To: T10 Technical Committee
From: Rob Elliott, Compaq Computer Corporation (Robert.Elliott@compaq.com)
Date: 1 November 2000
Subject: Mode pages equivalents for ECP commands

Revision history
Revision 0, 25 Oct 2000: first revision

Revision 1, 30 Oct 2000: Removed Deskew and AAF commands from this proposal (00-392r1 for the replacement) – this just leaves Margin Control and the general concept. Selected the overloaded Port Control page alternative and deleted the others. Added a bit in PPR that must be used to maintain margin control settings through negotiation.

Revision 2, 31 Oct 2000: Moved subpage code into the CDB for MODE SENSE and into a new mode page header for MODE SELECT. Added suggested changes to SPC-3 as well as SPI-4 to generalize this concept, with input from Ralph Weber (ENDL).

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 proposed letting targets understand ECP commands themselves, allowing margin control and margin reporting to be implemented via the same mechanism used for expanders.

00-392r1 proposes a REPORT SAVED TRAINING CONFIGURATION VALUES command for ECP. Its predecessors were 00-392r0 and 00-393r0 which proposed REPORT DESKEW VALUES and REPORT AAF values.

Overview
This proposal suggests implementing margin control related commands in targets with 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 be defined as protocol-specific, so other protocols can reuse the pages.

Since mode page codes are sparse, the new pages are implemented as subpages of the existing Port Control mode page (19h). A field is added to the existing page that indicates which sub-page is being written with MODE SELECT and which sub-page is being returned on a subsequent MODE SENSE. This causes the page to assume different lengths based on the subpage code.

This alternative upgrades a reserved field (that must be 0h in current devices) into a subpage identifier field. If zero, it maps to the current structure. 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

[subsections added]

18.1.4.1 Port Control mode page overview

The Port Control mode page (see table 73 and 73x) 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. An independent set of parameters shall be maintained for each initiator. The parameters saveable bit in the mode page format header returned with MODE SENSE shall be set to zero (except for the Synchronous Transfer Timeout field), indicating the parameters are not saved through resets.

After a MODE SELECT, parameter settings shall remain in effect until either:

a) Settings are changed by another MODE SELECT command,
b) a reset condition occurs,
c) an SDTR negotiation completes,
d) a WDTR negotiation completes, or
e) a PPR negotiation completes without the MAINTAIN MARGIN CONTROL SETTINGS bit set to one.

~~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~~	~~Reserved~~				~~Protocol Identifier (1h)~~			
~~4~~	~~Subpage~~							
~~...~~								
~~n~~								

The short page format of the port control page is used for subpage 00h. The long page format is used for subpages 01h – FEh.

Table 73 — Port control page – short page format

	7	6	5	4	3	2	1	0
0	PS	LONG (0)	Page Code (19h)					
1	Page Length (n-1)							
2	Reserved							
3	Reserved				PROTOCOL IDENTIFIER			
4	subpage-specific mode parameters							
...								
n								

Table 73x — Port control page – long page format

	7	6	5	4	3	2	1	0
0	PS	LONG (1)	Page Code (19h)					
1	Subpage Code							
2	Page Length (n-1)							

3		
4	Reserved	
5	Reserved	PROTOCOL IDENTIFIER
6	subpage-specific mode parameters	
…		
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 CODE field indicates which subpage is being accessed. Subpage code values are listed in table XX.

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

[long pages are 6 + length, short page is 4 + length]

Table XX. Subpage Identifier values.

Subpage Code	Port Control Page Length	Subpage name
00h	8h	Synchronous Transfer Timeout [existing]
01h	16h	Margin Control [this proposal]
02h	EAh	Saved Training Configuration Values [see 00-392r1]
03h	0Eh+	Current Settings [see 00-397r1]
04h – DFh	Vendor-specific	Vendor-specific
E0h – FEh		Reserved

[all text that follows is new, shown without change bars. Margin Control text is taken from 00-257r3 ECP and 00-378r0 (SPI-4 proposed revision 1 annex G). Any changes to those documents should be tracked here.]

18.1.4.2 Synchronous Transfer Timeout subpage

The Synchronous Transfer Timeout subpage (see table xx) is used to set or read the Synchronous Transfer Timeout.

[append this data structure to the short mode page format header]

Table xx. Synchronous Transfer Timeout subpage (00h)

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 x) contains parameters that set and report margin control values for usage between the initiator-target pair on subsequent synchronous and paced transfers.

[append this data structure to the long mode page format header]

Table X — Margin Control subpage (01h)

Bit Offset	7	6	5	4	3	2	1	0
0	RSVD	Reserved				RSVD		
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 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~~1000b. Up to 16 distinct values are available for each field, representing monotonically changing device response. Devices that support fewer than 16 distinct values for a field should round non-supported settings to a supported value.
[make the same editorial changes in annex G]
[an additional proposal is expected to define the field names used in both ECP and this mode page. E.g. what is driver strength?]

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.

Section 16.3.10 PARALLEL PROTOCOL REQUEST

Add bit 3 – MAINTAIN MARGIN CONTROL SETTINGS

A MAINTAIN MARGIN CONTROL SETTINGS bit of zero indicates that the target shall reset to their default values any margin control settings set with the Margin Control subpage of the Port Control mode page (see 18.1.4.3). A MAINTAIN MARGIN CONTROL SETTINGS bit of one indicates that the target shall maintain any margin control settings set with the Margin Control subpage.

Section 16.3.14 SYNCHRONOUS DATA TRANSFER REQUEST
In Table 60, to this existing description:
Synchronous transfer (i.e., Each SCSI device transmits data with a transfer period equal to or greater than, and a REQ/ACK offset equal to or less than, the values received in the other device's SDTR message) with ST DATA IN and ST DATA OUT phases. Any protocol options shall no longer be in effect (see 16.3.10).

Add: , and any margin control settings set with the Margin Control subpage (see 18.1.4.3) shall be reset.

Section 16.3.16.1 WIDE DATA TRANSFER REQUEST
To this existing text:
c) if both WDTR messages are not rejected with a MESSAGE REJECT message the WDTR message shall cause a reset of the synchronous transfer agreement to asynchronous mode and any protocol options shall no longer be in effect (i.e., DT DATA phase, paced transfers, information unit transfers, data group transfers, and QAS are disabled) (see 16.3.10).

Add: , and any margin control settings set with the Margin Control subpage (see 18.1.4.3) shall be reset.

SPC-n Changes
The concept of subpages requires changes for SPC-3. Text is based on SPC-2 revision 18a.

The MODE SELECT CDB does not contain a page code; that is sent as part of the parameter data (more than one page may be written at a time).

The MODE SENSE CDB does contain a page code indicating the single page to read. Page code 3Fh is used to read all pages. Similarly, subpage code FFh is used to read all subpages for the selected page code.

This proposal casts each existing mode page as subpage 00h of that page.

A new mode page format header is added for subpages 01h – FEh. This includes the subpage number and has a two byte length field. Subpage 00h is still limited to the old header with a one byte length field. Subpages E0h – FDh are vendor-specific.

7.11 MODE SENSE (6) command
…

Table 69 – MODE SENSE (6) command

	7	6	5	4	3	2	1	0
0	Operation code (1Ah)							
1	Reserved				DBD	Reserved		
2	PC		PAGE CODE					
3	~~Reserved~~SUBPAGE CODE							
4	ALLOCATION LENGTH							
5	CONTROL							

…

The PAGE CODE and SUBPAGE CODE fields specifyies which mode page(s) and subpage(s) to return. Mode page code usage is defined in table 71.

Table 71 – Mode page code usage for all devices

Page Code	Subpage Code	Description
00h	Vendor-specific	Vendor-specific (does not require page format)
01h – 1Fh	00h	See specific device-types (short page format)
	01h – DFh	See specific device types (long page format)
	E0h – FEh	Vendor-specific (long page format)
	FFh	Return all subpages for the specified device-specific page (short page format for page 00h and long page format for pages 01h - FEh)
20h – 3Eh	00h	Vendor-specific (short page format required)
	01h – FEh	Vendor-specific (long page format required)
	FFh	Return all subpages for the specified vendor-specific page (short page format for page 00h and long page format for pages 01h - FEh)
3Fh	00h	Return ~~all~~ subpage 00h for all mode pages (short page format)
	01h – FEh	Reserved
	FFh	Return all subpages for all mode pages (short page format for page 00h and long page format for pages 01h - FEh)

An application client may request any one or all of the supported mode pages from the device server. If an application client issues a MODE SENSE command with a page code or subpage code value not implemented by the target, the device server shall return CHECK CONDITION status and shall set the sense key to ILLEGAL REQUEST and the additional sense code to INVALID FIELD IN CDB.

[REMOVE THIS PARAGRAPH:]
A page code of 3Fh and a subpage code of 00h indicates that ~~all~~ subpage 00h for all mode pages implemented by the target shall be returned to the application client. A page code of 3Fh and a subpage code of 01h - FEh indicates that all subpages for all mode pages implemented by the target shall be returned to the application client. A page code of 3Fh and a subpage code of FFh indicates that all subpages of all mode pages implemented by the target shall be returned by the application client. A page code of 00h – 3Eh and a subpage code of FFh indicates that all subpages of the specified mode page implemented by the target shall be returned by the application client.[break paragraph here]
[perhaps the above paragraph should be removed, as the previous table contains all this information]

If the mode parameter list exceeds 256 bytes for a MODE SENSE(6) command or 65 536 bytes for a MODE SENSE(10) command, the device server shall return CHECK CONDITION status and the sense key shall be set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.

Mode page 00h, if implemented, shall be returned after all other mode pages.

7.12 MODE SENSE(10) command

…

Table 72 – MODE SENSE (10) command

	7	6	5	4	3	2	1	0
0	Operation code (5Ah)							
1	Reserved			LLBA	DBD	Reserved		
2	PC		PAGE CODE					

3	~~Reserved~~SUBPAGE CODE
4	Reserved
5	Reserved
6	Reserved
7	ALLOCATION LENGTH
8	
9	CONTROL

8.3.5 Mode page format and page codes

The short mode page format is defined in table 159. The long mode page format is defined in table 159x.

Table 159 — Short m~~M~~ode page format

	7	6	5	4	3	2	1	0
0	PS	~~Rsvd~~LONG (0)	PAGE CODE					
1	PAGE LENGTH (n – 1)							
2	Mode parameters							
n								

Table 159 — Long mode page format

	7	6	5	4	3	2	1	0
0	PS	LONG (1)	PAGE CODE					
1	SUBPAGE CODE							
2	PAGE LENGTH (n – 1)							
3								
4	Mode parameters							
n								

A LONG field of one indicates the Long mode page format is being used. A LONG field of zero indicates the Short mode page format is being used.

Each mode page contains a PAGE CODE field, a PAGE LENGTH field, and a set of mode parameters. The page codes are defined in this clause and in the mode parameter clauses in the command standard (see 3.1.12) for the specific device type. Each mode page with a LONG bit equal to one contains a SUBPAGE CODE field.

When using the MODE SENSE command, a parameters savable (PS) bit of one indicates that the mode page may be saved by the target in a non-volatile, vendor-specific location. A PS bit of zero indicates that the supported parameters cannot be saved. When using the MODE SELECT command, the PS bit is reserved.

The PAGE CODE field identifies the format and parameters defined for that mode page. Some page codes are defined as applying to all device types and other page codes are defined for the specific device type. The page codes that apply to a specific device type are defined in the command standard (see 3.1.12) for that device type.

When using the MODE SENSE command, if page code 00h (vendor-specific page) is implemented, the device server shall return that page last in response to a request to return all pages (page code 3Fh). When using the MODE SELECT command, this page should be sent last.

The PAGE LENGTH field specifies the length in bytes of the mode parameters that follow. If the application client does not set this value to the value that is returned for the page by the MODE SENSE command, the device server shall terminate the command with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST with the additional sense code set to INVALID FIELD IN PARAMETER LIST. The target is permitted to implement a mode page that is less than the full page length defined in this standard, provided no field is truncated and the PAGE LENGTH field correctly specifies the actual length implemented.

The mode parameters for each page are defined in the following clauses, or in the mode parameters clause in the command standard (see 3.1.12) for the specific device type. Mode parameters not implemented by the target shall be set to zero.

Table 160 defines the mode pages that are applicable to all device types that include the MODE SELECT and MODE SENSE commands.

Table 160 – Mode page codes

Page code	Description	Clause
0Ah	Control mode page	8.3.6
02h	Disconnect-reconnect mode page	8.3.7
15h	Extended mode page	8.3.x
16h	Extended device-type specific mode page	8.3.x
17h	Reserved	
1Ch	Informational exceptions control page	8.3.8
09h	Obsolete	3.3.7
1Ah	Power condition code	8.3.9
18h	Protocol specific LUN page	8.3.10
19h	Protocol specific port page	8.3.11
01h	(See specific device type)	
03h – 08h	(See specific device type)	
0Bh – ~~17h~~14h	(See specific device type)	
1Bh	(See specific device type)	
1Dh – 1Fh	(See specific device type)	
00h	Vendor-specific (does not require page format)	
20h – 3Eh	(See specific device type)	
3Fh	(valid only for the MODE SENSE command) Returns multiple pages and/or subpages~~return specified subpage for all pages (valid only for the MODE SENSE command)~~	7.11.

[this is the first page that needs to be expanded.]

8.3.11 Protocol specific port page

The protocol specific port page (see table 173 and table 174) provides protocol-specific controls that are associated with a port. The short page format is used for subpage 00h and the long page format is used for subpages 01h – FEh. See the protocol standard (see 3.1.41) for definition of the protocol-specific mode parameters.

Table 173 — Protocol specific port page – short page format

	7	6	5	4	3	2	1	0
0	PS	~~Reserved~~ LONG (0)	Page Code (19h)					
1	Page Length (n-1)							
2	Reserved							
3	Reserved				PROTOCOL IDENTIFIER			

4	Protocol-specific mode parameters
…	
n	

Table 173 — Protocol specific port page – long page format

	7	6	5	4	3	2	1	0
0	PS	LONG (1)	Page Code (19h)					
1	Subpage Code							
2	Page Length (n-1)							
3								
4	Reserved				PROTOCOL IDENTIFIER			
5	Protocol-specific mode parameters							
…								
n								

[Subpages can be added to any existing page using these structures. Two new pages are suggested to use up 2/3 of the remaining mode page codes, providing a generic location to put new mode pages (as subpages).]

8.3.xx Extended mode page

The extended mode page (see table xx) provides a means to access subpages.defined for all device types. Subpage 00h is reserved, so only the long mode page format is used.

Table xx — Extended mode page

	7	6	5	4	3	2	1	0
0	PS	LONG (1)	PAGE CODE (15h)					
1	SUBPAGE CODE							
2	PAGE LENGTH (n – 1)							
3								
4	Subpage-specific parameters							
n								

8.3.xx Extended device-specific mode page

The extended device-specific mode page (see table xx) provides a means to access subpages.defined differently for each device type. Subpage 00h is reserved, so only the long mode page format is used.

Table xx — Extended device-specific mode page

	7	6	5	4	3	2	1	0
0	PS	LONG (1)	PAGE CODE (16h)					
1	SUBPAGE CODE							
2	PAGE LENGTH (n – 1)							
3								
4	Subpage-specific parameters							
n								

[Add page codes 15h and 16h to Annex C]

[Two more comments by Ralph Weber:]
[How about for these two special pages having subpage 0 contain a list of supported subpages? It's tough to give subpage 0 any other generally useful meaning. This could be added later given that page 00h is reserved.]

[I should note that under these rules we could have subpages on the Control mode page (for example). So, maybe page code 15h isn't so very important.]