

To: T10 Technical Committee
From: Bob Sheffield(robert.l.sheffield@intel.com)
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Subject: 06-291r0: SAT- ATA PASS-THROUGH additional sense code and other clarifications

Revision history

Revision 0 (19 June 2006) First revision

Related documents

SAT-r08 - SCSI / ATA Translation revision 08
06-121r1 SAT-r08_LB_Comment_Resolution.pdf

Overview

Letter ballot comments received for SAT (see 06-121) regarding the clause on SAT-Specific SCSI Extensions were extensive. This proposal is intended to provide the resolution to all the letter ballot comments in clause 11.

Suggested changes

12 SAT-Specific SCSI Extensions

12.1 SAT-Specific SCSI Extensions Overview

This subclause defines additional SCSI commands, mode pages, and log pages that may be supported by a SATL to provide capabilities beyond those defined in the other SCSI command sets.

SCSI commands defined for SATL implementations include:

- a) ATA PASS-THROUGH (12) command; and
- b) ATA PASS-THROUGH (16) command.

Mode pages defined for SATL implementations include:

- a) PATA Control mode page.

12.2 ATA PASS-THROUGH commands

12.2.1 ATA PASS-THROUGH commands overview

This standard provides for an application client to:

- a) transmit an ATA command to an ATA device;
- b) optionally transfer data between the application client and an ATA device; and
- c) transfer completion status from an ATA device through the SATL.

This is accomplished by defining:

- a) CDBs containing ATA command information (see 12.2.2 and 12.2.3); and
- b) specific SCSI status and sense data usage for returning the results of an ATA command (see 12.2.4).

12.2.2 ATA PASS-THROUGH (12) command

Table 92 shows the CDB for the ATA PASS-THROUGH (12) command.

Table 92 — ATA PASS-THROUGH (12) command

Byte\Bit	7	6	5	4	3	2	1	0
0	OPERATION CODE (A1h)							
1	MULTIPLE_COUNT			PROTOCOL				Reserved
2	OFF_LINE	CK_COND	Reserved	T_DIR	BYTE_BLOCK	T_LENGTH		
3	FEATURES (7:0)							
4	SECTOR_COUNT (7:0)							
5	LBA_LOW (7:0)							
6	LBA_MID (7:0)							
7	LBA_HIGH (7:0)							
8	DEVICE							
9	COMMAND							
10	Reserved							
11	CONTROL (see 6.4)(see 6.4)							

[Table 97 shows the mapping between the fields and the ATA PASS-THROUGH \(12\) CDB to corresponding ATA command fields \(see ATA8-ACS\).](#)

If the SATL receives an ATA PASS-THROUGH (12) command it shall check the PROTOCOL field (see table 93) to determine the type of action requested.

Table 93 — PROTOCOL field

Code	Description
0	Hard Reset
1	SRST
2	Reserved
3	Non-data
4	PIO Data-In
5	PIO Data-Out
6	DMA
7	DMA Queued
8	Device Diagnostic
9	DEVICE RESET
10	UDMA Data In
11	UDMA Data Out
12	FPDMA ^a
13, 14	Reserved
15	Return Response Information
^a See SATA 2.5.	

The PROTOCOL field specifies the protocol to use when the ATA device executes the command.

~~ATA/ATAPI~~[ATA8-7-AAM](#) defines the meaning of protocol values ranging from 0 to 11.

A PROTOCOL value in the range from 3 to 12 requests the SATL to send an ATA command to the ATA device.

If the PROTOCOL field contains 15 (i.e., Return Response Information) the SATL shall not access the ATA device, but shall return the ATA Status Return Descriptor as defined in subclause 12.2.5. The SATL shall ignore all other fields in the CDB.

If the value in the PROTOCOL field is inappropriate for the command specified in the COMMAND field (see ~~ATA/ATAPI~~[ATA8-7](#) and [SATA 2.5ACS](#)) the SATL may lose communication with the ATA device, and this standard does not specify the SATL behavior if this occurs.

If the value in the PROTOCOL field is set to zero (i.e., ~~Hard-Hardware~~ Reset) and the attached device is a PATA device, then the SATL shall issue a pin 1 reset to the PATA device (see ~~ATA/ATAPI~~[ATA8-7APT](#)). If the value in the PROTOCOL field is set to zero (i.e., ~~Hard-Hardware~~ Reset) and the attached device is a SATA device, then the SATL shall issue a COMRESET to SATA device. When this protocol is selected, only the PROTOCOL and OFF_LINE fields are valid. The SATL shall ignore all other fields in the CDB.

If the PROTOCOL field is set to one the SATL shall issue a ~~soft-software~~ reset to the ~~attached~~ ATA device (see ~~ATA/ATAPI~~[ATA8-7AAM](#)). When this protocol is selected, only the PROTOCOL and OFF_LINE fields are valid. The SATL shall ignore all other fields in the CDB.

~~Some PROTOCOL values cause the SATL to reset the ATA device or to return information about the ATA device.~~

If the value in the PROTOCOL field requests the SATL to send a command to the ATA device, then the SATL shall ~~use set~~ the ~~FEATURES (7:0), SECTOR_COUNT (7:0), LBA_LOW (7:0), LBA_MID (7:0), LBA_HIGH (7:0), DEVICE-~~ and ~~fields in~~ the ~~ATA~~ command ~~using~~ fields ~~to initiate a command~~ in the ATA device. ~~These fields correspond to the registers defined in ATA/ATAPI~~[PASS-7](#) ~~volume 2 with the same names, and also to the FIS fields defined~~ ~~THROUGH CDB as shown~~ in ~~ATA/ATAPI~~ ~~7~~ ~~volume 3 with the same name~~[table 97](#).

The SATL shall determine if a data transfer is necessary and how to perform the data transfer by examining values in the MULTIPLE_COUNT field, PROTOCOL field, OFF_LINE field, T_DIR bit, BYTE_BLOCK bit, and T_LENGTH field. The SATL shall ignore the COMMAND field in the CDB except to copy the COMMAND field in the CDB to the COMMAND field in the Register – Host to Device FIS or to the ATA Command register. If the ATA command completes with an error, then ~~a copy of the PATA registers, or a copy of SATL shall return the SATA Register—Device to Host FIS shall be returned~~ Error Output fields (see ATA8-ACS) in the ATA Status-Return Descriptor descriptor (see 12.2.5).

The SATL shall configure the ATA host and device for the PIO, DMA, and UDMA speeds that both the SATL and ATA device support. The COMMAND field of the CDB may specify the ATA SET FEATURES command. The ATA PASS-THROUGH (12) command should not be used to issue an ATA SET FEATURES command that changes the PIO/DMA/UDMA or other transfer modes of the ATA device. The result of a SET FEATURES command that changes the PIO/DMA/UDMA or other transfer modes of the ATA device is outside the scope of this standard and may cause communication to be lost with the ATA device; preventing the SATL from performing any action based on the contents of the CDB.

The BYTE_BLOCK (Byte/Block) bit indicates whether the transfer length in the location specified by the T_LENGTH field specifies the number of bytes to transfer or the number of blocks to transfer. If the value in the BYTE_BLOCK bit is set to zero the SATL shall transfer the number of bytes specified in the location specified by the T_LENGTH field. If the value in the BYTE_BLOCK bit is set to one the SATL shall transfer the number of blocks specified in the location specified by the T_LENGTH field. The SATL shall ignore the BYTE_BLOCK bit when the T_LENGTH field is set to zero.

The CK_COND (Check Condition) bit may be used to request the SATL to return a copy of ATA register information in the sense data upon command completion. If the CK_COND bit is set to one the SATL shall return a status of CHECK CONDITION when the ATA command completes, even if the command completes ~~successfully. If the command completes successfully, the SATL shall set the sense key to NO SENSE—successfully~~ and ~~shall set the additional sense code to NO ADDITIONAL SENSE INFORMATION. The SATL shall~~ return the ATA registers and related information in the sense data using the ATA ~~Status-Return Descriptor (see table 12.2.5) descriptor (see 12.2.4). If the CK_COND bit is set to zero, the SATL shall terminate the command with CHECK CONDITION status only if an error occurs in processing the command. See clause 11 for a description of ATA error conditions.~~

~~If the CK_COND bit is set to zero, the SATL shall terminate the command with CHECK CONDITION status only if an error occurs in processing the command. See clause 11 for a description of ATA error conditions. If the CK_COND bit is set to one and the command completes successfully the SATL shall terminate the command with CHECK CONDITION status with a sense key of RECOVERED ERROR and an additional sense code of ATA PASS THROUGH INFORMATION AVAILABLE (see SPC-4) status.~~

The DEVICE field specifies a value for the SATL to load into the ATA DEVICE register or the DEVICE field of the Register - Host to Device FIS. Table 94 shows the bits in the DEVICE field.

Table 94 — ATA PASS-THROUGH (12) command and ATA PASS-THROUGH (16) command DEVICE field

Bit							
7	6	5	4	3	2	1	0
Obsolete	Command Specific	Obsolete	DEV	Command Specific			

~~The SATL shall ignore the DEV bit in the DEVICE field of the CDB. If the ATA host has two devices attached, the SATL may represent them as two distinct logical units or as two distinct SCSI target devices. The SATL shall set the DEV bit in the ATA DEVICE register to the value corresponding to the LUN or SCSI target port for each ATA device.~~

The SATL shall ignore the DEV bit in the DEVICE field of the CDB.

The SATL shall set the value of the DEV bit in the ATA device register based upon the mapping of ATA devices to I T L nexuses.

The SATL shall set the ATA host registers or construct the Register - Host to Device FIS using the values from the CDB in the FEATURES (7:0) field, the SECTOR_COUNT (7:0) field, the LBA_LOW (7:0) field, the LBA_MID (7:0) field, the LBA_HIGH (7:0) field, the DEVICE field, and the COMMAND field.

If the PROTOCOL field specifies a PIO data transfer, the SATL shall perform a PIO type transfer. The MULTIPLE_COUNT field specifies the ~~power logarithm base 2 of two for~~ the number of logical sectors ~~transferred a ATA host shall transfer~~ per DRQ Data Block (e.g, if the field is set to 4, the SATL shall transfer 2^4 (i.e., 16) logical sectors of data in each DRQ Data Block). If the MULTIPLE_COUNT field is nonzero and the COMMAND field is not a READ MULTIPLE command, a READ MULTIPLE EXT command, a WRITE MULTIPLE command, a WRITE MULTIPLE EXT command, or a WRITE MULTIPLE FUA EXT command, then the SATL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

The OFF_LINE field specifies the time period during which the ATA Status register and the ATA Alternate Status register may be invalid after command acceptance. In a SATL with a PATA device attached, some commands may cause the PATA device to place the ATA bus in an indeterminate state. This may cause the ATA host to see command completion before the command is completed. When the application client issues a command that is capable of placing the bus in an indeterminate state, it shall set the OFF_LINE field to a value that specifies the maximum number of seconds from the time a command is issued until the ATA Status register is valid. The SATL shall not use the ATA Status register or ATA Alternate Status register to determine ATA command completion status until this time has elapsed. The valid status is available ($2^{\text{off_line}+1} - 2$) seconds (i.e., 0, 2, 6, and 14 seconds) after the command register is stored.

NOTE 1 - If the application client specifies an off_line value that is too small, the results are indeterminate and may compromise the integrity of the data.

If the Transfer Direction (T_DIR) and the direction of the data transfer specified in the PROTOCOL field do not match, the SATL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.

If T_DIR is set to zero the SATL shall transfer from the application client to the ATA device. If T_DIR is set to one the SATL shall transfer from the ATA device to the application client. The SATL shall ignore T_DIR if T_LENGTH is set to zero.

The Transfer Length (T_LENGTH) field specifies where in the CDB the SATL shall locate the transfer length for the command (see table 95). The transfer length is an unsigned integer in the range of 00h to FFh.

Table 95 — T_LENGTH field

Code	Description
00b	No data is transferred
01b	The transfer length is specified in the FEATURES (7:0) field
10b	The transfer length is specified in the SECTOR_COUNT (7:0) field
11b	The transfer length is specified in the STPSIU field

~~The Table 97 shows the mapping from the~~ FEATURES (7:0) field, the SECTOR_COUNT (7:0) field, the LBA_LOW (7:0) field, the LBA_MID (7:0) field, the LBA_HIGH (7:0) field, the DEVICE field, and the COMMAND field ~~shall be copied in the ATA PASS-THROUGH (12) CDB to the corresponding ATA command fields or registers of the same name in the ATA host within the SATL~~ (see [ATA/ATAPI/ATA8-7ACS](#)).

12.2.3 ATA PASS-THROUGH (16) command

Table 96 shows format of the ATA PASS-THROUGH (16) command.

If the EXTEND bit is set to zero, then the FEATURES (15:8) field, the SECTOR_COUNT (15:8) field, the LBA_LOW (15:8) field, the LBA_MID (15:8) field, and the LBA_HIGH (15:8) field shall be ignored by the SATL, and the SATL shall process this command as specified in 12.2.2.

If the EXTEND bit is set to one, then the [FEATURES \(15:8\) field](#), the SECTOR_COUNT (15:8) field, the LBA_LOW (15:8) field, the LBA_MID (15:8) field, and the LBA_HIGH (15:8) field are valid, and the SATL shall process this command as specified in 12.2.2 except as described in the remainder of this subclause.

Table 96 — ATA PASS-THROUGH (16) command

Byte\Bit	7	6	5	4	3	2	1	0
0	OPERATION CODE (85h)							
1	MULTIPLE_COUNT			PROTOCOL				EXTEND
2	OFF_LINE	CK_COND	Reserved	T_DIR	BYTE_BLOCK	T_LENGTH		
3	FEATURES (15:8)							
4	FEATURES (7:0)							
5	SECTOR_COUNT (15:8)							
6	SECTOR_COUNT (7:0)							
7	LBA_LOW (15:8)							
8	LBA_LOW (7:0)							
9	LBA_MID (15:8)							
10	LBA_MID (7:0)							
11	LBA_HIGH (15:8)							
12	LBA_HIGH (7:0)							
13	DEVICE							
14	COMMAND							
15	CONTROL (see 6.4)(see 6.4)							

If the EXTEND bit is set to one and the value in the PROTOCOL field requests the SATL to send an ATA command to the device, then the SATL shall send a 48 bit ATA command to the ATA device. ~~The SATL shall use the FEATURES (7:0) field, the SECTOR_COUNT (7:0) field, the LBA_LOW (7:0) field, the LBA_MID (7:0) field, the LBA_HIGH (7:0) field, the FEATURES (15:8) field, the SECTOR_COUNT (15:8) field, the LBA_LOW (15:8) field, the LBA_MID (15:8) field, the LBA_HIGH (15:8) field, the DEVICE field and the COMMAND field to initiate a command in the ATA device. These fields correspond to the registers defined in ATA/ATAPI-7 volume 2 with the same names, and also to the FIS fields defined in ATA/ATAPI-7 volume 3 with the same names.~~ [Table 97 shows the mapping between the fields and the ATA PASS-THROUGH \(16\) CDB to corresponding ATA command fields \(see ATA8-ACS\).](#)

Table 97 — Mapping of ATA PASS-THROUGH (16) CDB fields to ATA command fields

CDB field	48-bit ATA command field	28-bit ATA command field
FEATURES (15:8)	Features (15:8)	n/a
FEATURES (7:0)	Features (7:0)	Features (7:0)
SECTOR_COUNT (15:8)	Count (15:8)	n/a
SECTOR_COUNT (7:0)	Count (7:0)	Count (7:0)
LBA_LOW (15:8)	LBA (31:24)	n/a
LBA_LOW (7:0)	LBA (7:0)	LBA (7:0)
LBA_MID (15:8)	LBA (39:32)	n/a
LBA_MID (7:0)	LBA (15:8)	LBA (15:8)
LBA_HIGH (15:8)	LBA (47:40)	n/a
LBA_HIGH (7:0)	LBA (23:16)	LBA (23:16)
DEVICE (7:4)	Device (7:4)	Device (7:4)
DEVICE (3:0)	Device (3:0)	LBA (27:24)
COMMAND	Command	Command

See 12.2.2 for a description of the MULTIPLE_COUNT field, the PROTOCOL field, the OFF_LINE field, the CK_COND bit, the T_DIR bit, and the BYTE_BLOCK bit.

The SATL shall determine the transfer length by the method specified in the T_LENGTH field (see table 98). If EXTEND bit is set to zero, the transfer length shall be an unsigned integer in the range from 00h to FFh. If EXTEND bit is set to one, the transfer length shall be an unsigned integer in the range from 0000h to FFFFh.

Table 98 — EXTEND bit and T_LENGTH field

EXTEND	T_LENGTH	Description
0b	00b	No data is transferred.
	01b	The transfer length is specified in the FEATURES (7:0) field.
	10b	The transfer length is specified in the SECTOR_COUNT (7:0) field.
	11b	The transfer length is specified in the STPSIU field.
1b	00b	No data is transferred.
	01b	The transfer length is specified in the FEATURES (7:0) field and the FEATURES (15:8) field.
	10b	The transfer length is specified in the SECTOR_COUNT (7:0) field and the SECTOR_COUNT (15:8) field.
	11b	The transfer length is specified in the STPSIU field.

12.2.4 ATA PASS-THROUGH status return

Table 100 shows the possible results of ATA PASS-THROUGH (12) command or ATA PASS-THROUGH (16) command processing depending on the value of the CK_COND bit in the CDB, as reflected in the ~~ATA_ERR_ERR~~ bit and ~~DF_DF~~ bit in the ~~ATA STATUS register or in the STATUS_HI_STATUS~~ field ~~and the STATUS_LO field of the SATA Set Device Bits—Device to Host FIS~~.

Table 99 — ATA command results

ATA_ERR	DF	sense data returned
zero	zero	No error, successful completion or command in progress. If the CK_COND bit is set to zero in the ATA PASS-THROUGH (12) command or the ATA PASS-THROUGH (16) command, then the SATL shall respond to a REQUEST SENSE command and shall return sense data with the sense key set to NO SENSE with the additional sense code set to NO ADDITIONAL SENSE INFORMATION. If the CK_COND bit is set to one in the ATA PASS-THROUGH (12) command or the ATA PASS-THROUGH (16) command, then the SATL shall terminate the command with CHECK CONDITION status with the sense key set to NO SENSE with the additional sense code set to ATA PASS-THROUGH INFORMATION AVAILABLE (see SPC-4). The sense data shall include the ATA Status Return Descriptor.
zero	one	The command was not accepted or otherwise failed to complete successfully. The SATL shall terminate the command with CHECK CONDITION status with the additional sense code set to ATA PASS-THROUGH INFORMATION AVAILABLE. The sense data shall include the ATA Status Return Descriptor.
one	zero	
one	one	Undefined

Table 100 — ATA command results

CK_COND	ERR	DF	sense data returned
zero	zero	zero	No error, successful completion or command in progress. The SATL shall respond to a REQUEST SENSE command and shall return sense data with the sense key set to NO SENSE with the additional sense code set to NO ADDITIONAL SENSE INFORMATION.
one			No error, successful completion or command in progress. The SATL shall terminate the command with CHECK CONDITION status with the sense key set to RECOVERED ERROR with the additional sense code set to ATA PASS-THROUGH INFORMATION AVAILABLE (see SPC-4). The sense data shall include the ATA Status Return Descriptor.
n/a	n/a	one	The ATA command was not accepted or otherwise failed to complete successfully. The SATL shall terminate the command with CHECK CONDITION status with the sense key and additional sense code set as described in clause 11 and the sense data shall include the ATA Status Return Descriptor (see 12.2.5).
	one	zero	

If the sense data is provided in response to an ATA PASS-THROUGH (12) command or ATA PASSTHROUGH (16) command in which the CK_COND bit was set to one, then the SATL shall set the additional sense code to ATA PASS- THROUGH INFORMATION AVAILABLE (see SPC-4), and shall include the ATA Status Return Descriptor (see 12.2.5) in the sense data.

NOTE 2 -This capability allows the host to retrieve the ATA register or field information with successful command completion by returning data in the ATA registers or fields.

Some ATA commands return information in the registers. ATA Register information may be retrieved by requesting the ATA Status Return Descriptor issuing the ATA PASS-THROUGH (12) command or ATA PASS-THROUGH (16) command with the PROTOCOL field set to 15 (i.e., Return Response Information).

12.2.5 ATA ~~Status-Return Descriptor~~descriptor

Table 101 shows the format of the ATA ~~Status-Return Descriptor~~descriptor returned in the sense data (see SPC-3 and SAM-3). The SATL shall return the ATA ~~Status-Return Descriptor~~descriptor if the PROTOCOL field in the ATA PASS-THROUGH (12) command or ATA PASS-THROUGH (16) command is set to 15 (i.e., Return Response Information).

The SATL shall support the ATA ~~Status-Return Descriptor~~descriptor if the SATL supports the ATA PASSTHROUGH (12) command or the ATA PASS-THROUGH (16) command. Each time the ATA ~~Status-Return Descriptor~~descriptor is requested; the SATL shall read the ATA registers and return those values in the sense data as shown in table 101. If the sense data is for an ATA PASS-THROUGH (12) command or for the ATA PASS-THROUGH (16) command with the EXTEND bit set to zero the SATL shall return the 28-bit extended status and shall set the EXTEND bit to zero. If the sense data is for an ATA PASS-THROUGH (16) command with the EXTEND bit set to one the SATL shall return the 48-bit extended status and shall set the EXTEND bit to one.

Table 101 — ~~Extended-ATA Status-Return Descriptor~~descriptor

Byte\Bit	7	6	5	4	3	2	1	0
0	DESCRIPTOR CODE (09h)							
1	ADDITIONAL DESCRIPTOR LENGTH (0Ch)							
2	Reserved							EXTEND
3	ERROR							
4	SECTOR_COUNT (15:8)							
5	SECTOR_COUNT (7:0)							
6	LBA_LOW (15:8)							
7	LBA_LOW (7:0)							
8	LBA_MID (15:8)							
9	LBA_MID (7:0)							
10	LBA_HIGH (15:8)							
11	LBA_HIGH (7:0)							
12	DEVICE							
13	STATUS							

If the EXTEND bit is set to one the SECTOR_COUNT (7:0) field and SECTOR_COUNT (15:8) field specify the ATA Sector Count. If the EXTEND bit is set to zero the SECTOR_COUNT (7:0) field specifies the ATA Sector Count and SECTOR_COUNT (15:8) field shall be ignored.

If the EXTEND bit is set to one the LBA_LOW (7:0) field, LBA_MID (7:0) field, LBA_HIGH (7:0) field, LBA_LOW (15:8) field, LBA_MID (15:8) field, and LBA_HIGH (15:8) field specify the ATA LBA. If the EXTEND bit is set to zero the LBA_LOW (7:0) field, LBA_MID (7:0) field, and LBA_HIGH (7:0) field specify the ATA LBA, and the LBA_LOW (15:8) field, LBA_MID (15:8) field, and LBA_HIGH (15:8) field shall be ignored.

12.3 SAT-specific mode pages

12.3.1 SAT-specific mode pages overview

This subclause describes mode pages that the SATL may implement that are unique to the SCSI – ATA translation environment. These mode pages are for use by the SATL and are shown in table 102 and

described in this subclause. Support for these mode pages is optional. A SATL should support the appropriate mode page for the attached ATA environment (e.g., PATA).

Table 102 — SCSI - ATA Translation specific mode pages

PAGE CODE	SUB PAGE CODE	Page name
0Ah	F1h	PATA Control Mode Page
0Ah	F2h	Reserved for SAT

12.3.2 PATA Control Mode Page (Page 0Ah, Sub Page F1h)

The PATA Control mode page provides PATA specific controls for a SATL to configure the underlying PATA host and to understand what parameters are communicated to the PATA device to ensure proper communication for specific transfer rates. This standard specifies the mode parameters that are provided for this mode page.

SATL implementations that support the attachment of PATA devices shall support this mode page when requested through MODE SENSE command. SATL implementations should allow application clients to configure alternate PATA timings using the MODE SELECT command.

Table 103 — PATA Control mode page

Byte\Bit	7	6	5	4	3	2	1	0
0	PS	SPF (1b)	PAGE CODE (0Ah)					
1	SUBPAGE CODE (F1h)							
2	(MSB)	PAGE LENGTH (4h)						(LSB)
3								
4	Reserved	MWDMA ^a field			Reserved		PIO ^b field	
		MWD2	MWD1	MWD0			PIO4	PIO3
5	Reserved	UDMA ^c field						
		UDMA6	UDMA5	UDMA4	UDMA3	UDMA2	UDMA1	UDMA0
6	Reserved							
7	Reserved							

^a MWDMA stands for Multi-Word Direct Memory Access and the MWDx bits specify a number of hardware-assisted data transfer modes defined in [ATA/ATAPIATA8-7APT](#).

^b PIO stands for Programmed Input and Output and the PIOx bits specify transfer modes performed under program control defined in [ATA/ATAPIATA8-7APT](#).

^c UDMA stands for Ultra Direct Memory Access and the UDMAX bits represent a number of hardware-assisted data transfer modes defined in [ATA/ATAPIATA8-7APT](#).

The parameters saveable (PS) bit is defined in SPC-3.

The SPF bit (see SPC-3) shall be set to one to access this mode page.

The PAGE CODE field shall be set to 0Ah.

The SUBPAGE CODE field shall be set to F1h.

SATL implementations may save the state of the timing parameters defined in this mode page. However, SATL implementations shall not use any saved parameters to configure the ATA host timing modes to an illegal configuration for the attached PATA device.

Application clients may use the MODE SENSE command for changeable values to determine the underlying ATA host support for a given ATA timing mode. The SATL shall support changeable mode parameters for this mode page.

When processing a MODE SENSE command, the SATL shall set the PIO3 bit and PIO4 bit as shown table 104 to identify the configured PIO mode.

Table 104 — PIO modes

PIO3	PIO4	PIO mode
0	0	Reserved
0	1	The ATA host shall use PIO mode 3 transfers.
1	0	The ATA host shall use PIO mode 4 transfers.
1	1	Reserved

When changeable values are requested, the PIO3 bit and the PIO4 bit indicate if the underlying ATA host supports those transfer modes. The PIO3 bit shall be set to one if the ATA host support PIO mode 3. The PIO3 bit and the PIO4 bit shall be set to one if the ATA host supports PIO mode 4.

If the SATL receives a MODE SELECT command and the PIO field indicates a change from the current setting, the SATL shall configure the ATA host to use the new PIO transfer rate, if supported. The application client shall not request a PIO mode setting that the ATA device is unable to support. If the application client requests a PIO setting that the ATA device is unable to support the SATL shall return a CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

The MWD0 bit, the MWD1 bit, and the MWD2 bit are collectively referred to as the MWDMA field. If the ATA host in the SATL is currently configured to use multi word DMA (MWDMA) the MWDMA field is used to determine what mode is currently being used, what modes are supported by the ATA host, and control of the MWDMA mode.

If the SATL receives a MODE SENSE command requesting the current values of the PATA Control mode page, the MWD0 bit shall be set to one by the SATL when the host and device are configured to use MWDMA mode 0. The MWD1 bit shall be set to one by the SATL when the host and device are configured to use MWDMA mode1. The MWD2 bit shall be set to one by the SATL when the host and device are configured to use MWDMA mode 2.

If the SATL receives a MODE SENSE command requesting the changeable values of the PATA Control mode page, the MWD0 bit shall be set to one if the ATA host supports MWDMA mode 0. The MWD1 bit and MWD0 bit shall each be set to one if the ATA host supports MWDMA mode 1. The MWD2 bit, the MWD1 bit, and the MWD0 bit shall be each be set to one if the ATA host supports MWDMA mode 2.

Table 105 specifies values set by the SATL in the MWD0 bit, the MWD1 bit, and the MWD2 bit for current and changeable MWDMA settings.

Table 105 — MWDMA modes reported by MODE SENSE

MWDMA ^a field			ATA host and device shared configuration settings returned as current values	ATA host support returned as changeable values
MWD0	MWD1	MWD2		
0	0	0	Configured not to use multiword DMA	Illegal combination
0	0	1	Configured to use MWDMA mode 1	
0	1	0	Configured to use MWDMA mode 2	
0	1	1	Configured to use MWDMA modes 1 and 2	
1	0	0	Configured to use MWDMA mode 0	MWDMA mode 0 supported
1	0	1	Configured to use MWDMA modes 0 and 2	Illegal combination
1	1	0	Configured to use MWDMA modes 0 and 1	MWDMA mode 1 supported
1	1	1	Configured to use MWDMA modes 0, 1 and 2	MWDMA mode 2 supported

^a If the application client attempts to set a MWDMA mode that is not supported by the ATA host environment, the SATL shall return a CHECK CONDITION status with the sense key set to ILLEGAL REQUEST with the additional sense code set to INVALID FIELD IN PARAMETER LIST.

If the SATL receives a MODE SELECT command and the MWDMA field indicates a change from the current settings, the SATL shall:

- 1) issue a SET FEATURES, sub-command 03h (Set Transfer Mode) to the ATA device, to set the MWDMA mode on the device to the requested state;
- 2) check the status of the SET FEATURES command once completed, and if the command completes in error, the SATL shall not change any host timing modes and shall complete the MODE SELECT command with a CHECK CONDITION status with the sense key set to ABORTED COMMAND and the additional sense code set to ATA DEVICE FAILED SET FEATURES, and the SATL shall take no further action regarding this MWDMA mode request; or
 - 1) if the SET FEATURES command completes without error the SATL shall configure the ATA host to communicate with the device at the requested MWDMA mode; and
 - 2) complete the MODE SELECT command with good status.

The MWDMA field values to configure ATA hosts and ATA devices using MODE SELECT have the same meaning as the MWDMA field values returned by MODE SENSE when current values are requested as shown in table 105.

If the SATL receives a request to set a MWDMA mode that is not supported by the ATA host or the attached PATA device, the SATL shall return a CHECK CONDITION status with the sense key set to ILLEGAL REQUEST with the additional sense code set to INVALID FIELD IN PARAMETER LIST.

The UDMA0 bit, the UDMA1 bit, the UDMA2 bit, the UDMA3 bit, the UDMA4 bit, the UDMA5 bit, and the UDMA6 bit are collectively referred to as the UDMA field, and are used to determine support for, current use of, and control of Ultra DMA (UDMA) timings on the ATA host and device. The SATL shall determine the highest UDMA mode supported as being the lower of the ATA host maximum transfer mode and the device maximum transfer mode.

NOTE 3 - The ATA device returns the UDMA transfer mode specified in IDENTIFY DEVICE data, word 88, bits 6:0 (see [ATA/ATAPI/ATA8-7ACS](#)).

If the SATL receives a MODE SENSE command requesting the changeable values of the PATA Control mode page, the UDMA field shall be set according to table 106.

Table 106 — UDMA Field Requirements for changeable MODE SENSE

Highest UDMA mode supported	UDMA0	UDMA1	UDMA2	UDMA3	UDMA4	UDMA5	UDMA6
UDMA Unsupported	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0
1	1	1	0	0	0	0	0
2	1	1	1	0	0	0	0
3	1	1	1	1	0	0	0
4	1	1	1	1	1	0	0
5	1	1	1	1	1	1	0
6	1	1	1	1	1	1	1

If the SATL receives a MODE SENSE command requesting the current values of the PATA Control mode page, the SATL shall set the UDMA field as defined in table 107. Only one UDMA bit shall be set to one at any time for such a request. If UDMA is not the current DMA transfer mode, all the bits in the UDMA field shall be set to zero. If a UDMA transfer mode is being used, all the bits in the MWDMA field shall be set to zero.

Table 107 — UDMA for current MODE SENSE settings

UDMA bit	Value	Description
UDMA0	0	ATA host and device are not communicating using UDMA Mode 0
	1	ATA host and device are communicating using UDMA Mode 0
UDMA1	0	ATA host and device are not communicating using UDMA Mode 1
	1	ATA host and device are communicating using UDMA Mode 1
UDMA2	0	ATA host and device are not communicating using UDMA Mode 2
	1	ATA host and device are communicating using UDMA Mode 2
UDMA3	0	ATA host and device are not communicating using UDMA Mode 3
	1	ATA host and device are communicating using UDMA Mode 3
UDMA4	0	ATA host and device are not communicating using UDMA Mode 4
	1	ATA host and device are communicating using UDMA Mode 4
UDMA5	0	ATA host and device are not communicating using UDMA Mode 5
	1	ATA host and device are communicating using UDMA Mode 5
UDMA6	0	ATA host and device are communicating using UDMA Mode 6
	1	ATA host and device are communicating using UDMA Mode 6

When the SATL receives a MODE SELECT command and the UDMA field indicates a change in the requested UDMA speed in the communications interface, the SATL shall:

- 1) issue a SET FEATURES, sub-command 03h, to set the UDMA timing mode on the device to the requested state;
- 2) check the status of the SET FEATURES command once completed, and if the command completes in error, the SATL shall not change any host timing modes and shall complete the MODE SELECT command with a CHECK CONDITION status with the sense key set to ABORTED COMMAND with the additional sense code set to ATA DEVICE FAILED SET FEATURES, and the SATL shall take no further action regarding this timing mode request; or

- 1) if the SET FEATURES command completes without error the SATL shall configure the ATA host to communicate with the device at the requested UDMA timing speeds; and
- 2) complete the MODE SELECT command with GOOD status.

If the application client attempts to set a mode that the underlying host or device does not support the SATL shall return a CHECK CONDITION status with the sense key set to ILLEGAL REQUEST with the additional sense code set to INVALID FIELD IN PARAMETER LIST.