

T10/05-245r4 SAT - SEND DIAGNOSTIC command and Self-Test Results

To: T10 Technical Committee
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Date: December 13, 2005
Subject: T10/05-245r4 SAT - SEND DIAGNOSTIC command and Self-Test Results

Revision History

Revision 0 (September 8, 2005) first revision

Revision 1 (November 8, 2005) second revision

Change details:

- 1) Removed "strikeouts" for clarity. (Note: "r0" has them for ref. if needed)
- 2) Removed the additional SMART READ LOG and READ LOG EXT text from the SELF-TEST RESULTS field of the Self-Test Results log page parameters.
- 3) "Set to a value of " changed to "set to" throughout the document.
- 4) Check for 48-bit Address feature set for the SELF-TEST RESULTS, TIMESTAMP, and ADDRESS OF FIRST FAILURE fields of log page (10h).
- 5) Build translation table for the SENSE KEY, ADDITIONAL SENSE CODE, and ADDITIONAL SENSE CODE QUALIFIER fields.

Revision 2 (November 11, 2005) third revision

Change details:

- 1) Deleted most of the "blue" notes to the W.G. and editor.
- 2) Kept the version of Table 71 the W.G. preferred and deleted the extra table examples.
- 3) Changed "small caps" headings in Table 71 to normal text w/1st letter cap.
- 4) Remove everything except "NN" in RH column heading of Table 71 and changed all "non 8xh" entries in the column to "n/a".
- 5) Removed "strike-out" data in Table 70 and changed all "=" to "is set to".
- 6) Changed all "non-packet device" to "ATA device".
- 7) Get rid of all "n+x" designations (if possible...one case difficult) by changing to using the ATA field or byte names.
- 8) Change all "Of the 512 bytes returned" to "From the returned data the SATL shall select".
- 9) Get rid of all ATA opcodes that follow ATA command names and also add "with the Log address set to".
- 10) Change the SEND DIAGNOSTIC command SELFTEST failure ADDITIONAL SENSE CODE from INTERNAL TARGET FAILURE (44h/00h) to LOGICAL UNIT FAILED SELF-TEST (3Eh/03h).
- 11) As requested by T13 experts, removed EXECUTE DEVICE DIAGNOSTICS command from the SEND DIAGNOSTIC SELFTEST bit field description and replaced with the "test if SMART supported/enabled...if yes, do SMART Short self-test routine immediately in captive mode...if no, do ATA verify command "algorithm".

Revision 3 (November 17, 2005) fourth revision

Change details: SAT editor's recommended improvements.

- 1) Change small caps to lower case for sense key and additional sense code in all instances.

- 2) Change SEND DIAGNOSTIC command cdb PF bit from “Shall be set to 0b.” to “if set to zero....., then....., if set to one....., then....” (other fields, too).
- 3) Replace all instances of the word “appropriate” with improved verbiage.
- 4) Introductory verbiage added prior to tables 28, 29, and 70.
- 5) Added words to the “description of test” column for the “Abort background self-test” of table 28 to comply with SPC-3 verbiage.
- 6) Removed text repeated for several fields in table 70 and created a new subclause (10.2.5) that contains the text and the table 70 field refers to the subclause (per editor request).
- 7) Subclause 10.2.5 changed to 10.2.6 and its paragraph text edited to now make reference to subclause 10.2.5 for the same “command selection” decision as is done for the other fields that refer to 10.2.5.

Revision 4 (December 13, 2005) fifth revision

Change details:

- 1) Incorporated ATA verify commands to LBA 0, Max LBA, and a random LBA as requested by the SAT W.G. in prior meeting (oversight by me per W.M. and R.W.) for SELFTEST bit field in Table 27.
- 2) “(see 10.2.5)” in Table 70 changed to “The SATL shall read the ATA log data as defined in 10.2.5.”
- 3) Changed “or” to “and” at end of 3rd statement list in 10.2.5.

Related Documents

- (T10) sat-r06 – SCSI to ATA Translation (SAT), Revision 6
- (T10) sbc-2r16 – SCSI Block Commands -2, Revision 16
- (T10) spc-3r23 – SCSI Primary Commands -3, Revision 23
- (T10) spc-4r01 – SCSI Primary Commands -4, Revision 01
- (T13) ata7v1r4b – AT Attachment with Packet Interface -7 Volume1, Revision 4b

Overview

1. The SEND DIAGNOSTIC command is a mandatory SCSI command per SBC-2.
2. The “self-test” feature of this command must be supported per SPC-3 if the command is supported.
3. Complexity of the emulation is estimated to be “minimal” to support the SEND DIAGNOSTIC “SELFTEST” bit for the “default self-test” feature.
4. Complexity of the emulation is estimated to be “medium-well” to support the SEND DIAGNOSTIC “SELF-TEST CODE” field for additional self-tests and report results in the Self-Test Results log page.

Suggested Changes

8.11 SEND DIAGNOSTIC command

The SEND DIAGNOSTIC command provides a mechanism for an application client to request diagnostic operations be performed on the target, logical unit or both. The SATL shall implement the default self-test feature (see SPC-3).

Table 27 - SEND DIAGNOSTIC command CDB fields

Field	Description or reference
OPERATION CODE	Set to 1Dh. This field value is specific to the SEND DIAGNOSTIC command.
SELF-TEST CODE	<ol style="list-style-type: none"> 1) If the SELFTEST field is set to 1b, the SATL shall disregard the content of this field. 2) If the SELFTEST field is set to 0b, the SATL shall determine if the SMART EXECUTE OFF-LINE IMMEDIATE command is supported and enabled from the ATA device IDENTIFY DEVICE data word 84, bit 1, and word 85, bit 0. If the SMART EXECUTE OFF-LINE IMMEDIATE command is supported and enabled the SATL shall respond as defined in Table 28. If the SMART EXECUTE OFF-LINE IMMEDIATE command is not supported the SATL shall return a CHECK CONDITION status with sense key set to ILLEGAL REQUEST and additional sense code set to INVALID FIELD IN CDB. If the SMART EXECUTE OFF-LINE IMMEDIATE command is supported, but not enabled, the SATL shall return a CHECK CONDITION status with sense key set to ABORTED COMMAND and additional sense code set to ATA DEVICE FEATURE NOT ENABLED.
PF	<ol style="list-style-type: none"> 1) If the PF bit is set to zero, then the SATL shall process the command as specified in SPC-3. 2) If the PF bit is set to one, then the SATL shall terminate the command with a CHECK CONDITION status with sense key set to ILLEGAL REQUEST and additional sense code set to INVALID FIELD IN CDB.
SELFTEST	<ol style="list-style-type: none"> 1) If set to 0b the SATL shall respond as defined in Table 28. 2) If set to 1b (i.e., default self-test feature) the SATL shall determine if the SMART EXECUTE OFF-LINE IMMEDIATE command is supported and enabled from the ATA device IDENTIFY DEVICE data word 84, bit 1, and word 85, bit 0. If the SMART EXECUTE OFF-LINE IMMEDIATE command is supported and enabled the SATL shall issue a SMART EXECUTE OFF-LINE IMMEDIATE command to the ATA device to perform the Execute SMART Short self-test routine immediately in captive mode (see Table 29). If the command completes successfully, the SATL shall return GOOD status. If the command fails the SATL shall return a CHECK CONDITION status with sense key set to HARDWARE ERROR and additional sense code set to LOGICAL UNIT FAILED SELF-TEST. If the SMART EXECUTE OFF-LINE IMMEDIATE command is not supported or enabled, the SATL shall send three single-sector (i.e., with one in the Sector Count register) ATA verify commands (see 3.1.17) to the attached ATA device with LBA zero, the max LBA, and a random LBA located between zero and the max LBA, respectively. If the commands complete successfully, the SATL shall return GOOD status. If any of the commands fail the SATL shall return a CHECK CONDITION status with sense key set to HARDWARE ERROR and additional sense code set to LOGICAL UNIT FAILED SELF-TEST.
DEVOFFL	<ol style="list-style-type: none"> 1) If the DEVOFFL bit is set to zero, then the SATL shall process the command as specified in SPC-3. 2) If the DEVOFFL bit is set to one, then the SATL shall terminate the command with a CHECK CONDITION status with sense key set to ILLEGAL REQUEST and additional sense code set to INVALID FIELD IN CDB.
UNITOFFL	<ol style="list-style-type: none"> 1) If the UNITOFFL bit is set to zero, then the SATL shall process the command as specified in SPC-3.

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	2) If the UNITOFFL bit is set to one, then the SATL shall terminate the command with a CHECK CONDITION status with sense key set to ILLEGAL REQUEST and additional sense code set to INVALID FIELD IN CDB.
PARAMETER LIST LENGTH	1) If the PARAMETER LIST LENGTH bit is set to zero, then the SATL shall process the command as specified in SPC-3. 2) If the PARAMETER LIST LENGTH bit is set to one, then the SATL shall terminate the command with a CHECK CONDITION status with sense key set to ILLEGAL REQUEST and additional sense code set to INVALID FIELD IN CDB.
CONTROL	(see 6.4)

Table 28 provides the SATL responses to SELF-TEST CODE field values of a SEND DIAGNOSTIC command.

Table 28 - SELF-TEST CODE field

Code	Name of Test	Description of Test
000b		Default self-test. Used when SELFTEST bit is set to 1.
001b	Background short self-test	The SATL shall perform the following: 1) return status for the command as soon as the CDB has been validated and initialize the Self-Test Results log page (see 10.2.2 and SPC-3); and 2) issue an ATA SMART EXECUTE OFF-LINE IMMEDIATE command to the ATA device to perform the Execute SMART Short self-test routine immediately in off-line mode (see Table 29).
010b	Background extended self- test	The SATL shall perform the following: 1) return status for the command as soon as the CDB has been validated and initialize the Self-Test Results log page (see 10.2.2 and SPC-3); and 2) issue an ATA SMART EXECUTE OFF-LINE IMMEDIATE command to the ATA device to perform the Execute SMART Extended self-test routine immediately in off-line mode (see Table 29).
011b	Reserved.	Unspecified (see SPC-3)
100b	Abort background self-test	If a previous SEND DIAGNOSTIC command specified a background self-test function and that self-test has not completed (see SPC-3) the SATL shall issue an ATA SMART EXECUTE OFF-LINE IMMEDIATE command to the ATA device to perform the Abort off-line mode self-test routine (see Table 29). If the command completes successfully, the SATL shall return GOOD status. If the command fails the SATL shall respond as defined in SPC-3.
101b	Foreground short self-test	The SATL shall issue an ATA SMART EXECUTE OFF-LINE IMMEDIATE command to the ATA device to perform the Execute SMART Short self-test routine immediately in captive mode (see Table 29). If the command completes successfully,

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		the SATL shall update the Self-Test Results log page prior to returning GOOD status. If the command fails the SATL shall first update the Self-Test Results log page (if capable, see SPC-3) then return a CHECK CONDITION status with sense key set to HARDWARE ERROR and additional sense code set to LOGICAL UNIT FAILED SELF-TEST.
110b	Foreground extended self-test	The SATL shall issue an ATA SMART EXECUTE OFF-LINE IMMEDIATE command to the ATA device to perform the Execute SMART Extended self-test routine immediately in captive mode (see Table 29). If the command completes successfully, the SATL shall update the Self-Test Results log page prior to returning GOOD status. If the command fails the SATL shall first update the Self-Test Results log page (if capable, see SPC-3) then return a CHECK CONDITION status with sense key set to HARDWARE ERROR and additional sense code set to LOGICAL UNIT FAILED SELF-TEST.
111b	Reserved	Unspecified (see SPC-3)

Table 29 provides the ATA register values for ATA SMART EXECUTE OFF-LINE IMMEDIATE commands used in SATL translations for the SEND DIAGNOSTIC command self-test codes.

Table 29 – SMART EXECUTE OFF-LINE IMMEDIATE commands

Subcommand	Register	Register value
Execute SMART Short self-test routine immediately in off-line mode	Features	D4h
	LBA Low	01h
	LBA Mid	4Fh
	LBA High	C2h
	Command	B0h
Execute SMART Extended self-test routine immediately in off-line mode	Features	D4h
	LBA Low	02h
	LBA Mid	4Fh
	LBA High	C2h
	Command	B0h
Abort off-line mode self-test routine	Features	D4h
	LBA Low	7Fh
	LBA Mid	4Fh
	LBA High	C2h
	Command	B0h
Execute SMART Short self-test routine immediately in captive mode	Features	D4h
	LBA Low	81h
	LBA Mid	4Fh
	LBA High	C2h
	Command	B0h
Execute SMART Extended self-test routine immediately in captive mode	Features	D4h
	LBA Low	82h
	LBA Mid	4Fh
	LBA High	C2h
	Command	B0h

[NOTE to editor: “Pop” the following information into the log parameters section.]

10.2 Log Pages

10.2.4 Self-Test Results log page

The Self-Test Results log page (see Table 69) provides the results from the most recent self-tests (see SPC-3).

Table 69- Self-Test Results log page fields

Field	Description or reference
PAGE CODE	Set to 10h. This field value is specific to the Self-Test Results log page.
PAGE LENGTH	(see SPC-3).
Self-test results log parameters (see SPC-3)	

Translations of the fields for the Self-test results log parameters for the Self-Test Results log page are provided in Table 70.

Table 70 - Self-test results log parameters

Field	Description or reference
PARAMETER CODE	Unspecified (see SPC-3)
DU	Shall be set to 0b (see SPC-3).
DS	Shall be set to 0b (see SPC-3).
TSD	Shall be set to 0b (see SPC-3).
ETC	Shall be set to 0b (see SPC-3).
TMC	Shall be set to 0h (see SPC-3).
LBIN	Shall be set to 1b (see SPC-3).
LP	Shall be set to 1b (see SPC-3).
PARAMETER LENGTH	(see SPC-3).
SELF-TEST CODE	(see SPC-3).
SELF-TEST RESULTS	The SATL shall read the ATA log data as defined in 10.2.5. <ol style="list-style-type: none"> 1) From the returned data from a READ LOG EXT command for the Extended SMART self-test log the SATL shall select the Self-test Execution Status bits from the Content of the self-test execution status byte (i.e., byte n + 1 of the Extended Self-test log descriptor entry) to return to the application client for this field (see ATA/ATAPI - 7). 2) From the returned data from a SMART READ LOG command for the SMART self-test log the SATL shall select the Content of the self-test execution status byte (i.e., byte n + 1 of the Self-test log descriptor entry) for the Self-test execution status bits to return to the application client for this field.
SELF-TEST NUMBER	Unspecified (see SPC-3)
TIMESTAMP	The SATL shall read the ATA log data as defined in 10.2.5. <ol style="list-style-type: none"> 1) From the returned data from a READ LOG EXT command for the Extended SMART self-test log the SATL shall select the Life timestamp (most significant byte) and Life timestamp (least significant byte) of the Extended Self-test log descriptor entry to return to the application client for this field. 2) From the returned data from a SMART READ LOG command for

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	the SMART self-test log the SATL shall select the Life timestamp (most significant byte) and Life timestamp (least significant byte) of the Self-test log descriptor entry to return to the application client for this field.
ADDRESS OF FIRST FAILURE	The SATL shall read the ATA log data as defined in 10.2.5. 1) From the returned data from a READ LOG EXT command for the Extended SMART self-test log the SATL shall select the Failing LBA (47:40), Failing LBA (39:32), Failing LBA (31:24), Failing LBA (23:16), Failing LBA (15:8), and Failing LBA (7:0) of the Extended Self-test log descriptor entry to return to the application client for this field. 2) From the returned data from a SMART READ LOG command for the SMART self-test log the SATL shall select the Failing LBA (most significant byte), Failing LBA (next most significant byte), Failing LBA (next least significant byte), and Failing LBA (least significant byte) of the Self-test log descriptor entry to return to the application client for this field.
SENSE KEY	10.2.6
ADDITIONAL SENSE CODE	10.2.6
ADDITIONAL SENSE CODE QUALIFIER	10.2.6

10.2.5 A method of determining ATA command selection for field translations

In order to translate the SELF-TEST RESULTS, TIMESTAMP, ADDRESS OF FIRST FAILURE, SENSE KEY, ADDITIONAL SENSE CODE, and ADDITIONAL SENSE CODE QUALIFIER fields of Self-test results log parameters the SATL shall:

- 1) Issue an IDENTIFY DEVICE command to the ATA device;
- 2) From the returned data the SATL shall determine if the ATA device supports the 48-bit Address feature set from bit 10 of word 83;
- 3) If the 48-bit Address feature set is supported the SATL shall issue a READ LOG EXT command with the Log address set to 07h (i.e., Extended SMART self-test log) to the ATA device; and
- 4) If the 48-bit Address feature set is not supported the SATL shall issue a SMART READ LOG command with the Log address set to 06h (i.e., SMART self-test log) to the ATA device.

10.2.6 Sense key, additional sense code, and additional sense code qualifier

The SATL shall determine the values for the SENSE KEY, ADDITIONAL SENSE CODE, and ADDITIONAL SENSE CODE QUALIFIER fields from the Content of the self-test execution status byte returned from a READ LOG EXT or SMART READ LOG command issued to the ATA device (see 10.2.5). The values returned shall be translated into sense data for the SENSE KEY, ADDITIONAL SENSE CODE, and ADDITIONAL SENSE CODE QUALIFIER fields as shown in Table 71.

Table 71: ATA Self-test execution status values translated to SCSI sense keys and sense codes

ATA Self-test execution status value	SCSI		
	Sense Key	Additional Sense Code	NN
0	NO SENSE	NO ADDITIONAL SENSE INFORMATION	n/a
1	ABORTED COMMAND	DIAGNOSTIC FAILURE ON COMPONENT NN (80h – FFh)	81h
2	ABORTED COMMAND	DIAGNOSTIC FAILURE ON COMPONENT NN (80h – FFh)	82h
3	ABORTED COMMAND	DIAGNOSTIC FAILURE ON COMPONENT NN (80h – FFh)	83h
4	HARDWARE ERROR	DIAGNOSTIC FAILURE ON COMPONENT NN (80h – FFh)	84h
5	HARDWARE ERROR	DIAGNOSTIC FAILURE ON COMPONENT NN (80h – FFh)	85h
6	HARDWARE ERROR	DIAGNOSTIC FAILURE ON COMPONENT NN (80h – FFh)	86h
7	MEDIUM ERROR	DIAGNOSTIC FAILURE ON COMPONENT NN (80h – FFh)	87h

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8	HARDWARE ERROR	DIAGNOSTIC FAILURE ON COMPONENT NN (80h – FFh)	88h
9-14	NO SENSE	NO ADDITIONAL SENSE INFORMATION	n/a
15	NO SENSE	NO ADDITIONAL SENSE INFORMATION	n/a