMV bit is set in status page. When cleared, the indicator is de-activated.
* Fqst FAULT: When set, the fault indicator is activated. When cleared, the indicator is de-activated.
* HOT SPARE: When set, the “hot spare” indicator is turned on. When cleared, the indicator is turned off.
* CONS CHECK: When set, the “consistency check in progress” indicator is turned on, showing that the device is participating in an array consistency check activity. When cleared, the indicator is turned off.
* REBUILD/REMAP: When set, the “rebuild/remap” indicator is turned on, showing that the device is participating in a rebuild or remap of the array contents. When cleared, the indicator is turned off.
* Device Off: When set, the Disk will be power off.
* Other fields are not affected.

### String Out Page (04h)

The String Out page is used to transmits a subenclosure dependent binary string from the application client to the enclosure services process of the primary subenclosure.

**This page only for QDEM tool only.**

Table 38 String Out Page (04h) Data Format

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bytes\Bits | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 0 | String Out (0x04) | | | | | | | |
| 1 | Obsolete | | | | | | | |
| 2~3 | *Page Length [n-3]* | | | | | | | |
| 4 | *String Out Command*  *SES\_STR\_OUT\_CMD\_SET\_SASADDR (0x1)*  *SES\_STR\_OUT\_CMD\_REBOOT (0x2)*  *SES\_STR\_OUT\_CMD\_CLEAR\_PHY\_ERR\_CNT (0x3)*  *SES\_STR\_OUT\_CMD\_SET\_SERIAL\_NUM (0x4)* | | | | | | | |
| 5~n |  | | | | | | | |

### Download Microcode Control Page (0Eh)

The Download Microcode Control page is used to upgrade the firmware of the JBOD device.

Table 39 Download Microcode Control Page (0Eh) Format

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bytes\Bits | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 0 | Download Microcode Control (0x0E) | | | | | | | |
| 1 | Subenclosure Identifier (0x00) | | | | | | | |
| 2~3 | *Page Length [n-3]* | | | | | | | |
| 4~7 | *Expected Generation Code* | | | | | | | |
| 8 | *Download Microcode Mode* | | | | | | | |
| 9~10 | Reserved | | | | | | | |
| 11 | *Buffer ID (0x00)* | | | | | | | |
| 12~15 | *Buffer Offset* | | | | | | | |
| 16~19 | *Microcode Image Length* | | | | | | | |
| 20~23 | *Microcode Image Data Length* | | | | | | | |
| 24~m | *Microcode Image Data* | | | | | | | |
| m+1~n | *PAD if needed* | | | | | | | |

**Download Microcode Mode:** The value can be 0x07. (Download with offset, save and activate).

**Buffer ID:** The value is 0x00 to update firmware for current SIM board.

### Subenclosure Nickname Control Page (0Fh)

The Subenclosure Nickname Control diagnostic page transmits a text string to the SES device to serve as the nickname for the specified subenclosure.

Table 40 Subenclosure Nickname Control Page (0Fh) Format

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bytes\Bits | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 0 | Subenclosure Nickname Control (0x0F) | | | | | | | |
| 1 | Subenclosure Identifier (0x00) | | | | | | | |
| 2~3 | Page Length [n-3] (44) | | | | | | | |
| 4~7 | *Expected Generation Code* | | | | | | | |
| 8~47 | *Subenclosure Nickname* | | | | | | | |

### Defined Extension Control Page (1Bh)

The Defined Extension Control page is used to control enclosure extension function.

**This page only for QDEM tool only.**

Table 41 Defined Extension Control Page (1Bh) Data Format

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bytes\Bits | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 0 | Defined Extension Control Page Code (0x1B) | | | | | | | |
| 1 | Obsolete | | | | | | | |
| 2~3 | *Page Length [n-3]* | | | | | | | |
| 4~5 | Handling Illegal Parameter (0x0100) | | | | | | | |
| 6~7 | *Control Element ID* | | | | | | | |
| 8~9 | *Operation Code*  *SES\_EXTENSION\_CMD\_RESET\_ELEMENT (0x0000)*  *SET\_SAS\_ADDRESS (0x8000)*  *SET\_SERIAL\_NUMBER (0X8001)*  *CLEAR\_ALL\_PHY\_ERROR (0X8004)* | | | | | | | |
| 10~11 | *Data Length* | | | | | | | |
| 12~n | *Extension Control Data* | | | | | | | |

# SMP Interface

The SMP is used to manage SAS expander and to communicate management information between SAS devices within a SAS domain. The SMP target component of SIM is responsible for processing and responding to incoming SMP requests, generating corresponding SMP responses to application client.

## SMP Frame Overview

**SMP Request Frame**

A SMP request frame from a SMP initiator is used to request a SMP function to be performed by a SAS device. The request frame format as following:

Table 42 SMP request frame (40h)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bytes\Bits | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 0 | SMP request frame type (0x40) | | | | | | | |
| 1 | *Function* | | | | | | | |
| 2 | *Allocated Response Length* | | | | | | | |
| 3 | *Request Length (00 or (n-7)/4)* | | | | | | | |
| 4~n-4 | Additional Request Bytes | | | | | | | |
| n-3~n | CRC | | | | | | | |

**SMP Response Frame**

An SMP response frame from SAS device is used to respond to an SMP request frame. The response frame format as following:

Table 43 SMP response frame (41h)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bytes\Bits | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 0 | SMP response frame type (0x41) | | | | | | | |
| 1 | *Function* | | | | | | | |
| 2 | *Function Result* | | | | | | | |
| 3 | *Response Length (00 or (n-7)/4)* | | | | | | | |
| 4~n-4 | Additional Response Bytes | | | | | | | |
| n-3~n | CRC | | | | | | | |

Note:

If allocated response length set to 0, the length of response data is depended on the SAS spec. which describing how many dwords to be transferred from target.   
It should set non-zero value in allocated/request length because LONG RESPONS bit is set to 1 in report general.

## Supported SMP Function Result

The SIM supported SMP function result status is as follows:

|  |  |
| --- | --- |
| **Value** | **Name** |
| 00h | Function Accepted |
| 01h | Unknown Function |
| 02h | Function Failed |
| 03h | Invalid Request Frame Length |
| 04h | Expander change count does not match |
| 05h | Expander Busy |
| 06h | Incomplete descriptor list |
| 10h | PHY Does Not Exist |
| 11h | Index Does Not Exist |
| 12h | PHY Does Not Support SATA |
| 13h | Unknown PHY Operation |
| 14h | Unknown PHY Test Function |
| 15h | PHY Test Function In Progress |
| 16h | PHY Vacant |
| 17h | Unknown PHY event source |
| 18h | Unknown Descriptor Type in discover list |
| 19h | Unknown PHY Filter in discover list |
| 1Ah | Affliction Violation |
| 20h | SMP Zone Violation |
| 21h | No Management Access Rights |
| 22h | Unknown enable/disable zoning value |
| 23h | Zone Lock Violation |
| 24h | Not Activated |
| 25h | Zone Group Out of Range |
| 26h | No Physical Presence |
| 27h | Saving not support |
| 28h | Source Zone Group does not exist |
| 29h | Disable Password not supported |

## Supported SMP Functions

The supported SMP request functions are as follows. If a host sends a function code which is not in the list, the SIM will respond the result of “UNKNOWN SMP FUNCTION” to host.

The detail frame format of the following SMP functions refers to SAS 2.0 specification.

Table 44 Supported SMP functions

|  |  |  |
| --- | --- | --- |
| **SMP functions** | **function code** | **Description** |
| Report General | 0x00 | Return general information about the device |
| Report Manufacturer INFO | 0x01 | Return vendor and product identification |
| Report Self Configuration | 0x03 | Return status of the discover process in a self-configuring expander device |
| Discover | 0x10 | Return information about the specified phy |
| Report PHY Error Log | 0x11 | Return error logging information about the specified phy |
| Report PHY SATA | 0x12 | Return information about a phy currently attached to a SATA phy |
| Report Route Information | 0x13 | Return phy-based expander route table information Response 'function failed' if self-configure |
| Report Phy Event | 0x14 | Return phy events for the specified phy |
| Discover List | 0x20 | Return information about the specified phys |
| Report Phy Event List | 0x21 | Return all phys’ events |
| Report Exp Route Table List | 0x22 | Return contents of the expander-based expander route table |
| Configure Route INFO | 0x90 | Change phy-based expander route table information Response 'function failed' if self-configure |
| Phy Control | 0x91 | Request actions by the specified phy |
| Phy Test function | 0x92 | Request a test function by the specified phy |
| Configure Phy Event | 0x93 | Configure phy events for the specified phy |
| Write GPIO register | 0x82 | N.A. |
| **Zoning requests** | | |
| Zone Lock | 0x86 | Lock a zoning expander device |
| Configure Zone Phy | 0x8A | Configure zone phy information |
| Configure Zone Permission | 0x8B | Configure the zone permission table |
| Report Zone Permission | 0x04 | Return the zone permission table values |
| Disable/Enable Zoning | 0x81 | Enable or disable zoning |
| Zone Activate | 0x87 | Set the zoning expander current values equal to the zoning expander shadow values |
| Zone Unlock | 0x88 | Unlock a zoning expander device |
| Configure Zone Manager Password | 0x89 | Configure the zone manager password |
| Report Zone Manager Password | 0x05 | Return the zone manager password |
| Report Zoned Broadcast | 0x85 | Transmit the specified Broadcast on the expander ports in the specified zone groups |

# Firmware Download

## Firmware Update through MegaCLI

If you use the RAID card to connect to S2PH, you can use the MegaCLI to update the FW.

MegaCLI used the SCSI buffer protocol to update FW.

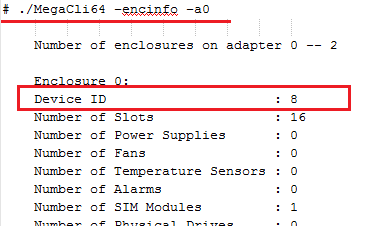
Please use following command :

**MegaCli -pdfwdownload -encdevid[EncID] -f FileName -a0**

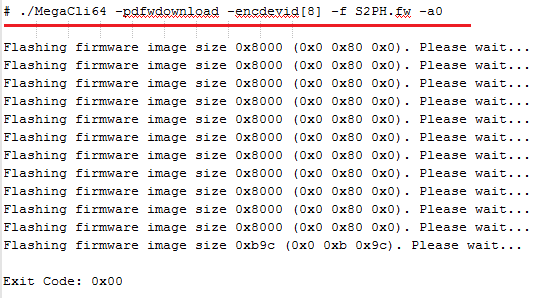
**EncID** can use the command “**MegaCli –encinfo –a0**” to get “Device ID”

### Example

STEP 1: Get EncID



STEP2: Update Firmware



STEP3: Restart S2PH

## Firmware Update through console port

We can use the following command in console port to trigger download firmware by XMODEM protocol:

**D51PH-1ULH > fdl e2 0 y**

After that, SIM card waits for getting firmware. User can use Xmodem application in host to send firmware to SIM card.

## Firmware Update through SCSI

We can use WRITE BUFFER command with mode = 2 and buffer id =0 to update the firmware to the JBOD.

## Firmware Update through SES device

### SES Download Commands

We can use SEND DIAGNOSTIC command with Download Microcode Control Page to update the firmware to the JBOD. By issuing RECEIVE DIAGNOSTIC RESULT command with Download Microcode Status Page, we can know the status of firmware downloading.

The downloadable firmware is in binary format that can be broken down into multiple packets. The maximum size of a packet is 4K bytes. No pre-processing on the file is required, and all relevant data is already compiled into this downloadable file.

The host utility can choose to check the download status by reading the relevant information in the Download Microcode Status Page.

We can choose to update both SIMs or only single SIM by setting the Buffer ID field in Download Microcode Status Page to different value. If the Buffer ID field is set to 0x01, it means we want to update both SIMs. If The Buffer ID field is set to 0x00, it means only the SIM who receives the Download Microcode Control page will be updated.

### SES Download Status

The SES Download Microcode Status Page can be used to dynamically check the firmware download status.