To: T10 Technical Committee
From: Rob Elliott, HP (elliott@hp.com)
Date: 12 November 2004
Subject: 04-222r2 SAS-1.1 More phy test patterns

Revision history

Revision 0 (8 July 2004) First revision, proposing a mode page to generate an arbitrary 8 character pattern.

Revision 1 (29 October 2004) Changed to be based on the diagnostic page defined by 04-181r2 and included in sas1r06. Limited the pattern to 4 characters (one dword). Add PRBS-7 predefined pattern.

Revision 2 (11 November 2004) Incorporated comments from November Physical WG meeting - removed PRBS-7 and expanded pattern to 2 dwords.

Related documents

04-181r2 SAS-1.1 Phy Test Functions diagnostic page (Mark Evans, Maxtor) (incorporated into sas1r06)
sas1r06 - Serial Attached SCSI 1.1 revision 6

Overview

Phy test patterns other than JTPAT and CJTPAT are desired. Rather than define specific patterns, a generic way to specify a repeating pair of dwords (composed of any combination of data and control characters) is proposed. This is like a feature available in Serial ATA's BIST FIS.

The November Physical WG requested that "phy test function" be changed to "phy compliance and characterization function" and "phy test pattern" be changed to "phy data pattern" throughout.

Suggested changes

4.15 Phy ~~test~~ compliance and characterization functions

The optional Protocol-Specific diagnostic page for SAS (see 10.2.8.1) provides a method for an application client to enable and disable a phy ~~test~~ compliance and characterization function (e.g., transmission of the CJTPAT) for a selected phy in a SAS target device.

The application client sends a SEND DIAGNOSTIC command with the Protocol-Specific diagnostic page specifying the phy in the SAS target device that is to perform the ~~phy test~~ function and the ~~phy test~~ function to be performed. If the ~~phy test~~ function requires a specific phy ~~test~~ data pattern and/or phy ~~test~~ data pattern physical link rate, then the Protocol-Specific diagnostic page specifies the phy ~~test~~ data pattern and phy ~~test~~ data pattern physical link rate.

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

The phy shall begin the specified ~~phy test~~ function after receiving an ACK for the RESPONSE frame transmitted in response to the SEND DIAGNOSTIC command that requested the ~~phy test~~ function.

Once a SAS phy has begun performing a ~~phy test~~ function, it shall ignore its receiver. To stop a SAS phy from performing a ~~phy test~~ function, an application client sends a SEND DIAGNOSTIC command to a SAS phy in the SAS target device that is not performing a ~~phy test~~ function ~~requestion~~requesting a ~~phy test~~ function of 00h. If no such phy is available, the ~~test~~ function only stops on power loss.

10.2.8 SCSI diagnostic parameters

10.2.8.1 Protocol-Specific diagnostic page

The Protocol-Specific diagnostic page for SAS provides a method for an application client to enable and disable phy ~~test~~ compliance and characterization functions (see 4.7) for selected phys. The diagnostic page format is specified in SPC-3.

The Protocol-Specific diagnostic page is transmitted using the SEND DIAGNOSTIC command. If the device server receives a RECEIVE DIAGNOSTIC RESULTS command with the PAGE CODE field set to 3Fh, it shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and

the additional sense code set to ILLEGAL FIELD IN PARAMETER LIST. Table 1 defines the Protocol-Specific diagnostic page for SAS.

Table 1 — Protocol-Specific diagnostic page for SAS

Byte\Bit	7	6	5	4	3	2	1	0
0	PAGE CODE (3Fh)							
1	Reserved				PROTOCOL IDENTIFIER (6h)			
2	(MSB)			PAGE LENGTH (001Ch)				
3								(LSB)
4	PHY IDENTIFIER							
5	PHY ~~TEST~~ COMPLIANCE AND CHARACTERIZATION FUNCTION							
6	PHY ~~TEST~~ DATA PATTERN							
7	Reserved				PHY ~~TEST~~ DATA PATTERN PHYSICAL LINK RATE			
8	Reserved							
10								
11	PHY DATA PATTERN CONTROL							
12	PHY DATA PATTERN							
19								
~~8~~20	Reserved							
31								

The PHY IDENTIFIER field specifies the phy identifier (see 4.2.7) of the phy that is to perform or to stop performing a phy ~~test~~ compliance and characterization function (i.e., the selected phy). If the PHY IDENTIFIER field specifies a phy that does not exist, 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 PHY ~~TEST~~ COMPLIANCE AND CHARACTERIZATION FUNCTION field specifies the phy ~~test~~ compliance and characterization function to be performed and is defined in table 2. If the PHY ~~TEST~~ COMPLIANCE AND CHARACTERIZATION FUNCTION field specifies a phy ~~test~~ compliance and characterization function that is not supported, 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 2 — PHY ~~TEST~~ COMPLIANCE AND CHARACTERIZATION FUNCTION **field**

Code	Description
00h	If the selected phy is performing a phy ~~test~~ compliance and characterization function, then the selected phy shall stop performing the ~~phy test~~ function and originate a link reset sequence. If the selected phy is not performing a phy ~~test~~ compliance and characterization function, then this function has no effect on the selected phy. [a]
01h	If the selected phy is not performing a phy ~~test~~ compliance and characterization function, the selected phy shall be set to transmit the phy ~~test~~data pattern specified by the PHY ~~TEST~~ DATA PATTERN field at the physical link rate specified by the PHY ~~TEST~~ DATA PATTERN PHYSICAL LINK RATE field and set to ignore its receiver. If the selected phy receives data while transmitting the pattern, then the selected phy shall ignore the received data. If the selected phy is performing a phy ~~test~~ compliance and characterization function, 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 PHY ~~TEST FUNCTION~~ COMPLIANCE AND CHARACTERIZATION FUNCTION IN PROGRESS. [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 phy ~~test~~ compliance and characterization function, then a power on may be required to cause the selected phy to stop performing the function and originate a phy reset sequence.

Editor's Note 1: The additional sense code returned if function 01h is selected while a function (including 01h) is already running needs to be assigned by SPC-3. Note the name is also changing from PHY TEST FUNCTION IN PROGRESS.

If the PHY ~~TEST~~ COMPLIANCE AND CHARACTERIZATION FUNCTION field is set to 01h, then the PHY ~~TEST~~ DATA PATTERN field specifies the phy ~~test~~data pattern to be transmitted.

If the PHY ~~TEST~~ DATA PATTERN field specifies a phy ~~test~~data 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 3 defines the PHY ~~TEST~~ DATA PATTERN field.

Table 3 — PHY ~~TEST~~ DATA PATTERN **field**

Code	Name	Description
00h	Reserved	
01h	JTPAT	The selected phy shall continuously transmit the JTPAT for RD+ and RD- (see A.1). ~~If the selected phy receives data while transmitting the pattern, then the selected phy shall ignore the received data.~~
02h	CJTPAT	The selected phy shall continuously transmit the CJTPAT (see A.2). ~~If the selected phy receives data while transmitting the pattern, then the selected phy shall ignore the received data.~~
03h	DWORDS	The selected phy shall continuously transmit the dword specified by the PHY DATA PATTERN CONTROL field and the PHY DATA PATTERN field. See table x for DWORDS phy data pattern examples. This pattern is only for use for transmitter and passive interconnect characterization. Patterns may be specified which do not appear during normal operation.
~~03h~~ 04h - FFh	Reserved	
F0h - FFh	Vendor specific	

Table xx lists some examples of phy data patterns used with the PHY DATA PATTERN field set to DWORDS.

Table 4 — DWORDS phy data pattern examples (informative)[new]

PHY DATA PATTERN CONTROL field	PHY DATA PATTERN field	Description
00h	4A4A4A4Ah 4A4A4A4Ah	D10.2 characters (see table 38 in 6.3.3). This is a repeating 01b pattern, which is the highest frequency pattern. This pattern is used for measuring skew and rise/fall times (see table 29 in 5.3.4).
00h	78787878h 78787878h	D24.3 characters (see table 38 in 6.3.3). This is a repeating 0011b pattern, which has half the highest frequency.
FFh	BCBCBCBCh BCBCBCBCh	K28.5 characters (see table 39 in 6.3.3). This pattern does not appear during normal operation.
88h	BC4A4A7Bh BC4A4A7Bh	ALIGN (0) dwords (see table 57 in 7.2.3).
00h	EBF4EBF4h EBF4EBF4h	Pairs of these characters: D11.7 followed by D20.7 (see table 38 in 6.3.3). This pattern contains a single bit of one polarity after five bits of the other polarity (i.e., 0000010b and 1111101b).

The PHY ~~TEST~~ DATA PATTERN PHYSICAL LINK RATE field specifies the physical link rate at which the phy ~~test~~data pattern shall be transmitted and is defined in table 5. If the physical link rate specified by the PHY ~~TEST~~ DATA PATTERN PHYSICAL LINK 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 5 — PHY ~~TEST~~ DATA PATTERN PHYSICAL LINK RATE **field**

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

The PHY DATA PATTERN CONTROL field and PHY DATA PATTERN field are only used if the PHY DATA PATTERN field is set to DWORDS. Each bit in the PHY DATA PATTERN CONTROL field corresponds to a byte in the PHY DATA PATTERN field. A bit set to one specifies that the corresponding byte in the PHY DATA PATTERN field shall be sent as a control character (Kxx.y). A bit set to zero specifies that the corresponding byte in the PHY DATA PATTERN field shall be sent as a data character (Dxx.y).