To: T10 Technical Committee
From: Rob Elliott, Compaq Computer Corporation (Robert.Elliott@compaq.com)
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Subject: Mode pages equivalents for ECP commands

Revision 0: first revision

Related documents
99-264r0 through r8 (by Larry Lamers and Ron Roberts, Adaptec) proposed putting margin control support in several different places: a new MARGIN CONTROL message, a new MARGIN CONTROL command, and in the information unit L_Q header.

00-257r3 (by John Lohmeyer, LSI Logic), the Expander Communication Protocol (ECP) proposal accepted by T10 in September 2000, includes ECP-based MARGIN CONTROL and MARGIN REPORT commands for communicating with expanders and initiators.

00-378r0 (by George Penokie, Tivoli) is the proposed text for SPI-4 revision 1, which incorporates ECP.

00-391r0 proposes letting targets understand ECP commands themselves, allowing margin control and margin reporting to be implemented via the same mechanism used for expanders.

00-392r0 proposes a REPORT DESKEW VALUES command for ECP.

00-393r0 proposes a REPORT AAF VALUES command for ECP.

Overview
In case 00-391 is rejected, this proposal suggests implementing margin control related commands via mode pages. The page format and semantics are intended to match those in the equivalent ECP commands. MODE SENSE is used to read the data and is equivalent to an inbound function. MODE SELECT is used to write the data and is equivalent to an outbound function.

Since these mode pages are SPI specific, they should be documented in SPI-4. New page numbers, if employed, need to be added to tables in SPC-2 or SPC-3. They should bedefined as protocol-specific, so other protocols can reuse the pages.

Since quite a few pages are possible, there are several options for handling them:
1) Create a new mode page to match each ECP command. Currently, one command exists and two are proposed. More commands could follow. This is the easiest solution to document but will run into problems with mode page code assignments.

2) Add a sub-page code field to the MODE SENSE and MODE SELECT CDBs to expand the mode page address space. There are only 3 mode page codes reserved across all device types today; a feature like this would help that problem. This changes ancient SCSI command structures.

3) Include a field in the mode page that indicates which sub-page is being written with MODE SELECT and which sub-page is being returned on a subsequent MODE SENSE. The existing Port Control page could be overloading with the additional functionality.

Both the separate mode pages per command and overloading the Port Control page alternatives are shown below. The Overload method is recommended.

Editor's node: all these solutions lead to duplicate wording for the commands between the ECP annex and the mode page section. A combined model section might be appropriate to describe the details.

Separate mode page per command alternative

18.1 SCSI mode parameters

Table 69 - Mode page codes for the SCSI parallel interface

Page code	Description	Subclause
02h	Disconnect-reconnect page	18.1.2
15h	*SPI Margin Control page*	*18.1.x*
16h	*SPI Deskew values page*	*18.1.x*
17h	*SPI AAF values page*	*18.1.x*
18h	*SPI* Logical Unit Control page	18.1.3
19h	*SPI* Port Control page	18.1.4

[all new text follows:]

18.x Margin Control page

The Margin Control mode page (see table xx) contains parameters that set and report margin control values for usage between the initiator-target pair on subsequent synchronous (??) and paced transfers. The page shall be implemented by LUN 0 of all SPI SCSI devices. The page shall not be implemented by logical units other than LUN 0. The implementation of any parameter and its associated functions is optional. The page follows the MODE SENSE / MODE SELECT rules specified by the SCSI Primary Commands-2 standard.

Only values for the devices participating in the current I_T connection are set and reported.

These parameter settings shall remain in effect until changed by another MODE SENSE command or by a reset condition.

The Margin Control page is shown in table X.

Table X — Margin Control page (15h)

Bit / Byte	7	6	5	4	3	2	1	0
0	USED	Reserved				D_CLASS		
1	DRIVER STRENGTH				Reserved			
2	SIGNAL GROUND BIAS				DRIVER PRECOMPENSATION			
3	SLEW RATE				Reserved			
4	Reserved				Reserved			
5	Reserved				Reserved			
6	Reserved				Reserved			
7	Vendor specific				Vendor specific			
8	Reserved							
9	Reserved							
10	Reserved							
11	Reserved							
12	Reserved							
13	Reserved							
14	Reserved							
15	Reserved							

The D_CLASS field shall be set to 011b. This field matches the D_CLASS field in ECP commands.

Two sets of margin control fields (DRIVER STRENGTH, SIGNAL GROUND BIAS, DRIVER PRECOMPENSATION, and SLEW RATE) are provided, one set for the near port and another set for the far port. If the first SEDB is used for the initiator settings, only the far port fields are used; the near port fields are reserved.

The margin control fields shall be implemented as two's-complement values with 0000b being the nominal value. The maximum supported setting for each field shall be 0111b and the minimum supported setting for each field shall be 1111b. Up to 16 distinct values are available for each field. Devices that support fewer than 16 distinct values for a field should round non-supported settings to a supported value.

In the case of the SIGNAL GROUND BIAS fields, values 0000b through 0111b shall enable the bias cancellation circuit and values 1000b through 1111b shall disable the bias cancellation circuit, if disabling of this circuit is supported.

The MODE SELECT command shall return the current settings for the initiator-target pair. Fields that are not implemented shall be reported as 0000b.

[REPORT DESKEW VALUES and REPORT AAF VALUES examples skipped]

Overload Port Control page alternative
This alternative preserves page codes by overloading the existing Port Control page. It upgrades a reserved field (that must be 0h in current devices) into a subpage identifier field. If non-zero, it indicates a new page is being used.

[Change bars from the original SPI-4 text are only shown for text that was rewritten, not moved.]

18.1.4 Port Control mode page

18.1.4.1 Port Control mode page overview
The Port Control mode page (see table 73) contains those parameters that select SPI SCSI device port operation options. The page shall be implemented by LUN 0 of all SPI SCSI devices. The page shall not be implemented by logical units other than LUN 0. The implementation of any bit and its associated functions is optional. The page follows the MODE SENSE / MODE SELECT rules specified by SCSI Primary Commands-2 standard.

After a MODE SELECT, parameter settings shall remain in effect until changed by another MODE SELECT command or by a reset condition.

Table 73 - Port Control page (19h)

	7	6	5	4	3	2	1	0
0	PS	Reserved	Page Code (19h)					
1	Page Length ~~(06h)~~							
2	Reserved							
3	*Subpage Identifier*				Protocol Identifier (1h)			
4	*Subpage*							
n								

The PROTOCOL IDENTIFIER field *of 1h* indicates ~~the protocol that~~ this mode page applies to *a SPI SCSI device*. *See SPC-2 for other Port Control page PROTOCOL IDENTIFIERS.* ~~The protocol identifier field has a value of 1h to indicate SPI SCSI devices.~~

The SUBPAGE IDENTIFIER field indicates which subpage shall being written with a MODE SELECT command and which page shall be returned on a subsequent MODE SENSE commands. Subpage Identifier values are listed in table XX.

The PAGE LENGTH field indicates the length of the Port Control page, including the length of the subpage.

Table XX. Subpage Identifier values.

Subpage Identifier	***Port Control Page Length***	***Subpage name***
0h	*8h*	*Synchronous Transfer Timeout*
1h	*14h*	*Margin Control*
2h		*Deskew Values*
3h	*40h*	*AAF Values*
4h – Fh		*Reserved*

[all text that follows is new. Text is taken from:
00-257r3 ECP and 00-378r0 (SPI-4 proposed revision 1 annex G) – MARGIN CONTROL
00-392r0 – REPORT DESKEW VALUES
00-393r0 – REPORT AAF VALUES
Any changes to those documents should be tracked here.
]

18.1.4.2 Synchronous Transfer Timeout subpage

The Synchronous Transfer Timeout subpage is used to set or read the Synchronous Transfer Timeout.

Table xx. Synchronous Transfer Timeout subpage (0h)

Bit Offset	7	6	5	4	3	2	1	0
0	Synchronous Transfer Timeout							
1								
2	Reserved							
3	Reserved							

The SYNCHRONOUS TRANSFER TIMEOUT field indicates the maximum amount of time in 1 millisecond increments that the target shall wait before generating an error by doing an unexpected bus free (see 10.3). The target shall only go to a BUS FREE phase if one of the following events causes the timer, once started, to not reset or reload before expiring.

a) If there is a REQ transition when there are no outstanding REQs waiting for an ACK then load and start the timer.
b) If there is a REQ transition when there are any outstanding REQs waiting for an ACK then there is no effect on the timer.
c) If there is an ACK transition when there are outstanding REQs waiting for an ACK then load and start the timer.
d) If after an ACK transition there are no outstanding REQs waiting for an ACK then stop the timer.

A SYNCHRONOUS TRANSFER TIMEOUT field value of 0000h indicates that the function is disabled. A value of FFFFh indicates an unlimited period.

18.1.4.3 Margin Control subpage

The Margin Control subpage (see table xx) contains parameters that set and report margin control values for usage between the initiator-target pair on subsequent synchronous (??) and paced transfers.

The Margin Control subpage is shown in table X.

Table X — Margin Control subpage (1h)

Bit Offset	7	6	5	4	3	2	1	0
0	USED	Reserved				D_CLASS		
1	DRIVER STRENGTH				Reserved			
2	SIGNAL GROUND BIAS				DRIVER PRECOMPENSATION			
3	SLEW RATE				Reserved			
4	Reserved				Reserved			
5	Reserved				Reserved			
6	Reserved				Reserved			
7	Vendor specific				Vendor specific			
8	Reserved							
9	Reserved							
10	Reserved							
11	Reserved							
12	Reserved							
13	Reserved							
14	Reserved							
15	Reserved							

The D_CLASS field shall be set to 011b. This field matches the D_CLASS field in ECP commands.

Two sets of margin control fields (DRIVER STRENGTH, SIGNAL GROUND BIAS, DRIVER PRECOMPENSATION, and SLEW RATE) are provided, one set for the near port and another set for the far port. If the first SEDB is used for the initiator settings, only the far port fields are used; the near port fields are reserved.

The margin control fields shall be implemented as two's-complement values with 0000b being the nominal value. The maximum supported setting for each field shall be 0111b and the minimum supported setting for each field shall be 1111b. Up to 16 distinct values are available for each field. Devices that support fewer than 16 distinct values for a field should round non-supported settings to a supported value.

In the case of the SIGNAL GROUND BIAS fields, values 0000b through 0111b shall enable the bias cancellation circuit and values 1000b through 1111b shall disable the bias cancellation circuit, if disabling of this circuit is supported.

The MODE SELECT command shall return the current settings for the initiator-target pair. Fields that are not implemented shall be reported as 0000b.

18.1.4.4 Deskew Values subpage

The DESKEW VALUES subpage is used to report the device's paced data transfer deskew values. These values are part of the saved training configuration values maintained by the device (see 18.8.4.2.1), representing the amount of deskew delay applied between the clock signal and each data signal.

The DATA OUT deskew values are from ACK to each data bit, only applicable during DATA OUT phases. The DATA IN deskew values are from REQ to each data bit, only applicable during DATA IN phases. These values are only used when the device is acting as an initiator.

Devices shall use the TARGET fields for their target deskew values. Devices that support initiator mode shall use the INITIATOR fields for their initiator deskew values.

The meaning of the fields is vendor-specific. For example, the fields could contain 8-bit signed values indicating the number of steps (e.g. 250 ps steps) of delay added to the clock (REQ or ACK) for each data bit. Certain values may be used to indicate errors (e.g. 80h (-128 if interpreted as signed) to indicate the skew was too large for the deskew circuitry to correct).

The data structure for this subpage shall include fields described in table xx.

Table xx — Deskew Values subpage (2h)

Bit Offset	7	6	5	4	3	2	1	0
0	RESERVED							
1	RESERVED							
2	RESERVED							
3	RESERVED							
4	TARGET DB[0] DESKEW VALUE							
…	…							
19	TARGET DB[15] DESKEW VALUE							
20	TARGET P1 DESKEW VALUE							
21	TARGET P_CRCA DESKEW VALUE							
22	INITIATOR DB[0] DESKEW VALUE							
	…							
37	INITIATOR DB[15] DESKEW VALUE							
38	INITIATOR P1 DESKEW VALUE							
39	INITIATOR P_CRCA DESKEW VALUE							

18.1.4.5 AAF VALUES subpage

The AAF VALUES subpage is used to report the device's paced data transfer AAF values. These values are part of the saved training configuration values maintained by the device (see 18.8.4.2.1), representing vendor-specific values.

[Editor's note: we could call this "VENDOR-SPECIFIC (or ADDITIONAL) TRAINING CONFIGURATION VALUES" to avoid using the term AAF.]

Devices shall use the TARGET fields for their deskew values used during DATA OUT phases in Devices that support initiator mode shall use the INITIATOR fields for their deskew values used during DATA IN phases in initiator mode.

The meaning of the fields is vendor-specific.

The data structure for this function shall include function specific fields described in table G.12x.

Table G.12x — AAF VALUES subpage

Bit Offset	7	6	5	4	3	2	1	0
0	RESERVED							
1	RESERVED							
2	RESERVED							
3	RESERVED							
4	TARGET DB[0] AAF VALUE							
…	…							
19	TARGET DB[15] AAF VALUE							
20	TARGET P1 AAF VALUE							
21	TARGET P_CRCA AAF VALUE							
22	TARGET BSY AAF VALUE							
23	TARGET SEL AAF VALUE							
24	TARGET RST AAF VALUE							
25	TARGET REQ AAF VALUE							
26	TARGET ACK AAF VALUE							
27	TARGET ATN AAF VALUE							
28	TARGET CD AAF VALUE							
29	TARGET IO AAF VALUE							
30	TARGET MSG AAF VALUE							
31	RESERVED							
32	INITIATOR DB[0] AAF VALUE							
…	…							
47	INITIATOR DB[15] AAF VALUE							
48	INITIATOR P1 AAF VALUE							
49	INITIATOR P_CRCA AAF VALUE							
50	INITIATOR BSY AAF VALUE							
51	INITIATOR SEL AAF VALUE							
52	INITIATOR RST AAF VALUE							
53	INITIATOR REQ AAF VALUE							
54	INITIATOR ACK AAF VALUE							
55	INITIATOR ATN AAF VALUE							
56	INITIATOR CD AAF VALUE							
57	INITIATOR IO AAF VALUE							
58	INITIATOR MSG AAF VALUE							
59	RESERVED							