To:      T10 Technical Committee
From:   Rob Elliott, HP (elliott@hp.com)
Date:    18 January 2006
Subject: 05-340r3 SBC-3 SPC-4 Background scan additions

## Revision history
Revision 0 (9 September 2005) First revision
Revision 1 (18 October 2005) Incorporated comments from September 2005 CAP WG. Upgraded text to be based on 05-369r0 (proposed SBC-3 revision 2) and added some corrections to some incorporation errors of the earlier proposals into 05-369.
Revision 2 (11 November 2005) Incorporated comments from November 2005 CAP WG.
Revision 3 (18 January 2006) Incorporated comments from January 2006 CAP WG.

## Related documents
sbc3r3 - SCSI Block Commands - 3 revision 3
spc4r01a - SCSI Primary Commands - 4 revision 1a
04-198r5 - SBC-3 Background Medium Scan (Gerry Houlder, Seagate)
04-317r1 - SPC-3 Enable Background Operations Error Reporting Bit (George Penokie, IBM)
05-313r0 - SBC-3 Change to Background Medium Scan (Gerry Houlder, Seagate)
05-375r0 - SBC-3 EBACKERR bit Error Reporting Clarification (George Penokie, IBM)

## Overview
Several changes and clarifications are proposed to the background scan operation recently added to SBC-3:

1. The additional sense code names proposed in 04-317r1 of WARNING - PRE-SCAN FAILED and WARNING - SCAN FAILED were interpreted by several readers as meaning the entire background scan failed, not just that it detected one or more bad logical blocks. These should be renamed to WARNING - PRE-SCAN DETECTED MEDIUM ERROR and WARNING - BACKGROUND SCAN DETECTED MEDIUM ERROR

2. There is no guidance for how long the logical unit should be idle before it starts performing the background scan. If software issues commands just as the logical unit chooses to resume a background scan, performance will degrade. A MINIMUM IDLE TIME BEFORE BACKGROUND SCAN mode page field is proposed to both report and select the idle time that a logical unit will wait for before resuming scanning.

3. There is no guidance for how long the logical unit should keep attempting to reallocate a logical block detected as problematic during a background scan before it starts attending to a new command. A MAXIMUM TIME TO SUSPEND BACKGROUND SCAN mode page field is proposed to report (and possibly select) the maximum time for stopping the background scan operation and resuming work on new commands.

4. It is unclear whether the new EBACKERR field honors the INTERVAL TIMER and REPORT COUNT fields. 05-375r0 resolves this (it does not honor them), so revision 1 of this proposal no longer discusses the issue.

5. It is unclear whether the TOTAL POWER ON MINUTES field contains the total time the drive has been powered on since manufacturing, or the time since the last power on. The WG recommended that it contain the total time the drive has been powered on since manufacturing.

6. Several paragraphs say that the scan starts at LBA zero and ends at the last LBA, implying a sequential scan. The WG recommended that the device server be allowed to scan any way it chooses (e.g., based on physical block layout rather than logical block layout) and not be required to scan in LBA order.

7. Background scanning should be suspended if the Background Scan Results log page becomes full of errors. Revision 1 proposed that this happen if the RLEC bit in the Control mode page is set to one (which generates a CHECK CONDITION/RECOVERED ERROR/LOG LIST CODES EXHAUSTED). Revision 2 and later propose a new SUSPEND_ON_LOG_FULL bit instead.

8. Background medium scan should start immediately when EN_BMS is set to one, not wait a whole Interval time. Also, the changes requested by 05-313r0 to cause the Background Medium Scan Interval Time to start at the beginning of the scan rather than the end were incomplete.

9. The maximum log page parameter code is inconsistent - should it be 0800h or 07FFh? 0800h is proposed.

10. A log parameter with a REASSIGN STATUS field set to 00h should never appear, so 00h should be marked Reserved.

11. The log parameters need to be defined as binary list parameters.

12. For consistency with other timer names, the PRE-SCAN TIMEOUT VALUE field is renamed BACKGROUND PRE-SCAN TIME LIMIT and its timer is called the Background Pre-Scan Timeout timer. The BMS INTERVAL TIME field is renamed BACKGROUND MEDIUM SCAN INTERVAL TIME and its timer is called the Background Medium Scan Interval timer.

13. For consistency with other timers, timer descriptions are changed to initializing to the value in the mode page, starting, and expiring (rather than initializing to 0 and counting up to the value in the mode page).

14. "Suspending" is the term used for temporarily stopping the scan (e.g., to process commands), while "halting" is used for completing background pre-scan or completing a pass of the background medium scan.

15. In SPC-4, the Self-Test Results log page includes a TIMESTAMP field that is basically the same as the Background Scan Results log page TOTAL POWER ON MINUTES field (except for the selected units of hours vs. minutes), so should have the same name. "Timestamp" is a term now taken by the SET/REPORT TIMESTAMP commands, so should not be used by the log pages for a different purpose. Both fields are renamed to ACCUMULATED POWER ON MINUTES.

16. The LBA field should be spelled out as LOGICAL BLOCK ADDRESS to follow SBC-2 conventions.

17. A log when intervention is required (LOWIR) bit is proposed to limit logging to medium errors demanding application client attention (ignoring those that the device server fixes on its own).

**Suggested changes to proposed SBC-3 revision 2 (05-369r0)**

**4.18 Background scanning operations**

**4.18.1 Background scanning overview**

During background scanning, ~~Medium scanning occurs when a~~the device server, without using any bandwidth on the service delivery subsystem, reads logical blocks from the medium for the purpose of:

  a)   identifying logical blocks that are difficult to read or unreadable;
  b)   logging ~~a~~ read problems; and
  c)   when allowed, ~~take~~taking a vendor-specific action to make the logical block readable again.

~~Background medium scanning is defined as any operation that is performed without using any bandwidth on the service delivery subsystem (see SAM-4). Logical blocks shall not be retained in cache after they are read.~~

If a logical block is readable but requires extra actions (e.g., retries or application of a correction algorithm) to be read, the device server may resolve the problem using vendor-specific means. The ARRE bit in the Read-Write Error Recovery mode page (see 6.3.5) controls whether the device server may automatically repair or relocate recoverable read errors.

If a logical block is unreadable, the device server may mark the logical block as bad so it may be relocated. The AWRE bit in the Read-Write Error Recovery mode page (see 6.3.5) controls whether the device server may relocate logical blocks during write operations. If allowed by the AWRE bit~~s~~ setting, logical blocks that have previously been noted as unrecoverable are reassigned at the start of the next write operation to that logical block.

During a background scan, the device server may scan the logical blocks in any order (e.g., based on physical block layout). The device server should not retain any logical blocks in cache memory after they are read.

**4.18.2 Background pre-scan ~~feature~~**

**4.18.2.1 Enabling the background pre-scan operation**

The background pre-scan ~~feature~~ operation is enabled after:

  1)   the EN_PS bit in the Background Control mode page (see 6.3.3) is set to zero;
  2)   the EN_PS bit is set to one; and
  3)   the SCSI device is power cycled if:

    A)   the SUSPEND_ON_LOG_FULL bit in the Background Control mode page (see 6.3.3) is set to zero, or if the SUSPEND_ON_LOG_FULL bit is set to one and the log is not full; and

    B)   the saved value of the EN_PS bit is set to one.

After ~~power is restored~~the background pre-scan operation is enabled, the device server shall:

a)   initialize the Background Pre-scan Time Limit timer to the time specified in the PRE-SCAN TIME LIMIT field in the Background Control mode page and start the timer;

b)   initialize the Background Medium Scan Interval timer to the time specified in the BACKGROUND MEDIUM SCAN INTERVAL TIME field in the Background Control mode page and start the timer; and

c)   begin the background pre-scan operation (i.e., ~~pre-scan timer is set to zero and~~ the ~~SCSI device~~ begins scanning the medium)~~ starting at LBA zero and ending with the last LBA~~.

### 4.18.2.2 Suspending the background pre-scan operation

The device server shall suspend the background pre-scan operation when any of the following occurs:

a)   a command is received from the application client; or

b)   the Background Scanning Results log page Background Medium Scan log parameters are all used and the SUSPEND_ON_LOG_FULL bit in the Background Control mode page (see 6.3.3) is set to one.

~~During this time, any commands from an application client shall cause the pre-scan operation to be suspended while the device server processes the commands.~~

When a command is received from the application client during the background pre-scan operation, the background pre-scan operation should be suspended within the time specified in the MAXIMUM TIME TO SUSPEND BACKGROUND SCAN field in the Background Control mode page (see 6.3.3).

While the background pre-scan operation is suspended and not halted (see 4.18.2.3), the device server shall convert each ~~A~~ write operation that accesses ~~an LBA~~a logical block that has not been scanned during the background pre-scan operation ~~is converted~~ into a write operation followed by a verify operation to verify that the data just written was read back successfully. If a write operation accesses ~~an LBA~~a logical block that has already been scanned during the background pre-scan operation then it ~~is~~shall be processed normally. Commands that do not perform write operations ~~are~~shall be processed normally.

The suspended background pre-scan operation shall resume where it left off when:

a)   all commands have been completed;

b)   ~~(i.e.,~~ no ACA condition exists~~)~~;

c)   the Background Scanning Results log page Background Medium Scan log parameters are not all used or the SUSPEND_ON_LOG_FULL bit in the Background Control mode page (see 6.3.3) is set to zero;

d)   the logical unit has been idle for the time specified in the MINIMUM IDLE TIME BEFORE BACKGROUND SCAN field in the Background Control mode page (see 6.3.3); and

e)   the background pre-scan operation has not been halted (see 4.18.2.3).

### 4.18.2.3 Halting the background pre-scan operation

The device server shall halt ~~T~~the background pre-scan operation ~~feature is halted~~ when any of the following occurs:

a)   the background pre-scan operation completes scanning all ~~LBAs~~logical blocks on the ~~SCSI device~~medium;

b)   an application client sets the EN_PS bit to zero (see 6.3.3);

c)   the Background Pre-scan Time Limit ~~pre-scan~~ timer expires~~reaches the value of the PRE-SCAN TIMEOUT VALUE field (see 6.3.3)~~;

d)   the device server detects a fatal error;

e)   the ~~SCSI~~device server detects a vendor~~-~~specific pattern of errors;

f)   the device server detects a medium formatted without a PLIST (see 4.8); or

g)   the device server detects temperature out of range.

Once the background pre-scan operation is halted, it is re-enabled as described in 4.18.2.1.

### 4.18.3 Background medium scan ~~feature~~

### 4.18.3.1 Enabling the background medium scan operation

~~If background pre-scan operationis enabled, it shall be completed or halted before background medium scan operation is started.~~

The background medium scan operation ~~feature~~ is enabled if: ~~by setting~~

    a) the background pre-scan operation (see 4.18.2) is not enabled;
    b) the SUSPEND_ON_LOG_FULL bit in the Background Control mode page (see 6.3.3) is set to zero or the SUSPEND_ON_LOG_FULL bit is set to one and the log is not full; and
    c) the EN_BMS bit in the Background Control mode page (see 6.3.3) is set to one.

If the background medium scan operation is enabled, the device server shall begin the background medium scan operation (i.e., begin scanning the medium) when:

    d) the Background Medium Scan Interval timer has expired; and
    e) the logical unit has been idle for the time specified in the MINIMUM IDLE TIME BEFORE BACKGROUND SCAN field in the Background Control mode page (see 6.3.3)

After power on, if the background pre-scan operation is not enabled (see 4.18.2.1), the device server shall set the Background Medium Scan Interval timer to zero (i.e., expired).

Whenever the background medium scan operation begins, the device server shall set the Background Medium Scan Interval timer to the time specified in the BACKGROUND MEDIUM SCAN INTERVAL TIME field in the Background Control mode page and start the timer.

### 4.18.3.2 Suspending the background medium scan operation

The device server shall suspend ~~Tt~~the background medium scan operation ~~feature is suspended~~ when any of the following occurs:

    a) a command is received from the application client;
    b) the Background Scanning Results log page Background Medium Scan log parameters are all used and the SUSPEND_ON_LOG_FULL bit in the Background Control mode page (see 6.3.3) is set to one;
    c) the background medium scan operation completes scanning all ~~LBAs~~logical blocks on the ~~device~~medium; or
    d) an application client sets the EN_BMS bit to zero (see 6.3.3)~~; or~~.
    ~~e) the SCSI device detects a vendor-specific pattern of errors.~~

When a command is received from the application client, the device server should suspend the background medium scan operation within the time specified in the MAXIMUM TIME TO SUSPEND BACKGROUND SCAN field in the Background Control mode page (see 6.3.3).

~~After the value in the BMS INTERVAL TIME field (see 6.3.3) has been reached , the device shall begin scanning the medium starting at LBA zero and ending with the last LBA. During this scan, any commands from an application client shall cause the background medium scan operation to be suspended while the device server processes the commands.~~ The suspended background medium scan operation shall resume where it left off when:

    a) all commands have been successfully completed:
    b) ~~(i.e.,~~ no ACA condition exists~~)~~;
    c) the Background Scanning Results log page Background Medium Scan log parameters are not all used or the SUSPEND_ON_LOG_FULL bit in the Background Control mode page (see 6.3.3) is set to zero;
    d) the EN_BMS bit is set to one; and
    e) the logical unit has been idle for the time specified in the MINIMUM IDLE TIME BEFORE BACKGROUND SCAN field in the Background Control mode page (see 6.3.3).

~~After the last LBA has been scanned, the timer .shall be set to zero and the background medium scan operation becomes dormant for a BMS interval time. Then the background medium scan operation starts another scanning cycle at LBA zero.~~

~~Once the background medium scan is suspended, it resumes from the spot where it left off when it is enabled (see 4.18.3.1).~~

#### 4.18.3.3 Halting the background medium scan operation

The device server shall halt the background medium scan operation when any of the following occurs:

    a)  the background medium scan operation completes scanning all logical blocks on the medium;
    b)  the device server detects a fatal error;
    c)  the device server detects a vendor-specific pattern of errors;
    d)  the device server detects a medium formatted without a PLIST (see 4.8); or
    e)  the device server detects temperature out of range.

Once the background medium scan operation is halted, it is re-enabled as described in 4.18.3.1.

#### 4.18.4 Interpreting the logged results

An application client may:

    a)  poll the Background Scan Results log page (see 6.2.2) to get information about background pre-scan
        and background medium scan activity; or
    b)  use the EBACKERR bit and the MRIE field in the Informational Exceptions Control mode page (see
        SPC-4) to select a method of indicating a failure occurredthat a medium error was detected. If the
        EBACKERR bit is set to one and a failure occursa medium error is detected, the following additional
        sense codes shall be returned using the method defined in the MRIE field:
        A)  WARNING - BACKGROUND PRE-SCAN DETECTED MEDIUM ERROR if the failure occurs
            during a background pre-scan an additional sense code of WARNING - PRE-SCAN FAILED shall
            be returned; orand
        B)  WARNING - BACKGROUND MEDIUM SCAN DETECTED MEDIUM ERROR if the failure occurs
            during a background medium scan an additional sense code of WARNING - SCAN FAILED shall
            be returned.

If an application client polls tThe Background Scan Results log page (see 6.2.2) to get information about
background pre-scan and background medium scan activity, then the bBackground sScanning sStatus
parameter (see table 92) has fields that may be used to indicates whether a background pre-scan or
background medium scan is active or suspended, the number of background scans performed on the
medium, and the progress of a background scan that is active. This information may be used by an application
client to monitor the background scanning operations and should be used by an application client after
notification via an informational exception.

If an application client uses the EBACKERR bit and the MRIE field in the Informational Exceptions Control mode
page (see SPC-4) to indicate an failure detected during a background pre-scan or background medium scan
failure and a failure occurs, then the application client should retrieve the Background Scan Results log page
to get information about the failure.

The Background mMedium sScan parameters (see table 94), if any, describe the physical and logical location
of any suspected bad logical blocks. The REASSIGN STATUS field (see table 95) indicates whether the defect
was completely handled by the device server or whether the application client may haveneeds to take action
(e.g., reassigning or re-writing an LBAa logical block) to fix a particular bad logical block.

After an application client analyzes the Background mMedium sScan parameters and has completed actions,
if any, to repair the bad logical blocks, it may delete the log entries by issuing a LOG SELECT command (e.g.,
with the PCR bit set to one, or with the PC bit set to 11b and the PARAMETER LIST LENGTH field set to zero)(see
SPC-34).

The background medium scan continues to run during log page accesses. To ensure that the log page does
not change during a sequence of accesses, the application client shall:

    1)  set the EN_BMS bit in the Background Control mode page (see 6.3.3) to zero to suspend the
        background medium scan;
    2)  read the log page with LOG SENSE command;
    3)  process the log page;
    4)  delete the log entries with the LOG SELECT command (e.g., with the PCR bit set to one); and
    5)  set the EN_BMS bit in the Background Control mode page (see 6.3.3) to one.

### 6.2.2 Background Scan Results log page

The Background Scan Results log page (see table 90) returns the bBackground sScanning sStatus parameter and zero or more Background mMedium sScan parameters when background scanning is supported. The bBackground sScanning sStatus parameter provides information about background pre-scan and background medium scan operations. Each medium error log entryBackground Medium Scan parameter corresponds to a logical block where an error was detected. If the medium scan log areaBackground Scan Results log page is filled up and the SUSPEND_ON_LOG_FULL bit in the Background Control mode page (see 6.3.3) is set to zero, a new medium scan log entryBackground Medium Scan parameter overwrites the oldest entry. When a LOG SELECT command with the PCR bit set to one is processed all Background mMedium sScan parameters are deleted,; however, the values in the bBackground sScanning sStatus parameter shall not be affected.

**Table 90 — Background Scan Results log page**

| Byte\Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Reserved | | PAGE CODE (15h) | | | | | |
| 1 | Reserved | | | | | | | |
| 2 | (MSB) | PAGE LENGTH (n - 3) | | | | | | |
| 3 | | | | | | | | (LSB) |
| Background sScanrResults log parameters | | | | | | | | |
| 4 | Background sScanning sStatus parameters (see table 3) | | | | | | | |
| 19 | | | | | | | | |
| Background Medium Scan parameter list | | | | | | | | |
| 20 | (MSB) | First Background mMedium sScan parameter (first)(see table 5) | | | | | | |
| 43 | | | | | | | | (LSB) |
| | ... | | | | | | | |
| n-23 | (MSB) | Last Background mMedium sScan parameter (last)(see table 5) | | | | | | |
| n | | | | | | | | (LSB) |

Table 91 defines the parameter codes for the Background Scan Results log page.

**Table 91 — Background Scan Results log page parameter codes**

| Parameter code | Description |
|---|---|
| 0000h | Background sScanning sStatus |
| 0001h - 0800h | Background Medium sScan |
| 07FFhh0801h - 7FFFhFFFFh | Reserved |

The bBackground sScanning sStatus parameter (see table 92) contains status information about the background pre-scan and background medium scan features.

**Table 92 — Background sScanning sStatus parameter format**

| Byte\Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | (MSB) | | | | | | | |
| 1 | | | PARAMETER CODE (0000h) | | | | | (LSB) |
| 2 | DU | DS | TSD | ETC | TMC | | LBIN | LP |
| 3 | | | PARAMETER LENGTH (0Ch) | | | | | |
| 4 | (MSB) | | | | | | | |
| 7 | | | ACCUMULATED POWER ON MINUTES | | | | | (LSB) |
| 8 | | | Reserved | | | | | |
| 9 | | | BACKGROUND SCANNING STATUS | | | | | |
| 10 | (MSB) | | | | | | | |
| 11 | | | NUMBER OF BACKGROUND SCANS PERFORMED | | | | | (LSB) |
| 12 | (MSB) | | | | | | | |
| 13 | | | BACKGROUND MEDIUM SCAN PROGRESS | | | | | (LSB) |
| 14 | | | Reserved | | | | | |
| 15 | | | | | | | | |

The contents of the DU, DS, TSD, ETC, LBIN, and LP bits and the TMC field are defined in SPC-4.

Table 93 defines the values for the log parameter control bits for this log parameter.

**Table 93 — Parameter control bits for Background Scanning Status log parameter**

| Field | Value for LOG SENSE | Value for LOG SELECT | Description |
|---|---|---|---|
| DU | 0 | any | The DU bit is not defined for list parameters, so shall be set to zero when read with the LOG SENSE command and shall be ignored when written with the LOG SELECT command. |
| DS | any | any | No specific requirements |
| TSD | any | any | No specific requirements |
| ETC | 0 | any | The ETC bit is not defined for list parameters, so shall be set to zero when read with the LOG SENSE command and shall be ignored when written with the LOG SELECT command. |
| TMC | 00b | any | The TMC field is not defined for list parameters, so shall be set to 00b when read with the LOG SENSE command and shall be ignored when written with the LOG SELECT command. |
| LBIN | 1 | 1 | The log parameter is in binary format. |
| LP | 1 | 1 | The log parameter is a list parameter. |

Editor's Note 1: modify these tables (along with all other log page parameter control bit tables) to

agree with the log page proposal passed in November 2005

The PARAMETER LENGTH field indicates the number of bytes remaining in the log parameter.

The ACCUMULATED POWER ON MINUTES field indicates the ~~total power on minutes~~number of minutes the device server has been powered on since manufacturing at the time the log page is requested.

Table 94 ~~specifies the meaning of~~ defines the BACKGROUND SCANNING STATUS field.

<p align="center">**Table 94 — BACKGROUND SCANNING STATUS field**</p>

| ~~Value~~ Code | Description |
|---|---|
| 00h | No background scan~~s~~ is active |
| 01h | Background medium scan is active |
| 02h | Background ~~P~~pre-scan is active |
| 03h | Background s~~S~~can halted due to fatal error |
| 04h | Background s~~S~~can halted due to a vendor-specific pattern of errors |
| 05h | Background s~~S~~can halted due to medium formatted without ~~P-list~~a PLIST (see 4.8) |
| 06h | Background s~~S~~can halted ~~–~~due to a vendor-specific cause |
| 07h | Background s~~S~~can halted due to temperature out of range |
| 08h | Background medium s~~S~~can ~~suspendeduntil BMS interval time (see 6.3.3) expires~~halted, waiting for Background Medium Scan Interval timer expiration |
| 09h - FFh | Reserved |

The NUMBER OF BACKGROUND SCANS PERFORMED field indicates the number of background scans that have been performed since the SCSI target device was originally shipped by the manufacturer.

The BACKGROUND MEDIUM SCAN PROGRESS field is a percent complete indication of the background medium scan. The returned value is a numerator that has 65 536 (i.e., 10000h) as its denominator.

A Background mMedium sScan parameter (see table 95) describes a defect location on the medium that was encountered by background scanning (see 4.18.2 and 4.18.3).

**Table 95 — Background Medium sScan parameter format**

| Byte\Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | (MSB) | | | | | | | |
| 1 | | | | PARAMETER CODE (0001h - 0800h) | | | | (LSB) |
| 2 | DU | DS | TSD | ETC | TMC | | LBIN | LP |
| 3 | PARAMETER LENGTH (14h) | | | | | | | |
| 4 | (MSB) | | | | | | | |
| 7 | | | | ACCUMULATED POWER ON MINUTES | | | | (LSB) |
| 8 | REASSIGN STATUS | | | | SENSE KEY | | | |
| 9 | ADDITIONAL SENSE CODE | | | | | | | |
| 10 | ADDITIONAL SENSE CODE QUALIFIER | | | | | | | |
| 11 | | | | | | | | |
| 15 | VENDOR SPECIFIC Vendor specific | | | | | | | |
| 16 | (MSB) | | | | | | | |
| 23 | LBALOGICAL BLOCK ADDRESS | | | | | | | (LSB) |

The contents of the DU, DS, TSD, ETC, LBIN, and LP bits and the TMC field are defined in SPC-4.

Table 96 defines the values for the log parameter control bits (see SPC-4) for this log parameter.

**Table 96 — Parameter control bits for Background Medium Scan log parameter**

| Field | Value for LOG SENSE | Value for LOG SELECT | Description |
|---|---|---|---|
| DU | 0 | any | The DU bit is not defined for list parameters, so shall be set to zero when read with the LOG SENSE command and shall be ignored when written with the LOG SELECT command. |
| DS | any | any | No specific requirements |
| TSD | any | any | No specific requirements |
| ETC | 0 | any | The ETC bit is not defined for list parameters, so shall be set to zero when read with the LOG SENSE command and shall be ignored when written with the LOG SELECT command. |
| TMC | 00b | any | The TMC field is not defined for list parameters, so shall be set to 00b when read with the LOG SENSE command and shall be ignored when written with the LOG SELECT command. |
| LBIN | 1 | 1 | The log parameter is in binary format. |
| LP | 1 | 1 | The log parameter is a list parameter. |

The PARAMETER LENGTH field indicates the number of bytes remaining in the log parameter.

The ACCUMULATED POWER ON MINUTES field indicates the total power on minutes number of minutes the device server has been powered on since manufacturing at the time the error was detected.

Table 97 ~~specifies~~ defines the REASSIGN STATUS field.

**Table 97 — REASSIGN STATUS field**

| ~~Value~~ Code | Reported if the LOWIR bit is set to one in the Background Control mode page (see 6.3.3) | Description |
|---|---|---|
| 0h | No | ~~no reassignment needed.~~ Reserved |
| 1h | Yes | The logical block specified by the LOGICAL BLOCK ADDRESS field failed and ~~R~~reassignment is pending receipt of ~~Reassign~~: [a] [b]<br>a) ~~write command~~ a command performing a write operation, ~~(~~ if auto write reallocation is allowed; or<br>b) a REASSIGN BLOCKS command (see 5.16). |
| 2h | No | ~~LBA~~ The logical block specified by the LOGICAL BLOCK ADDRESS field failed and was successfully reassigned by the device server with recovered data |
| 3h | Reserved | |
| 4h | Yes | The logical block specified by the LOGICAL BLOCK ADDRESS field failed and ~~R~~reassign~~ment~~by the device server failed; the logical block may or may not have an uncorrectable error |
| 5h | No | ~~LBA~~ The logical block specified by the LOGICAL BLOCK ADDRESS field failed and was recovered by the device server via ~~re-write~~a rewrite in-place |
| 6h | Yes | The logical block specified by the LOGICAL BLOCK ADDRESS field failed, was successfully reassigned by the application client, and contains valid data (e.g., by a REASSIGN BLOCKS command that successfully recovered the data, or by a command performing a write operation) [b] |
| 7h | Yes | The logical block specified by the LOGICAL BLOCK ADDRESS field failed, was successfully reassigned by the application client, but does not contain valid data (e.g., by a REASSIGN BLOCKS command that did not successfully recover the data) [b] |
| 8h | Yes | The logical block specified by the LOGICAL BLOCK ADDRESS field failed and was not successfully reassigned by the application client (e.g., by a REASSIGN BLOCKS command that failed) [b] |
| ~~6h~~9h - Fh | Reserved | |
| [a] The application client should use a command performing a write operation if it knows what data belongs on the logical block (e.g., in a redundancy group (see 4.14.1), it uses data regenerated from the data on the other logical units in the redundancy group). The REASSIGN BLOCKS may not be able to recover the data and does not report whether or not it successfully does so.<br>[b] The REASSIGN STATUS field in a given log parameter changes from 1h or 4h to 6h, 7h, or 8h when the logical block is reassigned, rewritten, or failed. If the logical block is reassigned or rewritten, any subsequent medium error to the logical block is reported in a new log parameter with the same value in the LOGICAL BLOCK ADDRESS field. | | |

The SENSE KEY field, ADDITIONAL SENSE CODE field, and the ADDITIONAL SENSE CODE QUALIFIER field may contain a hierarchy of additional information relating to error conditions that occurred during background scanning. They are represented in the same format used by the sense data (see SPC-4).

The LBALOGICAL BLOCK ADDRESS field indicates the logical block address associated with the medium error.

### 6.3.3 Background Control mode page

The Background Control mode page (see table 98) is a subpage of the Informational Exception Control mode page (see SPC-4) and provides controls over background operations. The mode page policy (see SPC-34) for this subpage shall be shared.

**Table 98 — Background Control mode page**

| Byte\Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | PS | SPF (1b) | PAGE CODE (1Ch) | | | | | |
| 1 | SUBPAGE CODE (01h) | | | | | | | |
| 2 | (MSB) | PAGE LENGTH (000Ch) | | | | | | |
| 3 | | | | | | | | (LSB) |
| 4 | Reserved | | | | | SUSPEND_ON_LOG_FULL | LOWIR | EN_BMS |
| 5 | Reserved | | | | | | | EN_PS |
| 6 | (MSB) | BACKGROUND MEDIUM SCAN BMS INTERVAL TIME | | | | | | |
| 7 | | | | | | | | (LSB) |
| 8 | (MSB) | BACKGROUND PRE-SCAN TIMEOUT VALUETIME LIMIT | | | | | | |
| 9 | | | | | | | | (LSB) |
| 10 | (MSB) | MINIMUM IDLE TIME BEFORE BACKGROUND SCANReserved | | | | | | |
| 11 | | | | | | | | (LSB) |
| 12 | (MSB) | MAXIMUM TIME TO SUSPEND BACKGROUND SCAN Reserved | | | | | | |
| 13 | | | | | | | | (LSB) |
| 14 | Reserved | | | | | | | |
| 15 | | | | | | | | |

Editor's Note 2: Delete vertical bars on the Reserved bytes at the end of the table

A SUSPEND_ON_LOG_FULL bit set to zero specifies that the device server shall continue running a background scan even if the Background Scan Results log page contains the maximum number of log parameters supported by the logical unit. A SUSPEND_ON_LOG_FULL bit set to one specifies that the device server shall suspend a background scan if the Background Scan Results log page contains the maximum number of log parameters supported by the logical unit.

A log only when intervention required (LOWIR) bit set to zero specifies that the device server shall log all suspected medium errors in the Background Scan Results log page (see 6.2.2). A LOWIR bit set to one specifies that the device server shall only log medium errors requiring application client intervention in the Background Scan Results log page as defined in table 8 in 6.2.2.

An enable background medium scan (EN_BMS) bit set to zero specifies that background medium scan isshall be disabled. An EN_BMS bit set to one specifies that background medium scan operations areshall be enabled. If the EN_PS bit is also set to one then a background medium scan operation shall not start until after the background pre-scan operation is halted or completed. The BMS interval time shall occur before a background medium scan operation is started. If a background medium scan is in progress when the EN_BMS bit is changed from one to zero, then the background medium scan shall be suspended before completing the

MODE SELECT command and remain suspended until the EN_BMS bit is set to one, at which time the background medium scan shall resume from the suspended location.

An enable pre-scan (EN_PS) bit set to zero specifies that background pre-scan isshall be disabled. If a background pre-scan operation is in progress when EN_PS is changed from a one to a zero then the background pre-scan operation shall be is halted before completing the MODE SELECT command. An EN_PS bit set to one specifies that a background pre-scan operation isshall be started after the next power on cycle. Once this background pre-scan has completed, another background pre-scan shall not occur unless the EN_PS bit is set to zero, then set to one, and another power on cycle occurs.

Editor's Note 3: In sbc3r03, the EN_BMS and EN_PS paragraphs are in the wrong order

The BACKGROUND MEDIUM SCAN BMS INTERVAL TIME field specifies the minimum time, in hours, between the start of one background pre-scan or background medium scan operation and the start of the next background medium scan operation. If the current background medium scan operation takes longer than the value specified in the BACKGROUND MEDIUM SCAN BMS INTERVAL TIME field, then the current background pre-scan or background medium scan or pre-scan continues until completion and the next background medium scan operation starts on completion of the current background pre-scan or background medium scan or pre-scan.

The BACKGROUND PRE-SCAN TIMEOUT VALUETIME LIMIT field specifies the maximum time, in hours, for a background pre-scan operation to complete. If the background pre-scan operation does not complete within the specified time then it is halted. A value of zero specifies an unlimited timeout value.

The MINIMUM IDLE TIME BEFORE BACKGROUND SCAN field specifies the time, in milliseconds, that the logical unit shall be idle before resuming a background pre-scan or a background medium scan.

The MAXIMUM TIME TO SUSPEND BACKGROUND SCAN field specifies the time, in milliseconds, that the logical unit should take to start processing a command received while it is performing a background pre-scan or a background medium scan.

**Suggested changes to SPC-4**

Global: Change WARNING - PRE-SCAN FAILED to WARNING - BACKGROUND PRE-SCAN DETECTED MEDIUM ERROR

Global: Change WARNING - SCAN FAILED to WARNING - BACKGROUND MEDIUM SCAN DETECTED MEDIUM ERROR

**7.2.10 Self-Test Results log page**

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The TIMESTAMPACCUMULATED POWER ON HOURS field contains the total accumulated power-onnumber of hours for the device server has been powered on since manufacturing at the time the self-test was completed. If the test is still in progress, the content of the TIMESTAMPACCUMULATED POWER ON HOURS field shall be set to zero. If the power-on hours for the device server at the time the self-test was completednumber of hours is greater than FFFFh then the content of the TIMESTAMPACCUMULATED POWER ON HOURS field shall be set to FFFFh.

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