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To: T10 SAS Protocol Working Group
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Subject: SAS-1.1, SAS phy test functions diagnostic page

Introduction

There has been much discussion about providing a standard method for invoking specific phy diagnostic test functions for SAS phys, particularly how to enable a SAS phy to send the JTPAT or CJTPAT continuously. The following is an attempt to provide a method using a new SAS protocol specific diagnostic page for the SEND DIAGNOSTICS command. Though other patterns may be defined in the future, this proposal is strictly limited to defining how a SAS initiator port may send a command to a SAS target device in order to enable (and disable) a specified SAS phy in the SAS target device to send JTPAT or CJTPAT continuously.

Revision 1 of the proposal includes input from the July 12th SAS working group. Revision 2 of this proposal includes minor editorial changes recommended during the September 13th SAS working group. This proposal is based on SPC-3r19 and SAS1r05.

Changes for SPC-3:

7.1.1 Diagnostic page format and page codes for all device types

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Table 178 — Diagnostic page codes

Page Code	Diagnostic page name	Reference
00h	Supported Diagnostic Pages	7.1.2
01h - 2Fh	Defined for SES-2 for: a) Enclosure services devices (i.e., SCSI devices with the PERIPHERAL DEVICE TYPE field set to 0Dh in standard INQUIRY data); and b) SCSI devices with the ENCSERV bit set to one in standard INQUIRY data (see 6.4.2).	SES-2
30h - 3EFh	Reserved	
3Fh	See specific SCSI transport protocol for definition	
40-7Fh	See specific device type for definition	
80h - FFh	Vendor-specific diagnostic pages	

Additions for SAS 1.1:

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4.7 Phy diagnostic testing model

The optional SAS protocol specific diagnostic page (see 10.2.x) provides a method for an application client to enable and disable a phy test function (e.g., transmission of the CJTPAT) for a selected phy in a SAS target device.

The application client sends a SEND DIAGNOSTIC command followed by a SAS protocol specific diagnostic page to a SAS target device containing a SAS phy that is to perform a phy test function. The SAS protocol specific diagnostic page specifies the SAS phy in the SAS target device that is to perform the phy test function and the test function to be performed. If the test function requires a specific test pattern and/or test pattern rate, then the SAS protocol specific diagnostic page specifies the test pattern and test pattern rate.

The SEND DIAGNOSTIC command may be sent to any SSP target port in a SAS target device that contains the SAS phy that is to perform the test function.

The SAS target device receives the COMMAND frame containing the SEND DIAGNOSTIC command and the DATA frame containing the SAS protocol specific diagnostic page. The SAS target device sends a RESPONSE frame for the COMMAND frame. If there were no errors in the COMMAND or DATA frames, and the SAS target device receives an ACK for the RESPONSE frame, then the SAS phy specified in the SAS protocol specific diagnostic page performs the specified test function.

Once a SAS phy has begun performing a test function, it ignores its receiver. To stop a SAS phy from performing a test function, an application client sends a SEND DIAGNOSTIC command to a SAS phy in the SAS target device that is not performing a test function, or the application client causes a power on **reset** to occur.

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10.2.x SCSI diagnostic parameters**10.2.x.1 Protocol specific diagnostic page**

The SAS protocol specific diagnostic page provides a method for an application client to enable and disable test functions for selected phys (see 4.7). The diagnostic page format is specified in SPC-3.

The SAS protocol specific diagnostic page is transmitted using the SEND DIAGNOSTIC command. If a SAS target device receives a RECEIVE DIAGNOSTIC RESULTS command with the PAGE CODE field set to 3Fh, the device server shall return CHECK CONDITION status for that RECEIVE DIAGNOSTIC RESULTS command. The sense key shall be set to ILLEGAL REQUEST and the additional sense code shall be set to ILLEGAL FIELD IN PARAMETER LIST. Table x defines the SAS protocol specific diagnostic page.

Table x — SAS Phy Test Functions diagnostic page

Byte\Bit	7	6	5	4	3	2	1	0
0	PAGE CODE (3Fh)							
1	Reserved				PROTOCOL IDENTIFIER (6h)			
2	(MSB) PAGE LENGTH (001C00h) (LSB)							
3								
4	PHY IDENTIFIER							
5	TEST FUNCTION							
6	TEST PATTERN							
7	Reserved				TEST PATTERN RATE			
8	Reserved							
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The PHY IDENTIFIER field specifies the phy identifier (see 4.2.7) of the phy in the SAS phy that is to perform or to stop performing a diagnostic test function (i.e., the selected phy). If the PHY IDENTIFIER field specifies a SAS phy that does not exist in the SAS target device, then the device server shall terminate the SEND DIAGNOSTIC command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

The TEST FUNCTION field specifies the test function to be performed. If the TEST FUNCTION field specifies a test function that is not supported by the specified SAS phy, then the device server shall terminate the SEND DIAGNOSTIC command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN PARAMETER LIST. Table v defines the TEST FUNCTION field.

Table v — TEST FUNCTION field

Code	Description
00h	If the selected phy is performing a diagnostic test function, then the selected phy shall be set to stop performing the test function and originate a link reset sequence. If the selected phy is not performing a diagnostic test function, then the device server shall terminate the SEND DIAGNOSTIC command. ^a
01h	If the selected phy is not performing a diagnostic test function, then the selected phy shall be set to transmit the test pattern specified by the TEST PATTERN field at the physical link rate specified by the TEST PATTERN RATE field and set to ignore its receiver. If the selected phy is performing a diagnostic test function, then the device server shall terminate the SEND DIAGNOSTIC command. ^a
02h - EFh	Reserved
F0h - FFh	Vendor specific
^a If there is no SSP target port available to receive a SEND DIAGNOSTIC command to stop a selected phy from performing a diagnostic test function, then a power on reset may be required to cause the selected phy to stop performing the function and originate a phy reset sequence.	

If the TEST FUNCTION field is set to 01h, then the TEST PATTERN field specifies the test pattern to be transmitted. If the TEST PATTERN field specifies a test pattern that is not supported by the specified SAS phy, then the device server shall terminate the SEND DIAGNOSTIC command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN PARAMETER LIST. Table y defines the TEST PATTERN field.

Table y — TEST PATTERN field

Code	Description
00h	Reserved
01h	The selected phy shall continuously transmit the JTPAT (see Annex A). If the selected phy receives data while transmitting JTPAT, then the selected phy shall ignore the received data.
02h	The selected phy shall continuously transmit the CJTPAT (see Annex A). If the selected phy receives data while transmitting CJTPAT, then the selected phy shall ignore the received data.
03h - Fh	Reserved

The TEST PATTERN RATE field specifies the physical link rate at which the test pattern shall be transmitted. If the physical link rate specified by the TEST PATTERN RATE field is less than the hardware minimum physical link rate or greater than the hardware maximum physical link rate, then the device server shall terminate the SEND DIAGNOSTIC command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN PARAMETER LIST. Table z defines the TEST PATTERN RATE field.

Table z — TEST PATTERN RATE field

Code	Description
0h - 7h	Reserved
8h	1,5 Gbps
9h	3,0 Gbps
Ah - Fh	Reserved

The selected phy shall begin to perform the diagnostic test function after:

- 1) the SAS target device received a COMMAND frame containing the SEND DIAGNOSTIC command and the DATA frame containing the SAS Phy Test Functions diagnostic page with no errors;
- 2) the SAS target port has sent a RESPONSE frame for the SEND DIAGNOSTIC command; and
- 3) the SAS target port has received acknowledgement that the SAS initiator port has received the RESPONSE frame for the SEND DIAGNOSTIC command (i.e., the SAS target port received an ACK for the RESPONSE frame from the SAS initiator port).