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To: **T10 CAP Working Group**
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Subject: **SPC-4, Even more log page cleanup**

1 Related documents

SPC-4r12 - SCSI Primary Command Set - 4, revision 14
05-242r2 - SPC, Combination of bits and fields in the LOG SELECT CDB and log parameters
06-079r1 - SPC, More log page cleanup

2 Introduction

After much work over the past several years in trying to clarify how the LOG SELECT command and LOG SENSE command and all of the combinations of bits and fields in those commands and log parameter data are supposed to work, additional issues have been identified that require clarification, including:

a) The distinction between data counter parameters and list parameters is not always clear. Most of the following is already defined in the standard, but some of the rules that define how the values listed below are affected under what conditions require clarification.
   A) There are always current cumulative and current threshold values for data counter parameters;
   B) There may be saved cumulative and/or saved threshold values for data counter parameters if saving these values is allowed by a device server, and an action has been taken to save parameters to non-volatile storage via a LOG SELECT command, a LOG SENSE command, or a vendor specific action;
   C) There are always default cumulative and default threshold values for data counter parameters, but these values may be vendor specific and may be zero;
   D) Default cumulative and default threshold values for data counter parameters may be changed by an application client using LOG SELECT commands, if this action is allowed by the device server;
   E) Default cumulative and default threshold values for data counter parameters may be saved (i.e., old values in non-volatile storage are replaced by new values) by an application client using LOG SELECT commands, if this action is allowed by the device server;
   F) There are always current values for list parameters;
   G) There may be saved values for list parameters, if saving these values is allowed by a device server, and an action has been taken to save list parameters to non-volatile storage via a LOG SELECT command, a LOG SENSE command, or a vendor specific action; and
   H) There are always default values for list parameters, but these values are vendor specific and may be zero.
b) The settings of the bits and fields for each of the log parameters defined in the draft standard should be clarified.

The following proposes resolutions to these and other issues that have been identified. Text that has been changed and text that has been moved from one clause to another is identified with change indications. Text that has been moved within a clause to make the flow more consistent is not identified with change indications.

The following includes input from the CAP working group meeting in San Jose on Wednesday, May 7, 2008.

3 Proposal

The following shows the proposed changes to SPC-4.

6.5 LOG SELECT command

The LOG SELECT command (see table 1) provides a means for an application client to manage statistical information maintained by the SCSI target device about the SCSI target device or its logical units. Device servers that implement the LOG SELECT command shall also implement the LOG SENSE command. Structures in the form of log parameters within log pages are defined as a way to manage the log data. The LOG SELECT command provides a method for sending zero or more log pages via the Data-Out Buffer. This standard defines the format of the log pages (see clause 7) ~~but does not~~ and defines some of the conditions and events that are logged.

Table 1 — LOG SELECT command

Byte \ Bit	7	6	5	4	3	2	1	0
0	OPERATION CODE (4Ch)							
1	Reserved						PCR	SP
2	PC		PAGE CODE					
3	SUBPAGE CODE							
4	Reserved							
6								
7	(MSB)		PARAMETER LIST LENGTH					
8								(LSB)
9	CONTROL							

The parameter code reset (PCR) bit instructs a device server whether or not to set parameters to their vendor specific default values (e.g., zero) (see table 3).

The save parameters (SP) bit instructs a device server whether or not to saves parameters to non-volatile memory (see table 3).

The page control (PC) field specifies which data counter parameter values (i.e., when the FORMAT AND LINKING field (see table 11) contains 00b or 10b) shall be processed by a device server in response to a LOG SELECT

command as defined in table 2. The PC field shall be ignored for list parameters (i.e., when the FORMAT AND LINKING field (see table 11) contains 01b or 11b).

Table 2 — Page control (PC) field

PC field ~~–[a]~~	Description
00b	Threshold values [a]
01b	Cumulative values [a]
10b	Default threshold values
11b	Default cumulative values

[a] ~~The PC field shall be ignored for list parameters (i.e., when the FORMAT AND LINKING field (see table 11) contains 01b or 11b).~~The threshold values and cumulative values for data counter parameters are:

1) the current values if there has been an update to a cumulative parameter value (e.g., by a LOG SELECT command or by a device specific event) in the specified page or pages since the last logical unit reset occurred;
2) the saved values, if saved parameters are implemented, current values have been saved, and an update has not occurred since the last logical unit reset; or
3) the vendor specific default values, if saved values are not available or not implemented.

When evaluated together, ~~T~~the combination of the values in the ~~parameter code reset (~~PCR~~)~~ bit, the ~~save parameters (~~SP~~)~~ bit, and the ~~page control (~~PC~~)~~ field specify the actions that a SCSI target device performs after receiving a LOG SELECT command.

If the PARAMETER LIST LENGTH field contains a value other than zero, then the actions that a SCSI target device performs after receiving a LOG SELECT command are determined by the values in the PCR bit, the SP bit, and the PC field as defined in table 7 (see 7.2.1.1).

Table 3 defines the meaning of the combinations of values for the PCR bit, the SP bit, and the PC field when the parameter list length is zero (i.e., when there is no parameter data being sent with the LOG SELECT command).

Table 3 — PCR bit, SP bit, and PC field meanings when parameter list length is zero (part 1 of 2)

PCR bit	SP bit	PC field	Description
0b	0b	0xb	This is not an error. The device server shall make no change to any ~~current threshold values or any current cumulative~~ log parameter values and shall not save any values to non-volatile media.
0b	1b	00b	The device server shall make no change to any log parameter values and shall process the optional saving of current ~~threshold~~ parameter values as follows: a) If the values are current threshold data counter parameters, then: A) if the device server implements saving of the current threshold values, then the device server shall save all current threshold values to non-volatile media; or B) If the device server does not implement saving of the current threshold values, then the device server shall terminate the command[a]; or b) If the parameters are current list parameters: A) if the device server implements saving of current list parameters, then the device server shall save all current list parameters to non-volatile media; or B) If the device server does not implement saving of current list parameters, then the device server shall terminate the command[a].
0b	1b	01b	The device server shall make no change to any log parameter values and shall process the optional saving of current ~~threshold~~ parameter values as follows: a) If the values are current cumulative data counter parameters, then: A) if the device server implements saving of the current cumulative values, then the device server shall save all current cumulative values to non-volatile media; or B) If the device server does not implement saving of the current cumulative values, then the device server shall terminate the command[a]; or b) If the parameters are current list parameters: A) if the device server implements saving of current list parameters, then the device server shall save all current list parameters to non-volatile media; or B) If the device server does not implement saving of current list parameters, then the device server shall terminate the command[a].
0b	xb	10b	The device server shall set all current threshold values to the vendor specific default threshold values[b] and shall not save any values to non-volatile media.
0b	xb	11b	The device server shall set all current cumulative values to the vendor specific default cumulative values[b] and shall not save any values to non-volatile media.
1b	0b	xxb	The device server shall: 1) Set all current threshold values to the vendor specific default threshold values[b]; 2) Set all current cumulative values to the vendor specific default cumulative values[b]; 3) Set all list parameters to their vendor specific default values[b]; and 4) Not save any values to non-volatile media.

[a] The command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

[b] Vendor specific default threshold values and vendor specific default cumulative values may be zero.

Table 3 — PCR bit, SP bit, and PC field meanings when parameter list length is zero (part 2 of 2)

PCR bit	SP bit	PC field	Description
1b	1b	00b	The device server shall process the optional saving of current threshold values as follows: a) If the device server implements saving of the current threshold values, then the device server shall: 1) Save all current threshold values to non-volatile media; 2) Set all current threshold values to the vendor specific default threshold values[b]; 3) Set all current cumulative values to the vendor specific default cumulative values[b];, and 4) Set all list parameters to their vendor specific default values. or b) If the device server does not implement saving of the current threshold values, then the device server shall terminate the command[a].
1b	1b	01b	The device server shall process the optional saving of current cumulative values as follows: a) If the device server implements saving of the current cumulative values, then the device server shall: 1) Save all current ~~threshold~~ cumulative values to non-volatile media; 2) Set all current threshold values to the vendor specific default threshold values[b]; 3) Set all current cumulative values to the vendor specific default cumulative values[b];, and 4) Set all list parameters to their vendor specific default values. or b) If the device server does not implement saving of the current cumulative values, then the device server shall terminate the command[a].
1b	1b	1xb	The device server shall: 1) Set all current threshold values to the vendor specific default threshold values[b]; 2) Set all current cumulative values to the vendor specific default cumulative values[b]; 3) Set all list parameters to their vendor specific default values; and 4) Not save any values to non-volatile media.

[a] The command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

[b] Vendor specific default threshold values and vendor specific default cumulative values may be zero.

The current cumulative values may be updated by the device server as defined for the specific log page or by the application client using the LOG SELECT command. The current threshold values may only be modified by the application client via the LOG SELECT command.

NOTE 1 - Log pages or log parameters that are not available may become available at some later time (e.g., after the logical unit has become ready).

When the PARAMETER LIST LENGTH field contains zero, ~~T~~the PAGE CODE field and SUBPAGE CODE field (see table 4) specify the log page or log pages to which the other CDB fields apply.

Table 4 — PAGE CODE field and SUBPAGE CODE field

PAGE CODE field	SUBPAGE CODE field	Description
00h	00h	All log parameters in all log pages [a]
00h - 3Fh	01h - FEh	All log parameters in the log page specified by the page code and subpage code
00h - 3Fh	FFh	All log parameters in the log pages specified by page code and all subpage codes
01h - 3Fh	00h	All log parameters in the log page specified by the page code
[a] This is equivalent to the LOG SELECT command operation specified by previous versions of this standard.		

Since each log page in the parameter list contains a PAGE CODE field and SUBPAGE CODE field (see 7.2.1), the command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB, if the PARAMETER LIST LENGTH field contains a value other than zero, and:

a) The PAGE CODE field contains a value other than zero; or
b) the SUBPAGE CODE field contains a value other than zero.

The PARAMETER LIST LENGTH field specifies the length in bytes of the parameter list that shall be located in the Data-Out Buffer. A parameter list length of zero specifies that no log pages shall be transferred. This condition shall not be considered an error.

6.6 LOG SENSE command

The LOG SENSE command (see table 5) provides a means for the application client to retrieve statistical or other operational information maintained by the SCSI target device about the SCSI target device or its logical units. It is a complementary command to the LOG SELECT command.

Table 5 — LOG SENSE command

Byte \ Bit	7	6	5	4	3	2	1	0
0	OPERATION CODE (4Dh)							
1	Reserved						PPC	SP
2	PC		PAGE CODE					
3	SUBPAGE CODE							
4	Reserved							
5	(MSB)							
6	PARAMETER POINTER							(LSB)
7	(MSB)							
8	ALLOCATION LENGTH							(LSB)
9	CONTROL							

The parameter pointer control (PPC) bit controls the type of parameters requested from the device server:

a) A PPC bit set to one specifies that the device server shall return a log page with parameter code values that have changed since the last LOG SELECT or LOG SENSE command. The device server shall return only those parameter codes that are greater than or equal to the contents of the PARAMETER POINTER field in ascending order of parameter codes from the specified log page;
b) A PPC bit set to zero specifies that the device server shall return those parameter codes that are greater than or equal to the contents of the PARAMETER POINTER field in ascending order of parameter codes from the specified log page; and
c) A PPC bit set to zero and a PARAMETER POINTER field set to zero specifies that the device server shall return all available log parameters from the specified log page.

If the PPC bit is set to one and the value of the SUBPAGE CODE field is set to FFh, then the command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

Saving parameters is an optional function of the LOG SENSE command. If the logical unit does not implement saving log parameters and if the save parameters (SP) bit is set to one, then the command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

An SP bit set to zero specifies the device server shall perform the specified LOG SENSE command and shall not save any log parameters. If saving log parameters is implemented, an SP bit set to one specifies that the device server shall perform the specified LOG SENSE command and shall save all log parameters identified as saveable by the DS bit (see 7.2) to a nonvolatile, vendor specific location.

For data counter log parameters (i.e., when the FORMAT AND LINKING field in the parameter control byte in the log parameter structure (see 7.2.1.2) contains 00b or 10b), the page control (PC) field (see table 2) specifies which log parameter values are to be returned by the device server in response to a LOG SENSE command.

For list parameters (i.e., when the FORMAT AND LINKING field in the parameter control byte in the log parameter structure (see 7.2.1.2) contains 01b or 11b), the PC field shall be ignored. If the parameters specified by the PAGE CODE field and SUBPAGE CODE field in the CDB are list parameters, then t~~T~~he parameter values returned by a device server in response to a LOG SENSE command are determined as follows:

1) the current list parameter values if there has been an update to a list parameter value (e.g., by a LOG SELECT command or by a device specific event) in the specified page or pages since the last logical unit reset occurred~~The specified parameter values at the last update (i.e., in response to a LOG SELECT or LOG SENSE command or done automatically by the device server for cumulative values)~~;
2) The saved list parameter values, if saved parameters are implemented, and an update has not occurred since the last logical unit reset; or
3) The vendor specific default list parameter values, if saved values are not available or not implemented, and an update has not occurred since the last logical unit reset.

The PAGE CODE field and SUBPAGE CODE field specify which log page of data is being requested (see 7.2). If the log page specified by the page code and subpage code combination is reserved or not implemented, the command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

The PARAMETER POINTER field allows the application client to request parameter data beginning from a specific parameter code to the maximum allocation length or the maximum parameter code supported by the logical unit, whichever is less. If the value of the PARAMETER POINTER field is larger than the largest available parameter code known to the device server for the specified log page, the command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

The ALLOCATION LENGTH field is defined in 4.3.5.6.

Log parameters within the specified log page shall be transferred in ascending order according to parameter code.

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7.2 Log parameters

7.2.1 Log page structure ~~and page codes~~ for all device types

7.2.1.1 Log page structure introduction

This subclause describes the log page structure ~~and the log pages~~ that ~~are~~is applicable to all SCSI devices. Log pages specific to each device type are described in the command standard (see 3.1.18) that applies to that device type. The LOG SELECT command (see 6.5) supports the ability to send zero or more log pages. The LOG SENSE command (see 6.6) returns a single log page specified by the combination of the PAGE CODE field and SUBPAGE CODE field in the CDB.

Each log page begins with a four-byte page header followed by zero or more variable-length log parameters defined for that log page. The log page format is defined in table 6.

Table 6 — Log page format

Byte \ Bit	7	6	5	4	3	2	1	0
0	DS	SPF	PAGE CODE					
1	SUBPAGE CODE							
2	(MSB)		PAGE LENGTH (n-3)					
3								(LSB)
Log parameter(s)								
4			Log parameter [first] ~~(see table 9)~~(see clause 7.2.1.2)					
x+3			(Length x)					
			.					
n-y+1			Log parameter [last] ~~(see table 9)~~(see clause 7.2.1.2)					
n			(Length y)					

For the LOG SENSE command (see 6.6), the DS bit indicates whether log parameters in this log page are saved when the SP bit is set to one in the CDB. If the DS bit is set to zero, the log parameters are saved when the SP bit is set to one. If the DS bit is set to one, the log parameters are not saved. For the LOG SELECT command (see 6.5), the disable save (DS) bit operates in conjunction with the parameter code reset (PCR) bit, the save parameters (SP) bit, the page control (PC) field, and the PARAMETER LIST LENGTH field in the CDB.

If the subpage format (SPF) bit is set to zero, then the SUBPAGE CODE field shall contain 00h. If the SPF bit is set to one, then the SUBPAGE CODE field shall contain a value between 01h and FFh.

The PAGE CODE field contains the number of the log page that is being transferred.

The SUBPAGE CODE field contains the subpage number of the log page that is being transferred.

If an application client specifies values in the PAGE CODE field and SUBPAGE CODE field for a log page that is reserved or not implemented by the logical unit, then the device server shall terminate the LOG SELECT command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

If the PARAMETER LIST LENGTH field in a LOG SELECT CDB contains zero, the meanings for the PCR bit, SP bit, and PC field are defined in 6.5.

If the PARAMETER LIST LENGTH field in a LOG SELECT CDB contains a non-zero value (i.e., when parameter data is being sent with the LOG SELECT command), table 7 defines the meaning for the combinations of values for:

a) The PCR bit, the SP bit, and the PC field in the LOG SELECT CDB; and
b) The DS bit in the LOG SELECT parameter data.

Table 7 — LOG SELECT PCR bit, SP bit, and DS bit meanings when parameter list length is not zero

PCR bit	SP bit	DS bit	Description
0b	0b	xb	The device server shall set the specified values[a] to the values in the parameter list and shall not save any values to non-volatile media.
0b	1b	0b	The device server shall set the specified values[a] to the values in the parameter list and shall process the optional saving of log parameter values as follows: a) If default data counter values are specified (see table 2), no values shall be saved; b) If values other than default data counter values are specified and the device server implements saving of the specified values[a], then the device server shall save the specified values[a] in the parameter list to non-volatile media; or c) If values other than default values are specified and the device server does not implements saving of one or more of the specified values[a], then the device server 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 PARAMETER LIST.
0b	1b	1b	The device server shall set the specified values[a] to the values in the parameter list and shall not save any values in the specified log page to non-volatile media.
1b	xb	xb	The device server 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.

[a] The specified parameters are determined by the FORMAT AND LINKING field contents (see table 11) in the LOG SELECT parameter data and by the PC field contents (see table 2) in the LOG SELECT CDB.

~~For data counter log parameters (i.e., log parameters in which the FORMAT AND LINKING field (see table 11) contains 00b or 10b), which data counter log parameter values are to be processed is specified the page control (PC) field in the CDB as follows:~~

a) ~~For a LOG SELECT command in which the PARAMETER LIST LENGTH field contains zero, the PC field usage is defined in 6.5; and~~

b) ~~For a LOG SENSE command (see 6.6) or a LOG SELECT command in which the PARAMETER LIST LENGTH field contains a non-zero value, the PC field usage is defined in table 8.~~

Table 8 — ~~Page control (PC) field~~

PC field [a]	Description
00b	Threshold values
01b	Cumulative values
10b	Default threshold values
11b	Default cumulative values

[a] The PC field shall be ignored for list parameters (i.e., when the FORMAT AND LINKING field (see table 11) contains 01b or 11b).

The value in the PAGE LENGTH field is the length in bytes of the log parameters that follow. If the application client sends a log page length that results in the truncation of any parameter, the command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

7.2.1.2 Log parameter structure

7.2.1.2.1 Log parameter structure introduction

Most log pages contain one or more special data structures called log parameters (see table 9). Log parameters may be data counters of a particular event(s), the conditions under which certain operations were performed, or list parameters that contain a character string or binary description of a particular event.

Table 9 — Log parameter

Byte \ Bit	7	6	5	4	3	2	1	0
0	(MSB)			PARAMETER CODE				
1								(LSB)
	Parameter control byte							
2	DU	Obsolete	TSD	ETC	TMC		FORMAT AND LINKING	
3	PARAMETER LENGTH (n-3)							
4				PARAMETER VALUE				
n								

Each log parameter begins with a four-byte parameter header followed by one or more bytes of PARAMETER VALUE data.

The PARAMETER CODE field identifies the log parameter being transferred for that log page. If an application client specifies a value in the PARAMETER CODE field in the LOG SELECT command parameter data that is reserved or not implemented by the logical unit, then the device server 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 PARAMETER LIST.

The DU bit, TSD bit, ETC bit, TMC field, and FORMAT AND LINKING field are collectively referred to as the parameter control byte. The bits and fields in the parameter control byte are defined in 7.2.1.2.2.

The parameter length field specifies the length in bytes of the parameter value field that follows. If the application client specifies a parameter length that results in the truncation of the parameter value field, the

command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

If an application client sends a log parameter that is not supported by the logical unit, the command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

If the application client sends a log parameter value that is outside the range supported by the logical unit, and rounding is implemented for that parameter, the device server may either:

a) Round to an acceptable value and terminate the command as described in 5.4; or
b) 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 PARAMETER LIST.

If the parameter data for one LOG SELECT command contains more than one log page and the log pages are not in ascending order by page code value then subpage code value, then the device server 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 PARAMETER LIST.

If the parameter data for one LOG SELECT command contains more than one log parameter in any one log page and the log parameters are not in ascending order by parameter code value, then the device server 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 PARAMETER LIST.

NOTE 2 - Application clients should send LOG SENSE commands prior to sending LOG SELECT commands to determine supported log pages and page lengths.

The SCSI target device may provide independent sets of log parameters for each logical unit or for each combination of logical units and I_T nexuses. If the SCSI target device does not support independent sets of log parameters and any log parameters are changed that affect other I_T nexuses, then the device server shall establish a unit attention condition (see SAM-4) for the initiator port associated with every I_T nexus except the I_T nexus on which the LOG SELECT command was received, with the additional sense code set to LOG PARAMETERS CHANGED.

7.2.1.2.2 Parameter control byte

7.2.1.2.2.1 Parameter control byte introduction

~~The du bit, tsd bit, etc bit, tmc field, and format and linking field are collectively referred to as the~~ The bits and fields in the parameter control byte~~. These fields~~ are described in this subclause.

For cumulative log parameter values, indicated by the PC field (see table 8) of the LOG SELECT command and LOG SENSE command, the disable update (DU) bit is defined as follows:

a) DU set to zero indicates that the device server shall update the log parameter value to reflect all events that should be noted by that parameter; or
b) DU set to one indicates that the device server shall not update the log parameter value except in response to a LOG SELECT command that specifies a new value for the parameter.

NOTE 3 - When updating cumulative log parameter values, a device server may use volatile memory to hold these values until a LOG SELECT or LOG SENSE command is received with an SP bit set to one or a vendor specific event occurs. As a result the updated cumulative log parameter values may be lost if a power cycle occurs.

The device server shall ignore the DU bit for threshold values, indicated by the PC field (see table 8) of the LOG SENSE command, or for list parameters as indicated by the FORMAT AND LINKING field received with a LOG

SELECT command. The device server shall ignore the value of the DU bit in any such log parameters received with a LOG SELECT command.

A target save disable (TSD) bit set to zero indicates that the logical unit implicitly saves the log parameter at vendor specific intervals. This implicit saving operation shall be done frequently enough to insure that the cumulative parameter values retain statistical significance (i.e., across power cycles). A TSD bit set to one indicates that either the logical unit does not implicitly save the log parameter or implicit saving of the log parameter has been disabled individually by an application client setting the TSD bit to one. An application client may disable the implicit saving for all log parameters without changing any TSD bits using the GLTSD bit in the Control mode page (see 7.4.6).

An enable threshold comparison (ETC) bit set to one indicates that a comparison to the threshold value is performed whenever the cumulative value is updated. An ETC bit set to zero indicates that a comparison is not performed. The value of the ETC bit is the same for cumulative and threshold parameters.

The threshold met criteria (TMC) field (see table 10) defines the basis for comparison of the cumulative and threshold values. The TMC field is valid only if the ETC bit is set to one. The value of the TMC field is the same for cumulative and threshold parameters.

Table 10 — Threshold met criteria (TMC) field

Code	Basis for comparison
00b	Every update of the cumulative value
01b	Cumulative value equal to threshold value
10b	Cumulative value not equal to threshold value
11b	Cumulative value greater than threshold value

If the ETC bit is set to one and the result of the comparison is true, the device server shall establish a unit attention condition (see SAM-4) for the initiator port associated with every I_T nexus, with the additional sense code set to THRESHOLD CONDITION MET.

The FORMAT AND LINKING field (see table 11) indicates the type of log parameter and how parameters that reach their maximum value are handled.

Table 11 — FORMAT AND LINKING field

Code	Log parameter type	Maximum value handling
00b	Data counter	If any other parameter in this log page reaches its maximum value, then this parameter shall stop incrementing until reinitialized by a LOG SELECT command.
01b	List format ASCII data (see 4.4.1)	No maximum values to handle
10b	Data counter	If another parameter reported in this log page reaches its maximum value, then this parameter shall not stop incrementing. This parameter may be reinitialized by a LOG SELECT command.
11b	List format binary data	No maximum values to handle

A FORMAT AND LINKING field set to 00b or 10b indicates that the parameter is a data counter. Data counters are saturating counters associated with one or more events. A data counter is incremented whenever one of these events occurs. If a data counter has associated with it a vendor specific maximum value, then upon reaching this maximum value, the data counter shall not be incremented (i.e., its value does not wrap). When a data counter reaches its maximum value, the device server shall set the associated DU bit to one and handle other data counters in the log page as defined in table 11. If the data counter is at or reaches its maximum value during the processing of a command, the device server shall complete the command. If the command

completes without error, except for the data counter being at its maximum value, and if the RLEC bit of the Control mode page (see 7.4.6) is set to one, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to RECOVERED ERROR, and the additional sense code set to LOG COUNTER AT MAXIMUM.

A FORMAT AND LINKING field set to 01b or 11b indicates that the parameter is a list parameter. If the FORMAT AND LINKING field set to 01b or 11b, the ETC bit and TMC field shall be set to zero. If the FORMAT AND LINKING field set to 01b or 11b and either the ETC bit and TMC field shall is set to a non-zero value in LOG SELECT parameter data, then the device server shall terminate the command with CHECK CONDITION status and shall set the sense key to ILLEGAL REQUEST and the additional sense code to INVALID FIELD IN PARAMETER LIST.

If more than one list parameter is defined in a single log page, the following rules apply to assigning parameter codes:

a) The parameter updated last shall have a higher parameter code than the parameter updated previously, except as defined in rule b); and
b) When the maximum parameter code value supported by the logical unit is reached, the device server shall assign the lowest parameter code value to the next log parameter (i.e., wrap-around parameter codes). If the associated LOG SELECT command completes without error, except for the parameter code being at its maximum value, and if the RLEC bit of the Control mode page (see 7.4.6) is set to one, then the command shall be terminated with CHECK CONDITION status, with the sense key set to RECOVERED ERROR, and the additional sense code set to LOG LIST CODES EXHAUSTED.

NOTE 4 - List parameters may be used to store the locations of defective blocks in the following manner. When a defective block is identified, a list parameter is updated to reflect the location and cause of the defect. When the next defect is encountered, the list parameter with the next higher parameter code is updated to record this defect. The size of the log page may be made vendor specific to accommodate memory limitations. It is recommended that one or more data counter parameters be defined for the log page to keep track of the number of valid list parameters and the parameter code of the parameter with the oldest recorded defect. This technique may be adapted to record other types of information.

If a LOG SELECT command's parameter data contains a FORMAT AND LINKING value that is not allowed (see table 12) based on the FORMAT AND LINKING field value returned by a LOG SENSE command, the LOG SELECT command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

Table 12 — Allowed LOG SELECT FORMAT AND LINKING field values

Format and linking values returned by LOG SENSE	LOG SELECT format and linking values			
	00b	01b	10b	11b
00b	Allowed	Not Allowed	Allowed	Not Allowed
01b	Not Allowed	Allowed	Not Allowed	Not Allowed
10b	Allowed	Not Allowed	Allowed	Not Allowed
11b	Not Allowed	Not Allowed	Not Allowed	Allowed

The values for the FORMAT AND LINKING field for each log parameter are defined in the clause defining each log parameter.

If the value in the FORMAT AND LINKING field is 00b or 10b (i.e., the log parameter is a data counter parameter), then the values for the bits and fields in the parameter control byte for a LOG SENSE command or LOG SELECT command are defined in (see 7.2.1.2.2.2).

If the value in the FORMAT AND LINKING field is 01b or 11b (i.e., the log parameter is a list parameter), then the values for the bits and fields in the parameter control byte for a LOG SENSE command or LOG SELECT command are defined in (see 7.2.1.2.2.3).

7.2.1.2.2.2 Parameter control byte settings for data counter parameters

If the FORMAT AND LINKING field is set to 00b or 10b (i.e., the parameter is a data counter parameter), then table 13 defines the values for the bits and fields in the parameter control byte.

Table 13 — Parameter control byte data counter parameters

Field	Value for LOG SENSE	Value for LOG SELECT	Description
DU	0 or 1	0 or 1	When the DU bit is set to zero, the device server shall update the log parameter value to reflect all events that should be noted by that parameter. When the DU bit is set to one, the device server shall not update the log parameter value except in response to a LOG SELECT command that specifies a new value for the parameter.
TSD	0 or 1	0 or 1	When the TSD bit is set to zero, the device server shall save the log parameter to its medium at vendor specific intervals. When the TSD bit is set to one, implicit saving of the log parameter is disabled by an application client.
ETC	0 or 1	0 or 1	When the ETC bit is set to one, a comparison to the threshold value is performed whenever the cumulative value is updated. When the ETC bit is set to zero, a comparison is not performed.
TMC	any	any	The TMC field defines the basis for comparison of the cumulative and threshold values. The TMC field is valid only if the ETC bit is set to one. See 7.2.1.2.2.1 for more about the definition of the TMC field and its values.
FORMAT AND LINKING	00b or 10b	00b or 10b	The log parameter is a data counter (see table 11).

7.2.1.2.2.3 Parameter control byte settings for list parameters

If the FORMAT AND LINKING field is set to 01b or 11b (i.e., the parameter is a list parameter), then table 14 defines the values for the bits and fields in the parameter control byte.

Table 14 — Parameter control byte for list parameters

Field	Value for LOG SENSE	Value for LOG SELECT	Description
DU	0	0 or 1 (i.e., ignored)	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.
TSD	0 or 1	0 or 1	When the TSD bit is set to zero, the device server shall save the log parameter to its medium at vendor specific intervals. When the TSD bit is set to one, implicit saving of the log parameter is disabled by an application client.
ETC	0	0 or 1 (i.e., ignored)	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 (i.e., ignored)	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.
FORMAT AND LINKING	01b	01b	The log parameter is an ASCII format list parameter (see table 11).
	11b	11b	The log parameter is a binary format list parameter (see table 11).

~~The parameter length field specifies the length in bytes of the parameter value field that follows. If the application client specifies a parameter length that results in the truncation of the parameter value field, the command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.~~

~~If an application client sends a log parameter that is not supported by the logical unit, the command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.~~

~~If the application client sends a log parameter value that is outside the range supported by the logical unit, and rounding is implemented for that parameter, the device server may either:~~

~~a) Round to an acceptable value and terminate the command as described in 5.4; or~~
~~b) 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 PARAMETER LIST.~~

~~If the parameter data for one LOG SELECT command contains more than one log page and the log pages are not in ascending order by page code value then subpage code value, then the device server 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 PARAMETER LIST.~~

~~If the parameter data for one LOG SELECT command contains more than one log parameter in any one log page and the log parameters are not in ascending order by parameter code value, then the device server 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 PARAMETER LIST.~~

~~NOTE 5 NOTE 45 Application clients should send LOG SENSE commands prior to sending LOG SELECT commands to determine supported log pages and page lengths.~~

~~The SCSI target device may provide independent sets of log parameters for each logical unit or for each combination of logical units and I_T nexuses. If the SCSI target device does not support independent sets of log parameters and any log parameters are changed that affect other I_T nexuses, then the device server shall establish a unit attention condition (see SAM-4) for the initiator port associated with every I_T nexus except the I_T nexus on which the LOG SELECT command was received, with the additional sense code set to LOG PARAMETERS CHANGED.~~

7.2.2 Log page codes for all device types

The page code assignments for the log pages are listed in table 266.

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7.2.3 Application Client log page

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~~The state of the log parameter control bits for parameters 0000h through 0FFFh is specified in table 15.~~

Table 15 — ~~Parameter control bits for general usage parameters (0000h through 0FFFh)~~

Bit or field	Value	Description
DU	1b	Value provided by application client
TSD	0b	Device server manages saving of parameter
ETC	0b	No threshold comparison is made on this value
TMC	xx	Ignored when the ETC bit is set to zero
FORMAT AND LINKING	11b	The parameter is a binary format list parameter

The FORMAT AND LINKING field for log parameters 0000h through 0FFFh shall be set to 11b, indicating that the parameters are binary format list parameters. The settings of the bits and fields in the parameter control byte for binary format list parameters are defined in 7.2.1.2.2.3.

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7.2.4 Buffer Over-Run/Under-Run log page

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The FORMAT AND LINKING field ~~(see table 264 in 7.2.1)~~ of each log parameter in the Buffer Over-Run/Under-Run log page shall be set to 00b or 10b, indicating~~it~~ that the parameters ~~contains a~~ are data counter parameters. The settings of the bits and fields in the parameter control byte for data counter parameters are defined in 7.2.1.2.2.2.

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7.2.5 Error Counter log pages

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The FORMAT AND LINKING field ~~(see table 264 in 7.2.1)~~ of each log parameter in the Error Counter log pages shall be set to 00b or 10b, indicating ~~it~~ that the parameters ~~contains a~~ are data counter parameters. The setting of the bits and fields in the parameter control byte for a data counter parameter are defined in 7.2.1.2.2.2.

7.2.6 Informational Exceptions log page

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~~The values of the log parameter control bits for the informational exceptions log parameter are specified in table 16.~~

Table 16 — ~~Parameter control bits for Informational exceptions log parameter (0000h)~~

Bit or field	Value	Description
DU	0b	Value provided by device server
TSD	0b	Device server manages saving of parameter
ETC	0b	No threshold comparison is made on this value
TMC	xx	Ignored when the ETC bit is set to zero
FORMAT AND LINKING	11b	The parameter is a binary format list parameter

The FORMAT AND LINKING field for log parameter 0000h for the Informational Exception log page shall be set to 11b, indicating that the parameter is a binary format list parameter. The settings of the bits and fields in the parameter control byte for binary format list parameters are defined in 7.2.1.2.2.3.

7.2.7 Last *n* Deferred Errors or Asynchronous Events log page

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~~The DU bit, TSD bit, ETC bit, and TMC field shall be set to zero. The FORMAT AND LINKING field shall be set to 11b to indicate a binary format list parameter.~~

The FORMAT AND LINKING field of each the log parameter for the Last *n* Deferred Errors or Asynchronous Events log page shall be set to 11b, indicating that the parameters are binary format list parameters. The settings of the bits and fields in the parameter control byte for binary format list parameters are defined in 7.2.1.2.2.3.

7.2.8 Last *n* Error Events log page

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~~The DU bit, TSD bit, ETC bit, and TMC field shall be set to zero. The FORMAT AND LINKING field shall be set to 01b to indicate an ASCII format list parameter.~~

The FORMAT AND LINKING field of each the log parameter for the Last *n* Error Events log page shall be set to 01b, indicating that the parameters are ASCII format list parameters. The settings of the bits and fields in the parameter control byte for ASCII format list parameters are defined in 7.2.1.2.2.3.

7.2.9 Non-Medium Error log page

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~~The FORMAT AND LINKING field (see table 11 in 7.2.1) of each log parameter shall be set to 00b or 10b indicating it contains a data counter.~~

The FORMAT AND LINKING field of each log parameter in the Non-Medium Error log page shall be set to 00b or 10b, indicating that the parameters are data counter parameters. The setting of the bits and fields in the parameter control byte for a data counter parameter are defined in 7.2.1.2.2.2.

7.2.10 Protocol Specific Port log page

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~~The contents of the DU bit, TSD bit, ETC bit, FORMAT AND LINKING field, and TMC field are defined in 7.2.1.~~

The FORMAT AND LINKING field of each log parameter for the Protocol Specific Port log page shall be set to 11b, indicating that the parameter is a binary format list parameter. The settings of the bits and fields in the parameter control byte for binary format list parameters are defined in 7.2.1.2.2.3.

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7.2.11 Self-Test Results log page

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~~The values of the log parameter control bits for self test results log parameters is specified in table 17.~~

Table 17 — ~~Parameter control bits for self test results log parameters~~

Bit or field	Value	Description
DU	0b	Value provided by device server
TSD	0b	Device server manages saving of parameter
ETC	0b	No threshold comparison is made on this value
TMC	xx	Ignored when the ETC bit is set to zero
FORMAT AND LINKING	11b	The parameter is a binary format list parameter

The FORMAT AND LINKING field of each log parameter for the Self-Test Results log page shall be set to 11b, indicating that the parameter is a binary format list parameter. The settings of the bits and fields in the parameter control byte for binary format list parameters are defined in 7.2.1.2.2.3.

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7.2.12 Start-Stop Cycle Counter log page

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~~.....For the log parameter in which the parameter code value is 0001h, the values of the parameter control bits are defined in table 18.~~

Table 18 — ~~Parameter control bits for date of manufacture parameter (0001h)~~

Bit or field	Value	Description
DU	0b	Value provided by device server
TSD	0b	Device server manages saving of parameter
ETC	0b	No threshold comparison is made on this value
TMC	xx	Ignored when the ETC bit is set to zero
FORMAT AND LINKING	01b	The parameter is an ASCII format list parameter

The FORMAT AND LINKING field for log parameter 0001h (i.e., the Date of Manufacturing parameter) for the Start-Stop Cycle Counter log page shall be set to 01b, indicating that the parameter is an ASCII format list parameter. The settings of the bits and fields in the parameter control byte for ASCII format list parameters are defined in 7.2.1.2.2.3.

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~~.....For the log parameter in which the parameter code value is 0002h, the values of the parameter control bits are defined in table 19.~~

Table 19 — ~~Parameter control bits for accounting date parameter (0002h)~~

Bit or field	Value	Description
DU	0b	Value provided by device server
TSD	0b	Device server manages saving of parameter
ETC	0b	No threshold comparison is made on this value
TMC	xx	Ignored when the ETC bit is set to zero
FORMAT AND LINKING	01b	The parameter is an ASCII format list parameter

The FORMAT AND LINKING field for log parameter 0002h (i.e., the Accounting Data parameter) for the Start-Stop Cycle Counter log page shall be set to 01b, indicating that the parameter is an ASCII format list parameter. The settings of the bits and fields in the parameter control byte for ASCII format list parameters are defined in 7.2.1.2.2.3.

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~~.....For the log parameter in which the parameter code value is 0003h, the values of the parameter control bits are defined in table 20.~~

Table 20 — ~~Parameter control bits for start-stop cycle counter parameters (0003h and 0004h)~~

Bit or field	Value	Description
DU	0b	Value provided by device server
TSD	0b	Device server manages saving of parameter
ETC	0b	No threshold comparison is made on this value
TMC	xx	Ignored when the ETC bit is set to zero
FORMAT AND LINKING	11b	The parameter is a binary format list parameter

The FORMAT AND LINKING field for log parameter 0003h (i.e., the Specified Cycle Count Over Device Lifetime parameter) for the Start-Stop Cycle Counter log page shall be set to 11b, indicating that the parameter is a binary format list parameter. The settings of the bits and fields in the parameter control byte for binary format list parameters are defined in 7.2.1.2.2.3.

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~~.....For the log parameter in which the parameter code value is 0004h, the values of the parameter control bits are defined in table 20.~~

The FORMAT AND LINKING field for log parameter 0004h (i.e., the Accumulated Start-Stop Cycles parameter) for the Start-Stop Cycle Counter log page shall be set to 11b, indicating that the parameter is a binary format list parameter. The settings of the bits and fields in the parameter control byte for binary format list parameters are defined in 7.2.1.2.2.3.

7.2.13 Statistics and Performance log pages

7.2.13.1 Statistics and Performance log pages overview

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7.2.13.2 General Statistics and Performance log page

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~~The values of the log parameter control bits and fields for the log parameters in the Statistics and Performance log page are as specified in table 21.~~

Table 21 — ~~Parameter control bits for the Statistics And Performance log page parameters~~

~~Bit or field~~	~~Value~~	~~Description~~
~~du~~	~~0b~~	~~Value provided by device server~~
~~tsd~~	~~0b~~	~~Device server manages saving of parameter~~
~~etc~~	~~0b~~	~~No threshold comparison is made on this value~~
~~tmc~~	~~xx~~	~~Ignored when the etc bit is set to zero~~
~~format and linking~~	~~10b~~	~~If another parameter reported in this log page reaches its maximum value, then this parameter shall not stop incrementing. This parameter may be reinitialized by a LOG SELECT command.~~

The FORMAT AND LINKING field of each Statistics and Performance log parameter in the Statistics and Performance log page shall be set to 10b, indicating that the parameter is a data counter parameter. The setting of the bits and fields in the parameter control byte for a data counter parameter are defined in 7.2.1.2.2.2.

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~~The values of the log parameter control bits and fields for the Idle Time log parameter are as specified in table 21.~~

The FORMAT AND LINKING field of the Idle Time log parameter in the Statistics and Performance log page shall be set to 10b, indicating that the parameter is data counter parameter. The setting of the bits and fields in the parameter control byte for a data counter parameter are defined in 7.2.1.2.2.2.

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~~The values of the log parameter control bits and fields for the Time Interval log parameter are as specified in table 21.~~

The FORMAT AND LINKING field of the Time Interval log parameter in the Statistics and Performance log page shall be set to 10b, indicating that the parameter is data counter parameter. The setting of the bits and fields in the parameter control byte for a data counter parameter are defined in 7.2.1.2.2.2.

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~~The values of the log parameter control bits and fields for the log parameters in the Force Unit Access Statistics and Performance log page are as specified in table 21.~~

The FORMAT AND LINKING field of the Force Unit Access Statistics and Performance log parameter in the Statistics and Performance log page shall be set to 10b, indicating that the parameter is a data counter parameter. The setting of the bits and fields in the parameter control byte for a data counter parameter are defined in 7.2.1.2.2.2.

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7.2.13.3 Group Statistics and Performance (n) log page

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~~The values of the log parameter control bits and fields for the Group n Statistics and Performance log parameter are specified in table 21 in 7.2.13.2.~~

The FORMAT AND LINKING field of the Group n Statistics and Performance log parameter in the Statistics and Performance log page shall be set to 10b, indicating that the parameter is a data counter parameter. The setting of the bits and fields in the parameter control byte for a data counter parameter are defined in 7.2.1.2.2.2.

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~~The values of the log parameter control bits and fields for the Group n Force Unit Access Statistics and Performance log parameter are specified in table 21 in 7.2.13.2.~~

The FORMAT AND LINKING field of the Group n Force Unit Access Statistics and Performance log parameter in the Statistics and Performance log page shall be set to 10b, indicating that the parameter is a data counter parameter. The setting of the bits and fields in the parameter control byte for a data counter parameter are defined in 7.2.1.2.2.2.

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7.2.14 Supported Log Pages log page

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7.2.15 Supported Log Pages and Subpages log page

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7.2.16 Supported Subpages log page

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7.2.17 Temperature log page

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~~.....The state of the parameter control bits for parameter 0000h is specified in table 22.~~

Table 22 — ~~Parameter control bits for temperature parameters (0000h and 0001h)~~

Bit or field	Value	Description
DU	0b	Value provided by device server
TSD	0b	Device server manages saving of parameter
ETC	0b	No threshold comparison is made on this value
TMC	xx	Ignored when the ETC bit is set to zero
FORMAT AND LINKING	11b	The parameter is a binary format list parameter

The FORMAT AND LINKING field of the Temperature log parameter for the Temperature log page shall be set to 11b, indicating that the parameter is a binary format list parameter. The settings of the bits and fields in the parameter control byte for binary format list parameters are defined in 7.2.1.2.2.3.

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.....The state of the parameter control bits for parameter 0001h is specified in table 22.

The FORMAT AND LINKING field of the Reference Temperature log parameter for the Temperature log page shall be set to 11b, indicating that the parameter is a binary format list parameter. The settings of the bits and fields in the parameter control byte for binary format list parameters are defined in 7.2.1.2.2.3.