S85G-6925-00

OEM INTERFACE SPECIFICATIONS

for

DVAS-2810 (810MB)

2.5-Inch Hard Disk Drive with SCSI Interface

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1. General

1.1 Introduction

This specification describes the host interface of DVAS-2810.
The drives support both Synchronous SCSI and Asynchronous SCSI.

The interface conforms to the *draft proposed American National Standard for information systems - SMALL COMPUTER SYSTEM INTERFACE - 2 (SCSI-2) October 17, 1991*.
The vendor specific items and options supported by the drives are described in each section.

1.2 References

- *OEM FUNCTIONAL SPECIFICATIONS for DVAS-2810 2.5-Inch Hard Disk Drive with SCSI Interface (S85G-6924)*
- *American National Standard for information systems - (X3.131-1994)*
  SMALL COMPUTER SYSTEM INTERFACE - 2 (SCSI-2) January 31, 1994

1.3 Terminology

Drive Drive indicates DVAS-2810.

Host Host indicates the system that the drive is attached to.

LUN. Logical Unit Number. An encoded three bit identifier for the logical unit.

VU. Vendor Unique bits.

LBA. Logical Block Address.

RSVD. Reserved.

MSB. Most Significant bit.

LSB. Least Significant bit.

2. SCSI COMMAND SET

Summaries of the SCSI commands supported by the file are listed below. where O=optional, M=mandatory, E=extended, R=reserved and V=vendor unique. The column “SCSI-1” refers to ANSI version 1 standard. The column “CCS” refers to the ANSI sub-committee Common Command Subset for DASD devices. The column “SCSI-2” refers to the current revision of the version 2 standard available at the time this document was created and is shown for information only for compliance with future ANSI standards.

SCSI–1	CCS	SCSI–2	CODE	COMMAND
M	M	M	04h	FORMAT UNIT
E	M	M	12h	INQUIRY
O	O	O	15h	MODE SELECT
O	O	O	1Ah	MODE SENSE
M	M	M	08h	READ
E	M	M	25h	READ CAPACITY
O	O	O	37h	READ DEFECT DATA
E	M	M	28h	READ EXTENDED
R	O	O	3Ch	READ BUFFER
R	R	O	3Eh	READ LONG
O	O	O	07h	REASSIGN BLOCK
O	M	M	17h	RELEASE
M	M	M	03h	REQUEST SENSE
O	M	M	16h	RESERVE
O	O	O	01h	REZERO UNIT
O	O	O	0Bh	SEEK
O	O	O	2Bh	SEEK EXTENDED
O	M	M	1Dh	SEND DIAGNOSTICS
O	O	O	1Bh	START/STOP UNIT
O	M	M	00h	TEST UNIT READY
O	O	O	2Fh	VERIFY
M	M	M	0Ah	WRITE
E	M	M	2Ah	WRITE EXTENDED
O	O	O	2Eh	WRITE AND VERIFY
R	O	O	3Bh	WRITE BUFFER
R	R	O	3Fh	WRITE LONG

Figure 2-1. SCSI Commands Supported. (In Alphabetical order)

SCSI–1	CCS	SCSI–2	CODE	COMMAND
O	M	M	00h	TEST UNIT READY
O	O	O	01h	REZERO UNIT
M	M	M	03h	REQUEST SENSE
M	M	M	04h	FORMAT UNIT
O	O	O	07h	REASSIGN BLOCK
M	M	M	08h	READ
M	M	M	0Ah	WRITE
O	O	O	0Bh	SEEK
E	M	M	12h	INQUIRY
O	O	O	15h	MODE SELECT
O	M	M	16h	RESERVE
O	M	M	17h	RELEASE
O	O	O	1Ah	MODE SENSE
O	O	O	1Bh	START/STOP UNIT
O	M	M	1Dh	SEND DIAGNOSTICS
E	M	M	25h	READ CAPACITY
E	M	M	28h	READ EXTENDED
E	M	M	2Ah	WRITE EXTENDED
O	O	O	2Bh	SEEK EXTENDED
O	O	O	2Eh	WRITE AND VERIFY
O	O	O	2Fh	VERIFY
O	O	O	37h	READ DEFECT DATA
R	O	O	3Bh	WRITE BUFFER
R	O	O	3Ch	READ BUFFER
R	R	O	3Eh	READ LONG
R	R	O	3Fh	WRITE LONG

Figure 2-2. SCSI Commands Supported. (By Command Code)

2.1 Flag and Link Bits

Many of the structures in this section have fields names FLAG and LINK. The meaning of these fields is defined below.

FLAG The Flag bit specifies which message the target shall return to the initiator if the link bit is one and the command completes without any error. If Link is zero, Flag must also be zero. If Link is one and the command terminates successfully, the file will send either the LINKED COMMAND COMPLETE message (FLAG=0) or the LINKED COMMAND COMPLETE WITH FLAG message (FLAG=1). Typically this bit is used to cause an interrupt in the initiator between linked commands.

LINK This bit is set to one to indicate that the initiator desires an automatic link to the next command upon successful completion of the current command. Upon successful completion of the command, the file will return INTERMEDIATE GOOD status and then send one of the two messages defined under Flag above.

Upon unsuccessful completion of the command, the file will return CHECK CONDITION status or RESERVATION CONFLICT status and then send the COMMAND COMPLETE message. No further commands in the chain are executed.

2.2 Abbreviations

These abbreviations are used throughout the following sections:

LUN. Logical Unit Number. An encoded three bit identifier for the logical unit.

VU. Vendor Unique bits.

LBA. Logical Block Address.

RSVD. Reserved.

MSB. Most Significant bit.

LSB. Least Significant bit.

2.3 FORMAT UNIT (04)

	BIT 7	6	5	4	3	2	1	0
BYTE 0	Command code (04h)							
BYTE 1	LUN			Format Level				
BYTE 2	VU = 0							
BYTE 3	(MSB)							
BYTE 4	Interleave Factor							(LSB)
BYTE 5	VU = 0		RSVD = 0				Flag	Link

Figure 2-3. FORMAT UNIT (04)

The FORMAT command performs a physical formatting of the file media. This includes relocation of defective sectors, and the overwriting of all data areas with a constant data pattern. The FORMAT command may be used to effectively erase the entire data area of the media. Reserved areas of the media are not affected by the FORMAT command.

Only a null defect list will be accepted from the initiator. The file manages two internal defect lists. The first is the time of manufacture, or “P” list. The second (“G” list) is a grown defect list consisting of entries corresponding to an initiator's use of the REASSIGN BLOCK command. The “P” list may never be altered. Contents of the “G” list may be erased at format time.

Interleave Factor can be set any value from 0 to 0FFFFh, but all of them are regarded as 1:1.

Format Level specifies whether the grown defect list should be erased or retained and used during the format operation.

Format Level	Description
00000	The grown defect list will be retained and all data will be erased. No DATA OUT phase will be executed.
10000	The grown defect list will be retained and all data will be erased. A DATA OUT phase will be executed but the defect list length must be 0 or the command will end with CHECK CONDITION status with sense key of ILLEGAL REQUEST and additional sense code of INVALID FIELD IN CDB.
11000	The grown defect list will be erased and the file will be formatted with the manufacturing defect list only. A DATA OUT phase will be executed but the defect list length must be 0 or the command will end with CHECK CONDITION status with sense key of ILLEGAL REQUEST and additional sense code of INVALID FIELD IN CDB.

2.3.1 Defect List

	BIT 7	6	5	4	3	2	1	0
BYTE 0	Reserved = 0							
BYTE 1	0	0	0	0	0	0	Immd	0
BYTE 2	Defect list length MSB = 0							
BYTE 3	Defect list length LSB = 0							

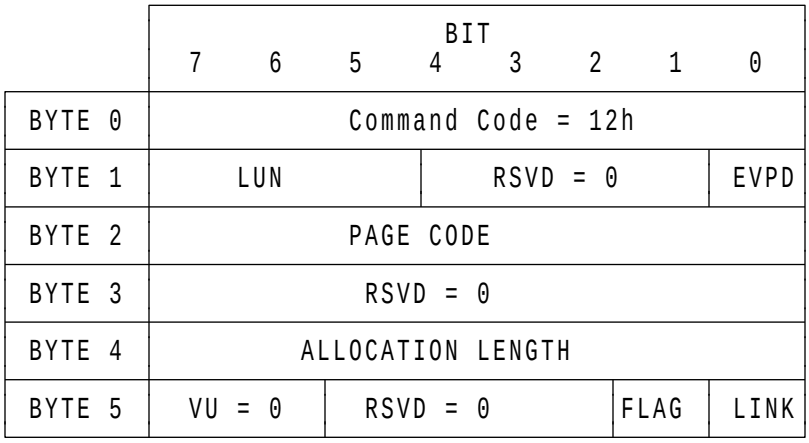
Figure 2-4. Format of Defect List Header. Format of the defect list header sent during the data out phase for the b'10000' and b11000 modes.

The Immediate bit (bit 1 of byte 1) of the Format Unit Defect List Header specifies the following:

- When it is set to 1;
  - The drive shall immediately return a status before starting the actual formatting process. operation.
  - The REQUEST SENSE command is used to determine the progress of the FORMAT UNIT command.

    A sense key of NOT READY is returned with an additional sense code of LOGICAL UNIT NOT READY, FORMAT IN PROGRESS .
    Bytes 16 & 17 of the additional sense data contains a value which indicates the current percentage to complete the FORMAT UNIT process. The actual percentage can be calculated by dividing this value by '10000'x.
- When it is set to zero,
  - Status will be returned when the FORMAT UNIT operation is completed.

2.4 INQUIRY (12)



	BIT 7	6	5	4	3	2	1	0
BYTE 0	Command Code = 12h							
BYTE 1	LUN			RSVD = 0				EVPD
BYTE 2	PAGE CODE							
BYTE 3	RSVD = 0							
BYTE 4	ALLOCATION LENGTH							
BYTE 5	VU = 0		RSVD = 0				FLAG	LINK

Figure 2-5. INQUIRY (12)

The INQUIRY command requests the parameters of the target to be sent to the initiator.

An EVPD bit of one specifies that the file shall return the optional vital product data specified by the code page field. The file does not support this option.

EVPD	PAGE CODE	Description
0	0	The file returns the standard INQUIRY data.
0	Non Zero	The file return CHECK CONDITION status with the sense key of ILLEGAL REQUEST and the additional sense code of INVALID FIELD IN CDB.

Allocation Length specifies the number of bytes that the initiator has allocated for INQUIRY data to be returned. An allocation length of zero implies that no data is to be returned. The file will terminate the DATA IN phase when all available INQUIRY data has been transferred or when allocation length bytes have been transferred, whichever is less.

If an INQUIRY command is received from an initiator with a pending unit attention condition (before the target reports CHECK CONDITION status), the file processes the INQUIRY command. The unit attention condition is not cleared by this action.

Two different formats for the INQUIRY data are defined.

- The first format is returned when an invalid LUN is specified by the initiator.
- The second format is returned when a valid LUN is specified by the initiator.

Each of these formats is described in the following sections.

Note: Fields with a value shown inside quotes (e.g. Value = 'xyz') are character fields. A value not in quotes is a numeric value. Character fields are alpha-numeric and represented in ASCII, not EBCDIC.

2.4.1 INQUIRY Data Format (When Invalid LUN is Specified)

BYTE	BIT 7	6	5	4	3	2	1	0
0	Qualifier			Peripheral Dev. Type				
1	RMB=0	Device–type Modifier						
2	ISO=0		ECMA=0			ANSI=2		
3	RSVD = 0				RDF=2			
4	Additional Length = 0							

Figure 2-6. INQUIRY DATA ú Invalid LUN Specified

- **Qualifier** is set to 011b. This indicates the LUN specified in the Command Block is not present.[1]
- **Peripheral Dev. Type** is set to 1Fh.
- **Removal Media Bit (RMB)** is always set to zero to indicate no removal media exist.
- **Device-Type Modifier** is set to zero.
- **ISO** is set to zero to indicate that this product does not claim compliance to the International Organization for Standardization (ISO) version of SCSI (ISO DP 9316).
- **ECMA** is set to zero to indicate that this product does not claim compliance to the European Computer Manufacturers Association (ECMA) version of SCSI (ECMA-111).
- **ANSI** indicates the level of the ANSI standard that is supported by the product. The file supports ANSI SCSI version 2.
- **RDF** is set to two to indicate that the Inquiry Data Format as specified in ANSI SCSI version 2 is supported by the file.

[1] In general, the drive will respond with CHECK CONDITION status. to the all command with an invalid LUN. The Inquiry command is the only exception.

2.4.2 Inquiry Data Format (When Valid LUN is Specified)

BYTE	BIT 7	6	5	4	3	2	1	0
0	Qualifier = 0			Peripheral Device Type = 0				
1	RMB=0	Reserved = 0						
2	ISO = 0		ECMA = 0			ANSI = 2		
3	Rsvd = 0				RDF = 2			
4	Additional Length = 103							
5–6	Reserved = 0							
7	REL_A = 0	Wb_32 = 0	Wb_16 = 0	Sync = 1	Link = 1	Resrv = 0	CmdQu = 0	SftRe = 0
8–15	Vendor ID = 'IBM '							
16–31	Product ID = 'DVAS–2810' '							
32–35	Product Revision Level (ASCII)							
36–43	Unit Serial Number (ASCII)							
44–55	RAM u Code P/N (ASCII)							
56–95	Reserved = 0							
96–97	Reserved = ' '							
98–101	Plant of Manufacture = ' '							
102–105	Date of Manufacture = MMYY (ASCII)							
106–107	Reserved = ' '							

Figure 2-7. INQUIRY Data ú Valid LUN Specified

- **Qualifier** is set to zero to indicate that the LUN specified in the Command Block is currently supported.
- **Peripheral Device Type** is set to zero to indicate that the device is a Direct-Access.
- Field Bytes 1 ú 3 are defined in 2.4.1, “INQUIRY Data Format (When Invalid LUN is Specified)” on page 2-7.
- **Additional Length** indicates that 103 bytes of inquiry information follows.
- **REL_A** is set to zero to indicate that the file does not support 'Relative Address Mode'.
- **Wb_32** is set to zero to indicate that the file does not support 32-bit wide data transfers.
- **Wb_16** is set to zero to indicate that the file does not support 16-bit wide data transfers.
- **Sync** is set to one to indicate that the file supports synchronous data transfer.

- **Link** is set to one to indicate that the file supports linked commands.
- **CmdQu** is set to zero to indicate that the file dose not supports command queuing
- **SftRe** is set to zero to indicate that the target supports Hard Reset only.
- **Vendor ID** is 'IBM' padded with ASCII blanks.
- **Product ID** is specified in ASCII character.
- **Product Revision Level** indicates the level of microcode. It indicates ROM microcode level before the media is available and RAM microcode after available.
- **Unit Serial Number** contains the file serial number. If the media is not available, this field will contain ASCII spaces (20h).
- **RAM Microcode P/N** is specified in ASCII characters.
- **Plant of Manufacture** is the plant code of manufacture. If the media is not available, this field will contain ASCII spaces (20h).
- **Date of Manufacture** contains 2 digit month followed 2 digit year. If the media is not available, this field will contain ASCII spaces (20h).

2.5 MODE SENSE (1A)

	BIT 7	6	5	4	3	2	1	0
BYTE 0	Command code = 1Ah							
BYTE 1	LUN				RSVD = 0			
BYTE 2	PCF				Page Code			
BYTE 3	RSVD = 0							
BYTE 4	Allocation Length							
BYTE 5	VU = 0			RSVD = 0			FLAG	LINK

Figure 2-8. MODE SENSE (1A)

The MODE SENSE command provides a means for the file to report various device parameters to the initiator. It is the complement to the MODE SELECT command.

Allocation Length indicates the maximum number of bytes the initiator has set aside for the DATA IN phase. A value of zero is not considered an error. If the allocation length is smaller than the amount available, then that portion of the data up to the allocation length will be sent. It is noted that this may result in only a portion of a multi-byte field being sent.

2.5.1.1.1 Page Control Field: PCF (Page Control Field) defines the type of Page Parameter values to be returned.

PCF **Meaning**

0 0 **Report current values.** The file returns the current values under which the logical unit is presently configured for the page code specified. The current values returned are:

1. The parameters set in the last successful MODE SELECT command.
2. The saved values if a MODE SELECT command has not been executed since the last power-on, hard RESET condition, or BUS DEVICE RESET message .

   Note: The file will not process the Mode Select command until the completion of spin-up. Therefore, the initiator cannot modify the current values prior to the saved values being read in.
3. The default values if saved values are not available or not supported.

0 1 **Report changeable value.** The file returns the changeable values for the page code specified. The page requested shall be returned containing information that indicate which fields are changeable. All bits of parameters that are changeable shall be set to one. Parameters that are *defined by the file* shall be set to zero. If any part of a field is changeable all bits in that field shall be set to one.

Note: For a value field such as the buffer ratios of page 2, the bit field will not indicate the range of supported values but rather that the field is supported.

1 0 **Report default value.** The file returns the default values for the page code specified. The parameters not supported by the file are set to zero.

1 1 **Report saved value.** The file returns the saved value for the page code specified.

Saved values are one of following :

- the values saved as a result of MODE SELECT command
- identical to the default values
- zero when the parameters are not supported

The Page Length byte value of each page returned by the file indicates up to which fields are supported on that page.

2.5.1.1.2 Page Code: This field specifies which page or pages to return. Page code usage is defined in Figure 2-9.

Page Code	Description
01h – 1Fh	Return specific page.
3Fh	Return all available pages.

Figure 2-9. Page Code Usage

2.5.2 Mode Parameter List

The mode parameter list contain a header, followed by zero or more block descriptors, followed by zero or more variable-length pages.

2.5.2.1 HEADER

	7	6	5	4	3	2	1	0
BYTE 0	Mode Data Length							
BYTE 1	Medium Type = 0							
BYTE 2	WP	RSVD = 0						
BYTE 3	Block Descriptor Length (= 0 or 8)							

Figure 2-10. MODE Parameter List (Header)

- **Mode Data Length**. When using the MODE SENSE command, the mode data length field specifies the length in bytes of the following data that is available to be transferred. The mode data length does not include the length byte itself. When using the MODE SELECT command, this field is reserved.
- **Medium Type** field is always set to zero in the file. (Default medium type)
- **WP**. When used with the MODE SELECT command, the write protect (WP) bit is reserved.

  When used with the MODE SENSE command, a write protect (WP) bit of zero indicates that the medium is write enabled.
- **Block Descriptor Length**. This field specifies the length in bytes of the block descriptors.

  When used with the MODE SELECT command, zero or eight are supported by the file.

  When used with the MODE SENSE command, the file returns eight to indicate that only a single block descriptor is available.

2.5.2.2 Block Descriptor

BYTE 0	Density code = 0
BYTE 1 BYTE 2 BYTE 3	Number of Blocks (MSB) (LSB)
BYTE 4	RSVD = 0
BYTE 5 BYTE 6 BYTE 7	Block Length = 200h

Figure 2-11. MODE Parameter Block Descriptor

The Block descriptor provides formatting information about the NUMBER OF BLOCKS (user addressable) to format at the specified BLOCK LENGTH.

- **Number of Blocks**

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  When used with the MODE SELECT command, the **Number of Blocks** field must be;

  – Zero to indicate all available blocks
  – The exact number of blocks in the data area of the file, which can be obtained with the MODE SENSE command.

  Any other value is invalid, and causes the command to fail with CHECK CONDITION status.

  When used with the MODE SENSE command, the field contain exact number of blocks.

- **Block Length**

  When used with the MODE SELECT command, the **Block length** field must contain 200h, or the file will terminate the command with CHECK CONDITION status.

  When used with the MODE SENSE command, the field will return always contain 200h.

2.5.2.3 Page Descriptor

BYTE 0	PS	RSVD=0	Page Code
BYTE 1	Page Length		
BYTE 2–n	Mode Parameters		

Figure 2-12. MODE Parameter Page Format

Each mode page contains a page code, a page length, and a set of mode parameters.

When using the MODE SENSE command, a parameter savable (PS) bit of one indicates that the mode page can be saved by the file in the reserved area of the file.

A PS bit of zero indicates that the supported parameters cannot be saved. When using the MODE SELECT command, the PS bit is reserved (zero).

The file supports the following mode page code:

Page	Description	PS
00	Vendor Unique Parameters	1
01	Read–Write Error Recovery Parameters	1
02	Disconnect/Reconnect Control Parameters	1
03	Format Parameters	0
04	Geometry Parameters	0
08	Caching Parameters	1
0D	Power Condition	1
38	Standby Timer Parameters	1

Figure 2-13. Page Code Usage

The page length field specifies the length in bytes of the mode parameters that follow. If the initiator does not set this value to the value that is returned for the page by the MODE SENSE command, the file will terminate the command with CHECK CONDITION status.

2.5.3 Page 0 (Vendor Unique Parameters)

	BIT 7	6	5	4	3	2	1	0
BYTE 0	PS	RSVD=0	Page Code = 00h					
BYTE 1	Page Length = 06h							
BYTE 2	Reserved = 0			UAI=0	Reserved = 0			
BYTE 3	Reserved = 0							
BYTE 4	Reserved = 0							
BYTE 5	Reserved = 0		DSN=0	Reserved = 0				
BYTE 6	Reserved = 0							DPC=0
BYTE 7	Reserved = 0							

Figure 2-14. Page 0

- **UAI**, Unit Attention Inhibit bit, is set to zero to indicates that the file posts Unit Attention.
- **DSN**, Disable Target Initiated Synchronous Negotiation bit indicates whether the file will perform Target Initiated Synchronous Negotiation. A bit of one indicate the file does not perform Target Initiated Synchronous Negotiation, while a bit of zero indicates that the file does.
- **DPC**, Disable Parity Checking bit, is set to zero to indicates that the file enables Parity Checking.

Changeable Parameter	**Default Value**
UAI	0
DSN	0
DPC	0

Note: These three bits are saved in the reserved area of the media and loaded during POR. So the file uses the default values during POR.

2.5.4 Page 1 (Read/Write Error Recovery Parameters)

	BIT 7	6	5	4	3	2	1	0
BYTE 0	PS	RSVD=0	Page Code = 01h					
BYTE 1	Page Length = 0Ah							
BYTE 2	AWRE = 0	ARRE = 0	TB	RC = 0	EER = 0	PER	DTE	DCR
BYTE 3	Read Retry Count = 01h							
BYTE 4	Correction Span = 28h							
BYTE 5	Head Offset Count (Not used) = 00h							
BYTE 6	Data Strobe Offset Count (Not used) = 00h							
BYTE 7	Reserved = 00h							
BYTE 8	Write Retry Count = 01h							
BYTE 9	Reserved = 00h							
BYTE 10	(MSB) Recovery Time Limit (Not Used) = 0000h							
BYTE 11	(LSB)							

Figure 2-15. Page 1

The Read-Write recovery parameters that will be used during any command that performs a read or write operation to the medium.

- **AWRE**, an Automatic write reallocation enabled bit. **Must be set to zero** , indicating that the file shall not perform automatic reallocation of defective data blocks during write operations.
- **ARRE**, an Automatic read reallocation enabled bit. **Must be set to zero** , indicating that the file shall not perform automatic reallocation of defective data blocks during read operations.
- **TB**, Transfer Block bit, is set to one to indicate that a data block that is not recovered within the recovery limits specified shall be transferred to the initiator before CHECK CONDITION status is returned.
  A TB bit of zero indicates that such a data block shall not be transferred to the initiator. Data blocks that can be recovered within the recovery limits are always transferred, regardless of the value of the bit.
- **RC**, A read continuous bit. **Must be set to zero** , indicating that the error recovery operations that cause delays are acceptable during the data transfer. Data shall not be fabricated.
- **EER**,An enable early recovery bit. **Must be set to zero** , indicating that the file shall use an error recovery procedure that minimizes the risk of mis-detection or miscorrection. during the data transfer. Data shall not be fabricated.
- **PER**, Post Error bit, is set to one to indicate that the file reports recovered errors.
- **DTE**, Disable Transfer on Error bit, is set to one to indicate that the file terminates the DATA phase upon detection of a recovered error .

- **DCR**, Disable Correction bit, is set to one to indicate that Error the Correction Code is not used for data error recovery.
  A DCR bit of zero indicates that ECC is applied to recover the data. (See 7.10, “Error Recovery Procedures” on page 7-9 for the details.)
- **Read Retry Count** is set to one to indicate that the file attempts its full recovery algorithm during read operations. A value of zero disables all error recovery procedures.
- **Correction Span** field specifies the size, in bits, of the largest data error burst for which data error correction may be attempted. A correction span of zero specifies that the file shall use its default value. The file only accepts value of zero, or the default value.
- **Head Offset Count** is not supported by the file.

  Note: Head Offset is implemented in the read error recovery routine. The user can not modify the offset value.
- **Write Retry Count** is set to one to indicate that the file attempts its full recovery algorithm during write operations. A value of zero disables all error recovery procedures.

Changeable Parameter	Default Value
TB	0
PER	0
DTE	0
DCR	0
Read Retry Count	01
Write Retry Count	01

Note: The file supports only 0 and 1 as Read/Write Retry Count. If initiator sets the larger value than 1 by Mode Select Command, the file returns GOOD STATUS but changes the value to 1, and returns 1 as Read/Write Retry Count for Mode Sense Command.

The following summarizes valid modes of operation.

PER	DTE	DCR	TB	DESCRIPTION
0	**0**	**0**	**0**	Retries and Error Correction are attempted. Recovered and/or corrected data (if any) is transferred with no CHECK CONDITION status at the end of the transfer. **no err** The transfer length is exhausted. **soft err** The transfer length is exhausted. Transferred data includes blocks containing recovered errors. **hard err** Data transfer stops when an unrecoverable error is encountered. The unrecoverable block is not transferred to the initiator. The file then creates the CHECK CONDITION status with the appropriate Sense Key.
0	**0**	**0**	**1**	Retries and Error Correction are attempted. Recovered and/or corrected data (if any) is transferred with no CHECK CONDITION status at the end of the transfer. **no err** The transfer length is exhausted. **soft err** The transfer length is exhausted. Transferred data includes blocks containing recovered errors. **hard err** Data transfer stops when an unrecoverable error is encountered. The unrecoverable block is transferred to the initiator. The file then creates the CHECK CONDITION status with the appropriate Sense Key.
0	**0**	**1**	**0**	Retries are attempted but no error correction (ECC) is applied. Recovered data (if any) is transferred with no CHECK CONDITION status at the end of the transfer. **no err** The transfer length is exhausted. **soft err** The transfer length is exhausted. Transferred data includes blocks containing recovered errors. **hard err** Data transfer stops when an unrecoverable error is encountered. The unrecoverable block is not transferred to the initiator. The file then creates the CHECK CONDITION status with the appropriate Sense Key.
0	**0**	**1**	**1**	Retries are attempted but no error correction (ECC) is applied. Recovered data (if any) is transferred with no CHECK CONDITION status at the end of the transfer. **no err** The transfer length is exhausted. **soft err** The transfer length is exhausted. Transferred data includes blocks containing recovered errors. **hard err** Data transfer stops when an unrecoverable error is encountered. The unrecoverable block is transferred to the initiator. The file then creates the CHECK CONDITION status with the appropriate Sense Key.
0	**1**	**0**	**0**	Illegal Request-DTE must be zero when PER is zero
0	**1**	**0**	**1**	Illegal Request-DTE must be zero when PER is zero
0	**1**	**1**	**0**	Illegal Request-DTE must be zero when PER is zero
0	**1**	**1**	**1**	Illegal Request-DTE must be zero when PER is zero
1	**0**	**0**	**0**	The highest level error, (See 5.2, “Priority of Error Reporting” on page 5-7) is reported at the end of transfer. Retries and error correction are attempted. Recovered and/or corrected data (if any) is transferred with CHECK CONDITION status and RECOVERED ERROR Sense Key set at the end of the transfer.

no err The transfer length is exhausted.

soft err The transfer length is exhausted. Transferred data includes blocks containing recovered errors. The information byte in the sense data will contain the logical block address of the last recovered error.

hard err Data transfer stops when an unrecoverable error is encountered. The unrecoverable block is not transferred to the initiator. The file then creates the CHECK CONDITION status with the appropriate Sense Key.

1 0 0 1 The highest level error, (See 5.2, “Priority of Error Reporting” on page 5-7) is reported at the end of transfer. Retries and error correction are attempted. Recovered and/or corrected data (if any) is transferred with CHECK CONDITION status and RECOVERED ERROR Sense Key set at the end of the transfer.

no err The transfer length is exhausted.

soft err The transfer length is exhausted. Transferred data includes blocks containing recovered errors. The information byte in the sense data will contain the logical block address of the last recovered error.

hard err Data transfer stops when an unrecoverable error is encountered. The unrecoverable block is transferred to the initiator. The file then creates the CHECK CONDITION status with the appropriate Sense Key.

1 0 1 0 The highest level error, (See 5.2, “Priority of Error Reporting” on page 5-7) is reported at the end of transfer. Retries are attempted but ECC is not applied. Recovered and/or corrected data (if any) is transferred with CHECK CONDITION status and RECOVERED ERROR Sense Key set at the end of the transfer.

no err The transfer length is exhausted.

soft err The transfer length is exhausted. Transferred data includes blocks containing recovered errors. The information byte in the sense data will contain the LBA of the last recovered error.

hard err Data transfer stops when an unrecoverable error is encountered. The unrecoverable block is not transferred to the initiator. The file then creates the CHECK CONDITION status with the appropriate Sense Key.

1 0 1 1 The highest level error, (See 5.2, “Priority of Error Reporting” on page 5-7) is reported at the end of transfer. Retries are attempted but ECC is not applied. Recovered and/or corrected data (if any) is transferred with CHECK CONDITION status and RECOVERED ERROR Sense Key set at the end of the transfer.

no err The transfer length is exhausted.

soft err The transfer length is exhausted. Transferred data includes blocks containing recovered errors. The information byte in the sense data will contain the LBA of the last recovered error.

hard err Data transfer stops when an unrecoverable error is encountered. The unrecoverable block is transferred to the initiator. The file then creates the CHECK CONDITION status with the appropriate Sense Key.

1 1 0 0 The highest level error, (See 5.2, “Priority of Error Reporting” on page 5-7) is reported at the end of transfer. Retries and error correction are attempted. Recovered and/or corrected data (if any) is transferred with CHECK CONDITION status and RECOVERED ERROR Sense Key set at the end of the transfer.

no err The transfer length is exhausted.

soft err The transfer stops on the first soft error detected. The information in the sense data shall contain the LBA of the block in error.

hard err Data transfer stops on the unrecoverable error. The file then creates the CHECK CONDITION status with the appropriate Sense Key.

1 1 0 1 The highest level error, (See 5.2, “Priority of Error Reporting” on page 5-7) is reported at the end of transfer. Retries and error correction are attempted. Recovered and/or corrected data (if any) is transferred with CHECK CONDITION status and RECOVERED ERROR Sense Key set at the end of the transfer.

no err The transfer length is exhausted.

soft err The transfer stops on the first soft error detected. The information in the sense data shall contain the LBA of the block in error.

hard err Data transfer stops on the unrecoverable error. The unrecoverable error block is returned to the initiator. The file then creates the CHECK CONDITION status with the appropriate Sense Key.

1 1 1 0 The highest level error, (See 5.2, “Priority of Error Reporting” on page 5-7) is reported at the end of transfer. Retries are attempted but ECC is not applied. Recovered data is transferred with CHECK CONDITION status and RECOVERED ERROR Sense Key set at the end of the transfer.

no err The transfer length is exhausted.

soft err The transfer stops on the first soft error detected. The recovered error block is returned to the initiator. The information in the sense data shall contain the logical block address of the block in error.

hard err Data transfer stops on the unrecoverable error. The file then creates the CHECK CONDITION status with the appropriate Sense Key.

1 1 1 1 The highest level error, (See 5.2, “Priority of Error Reporting” on page 5-7) is reported at the end of transfer. Retries are attempted but ECC in not applied. Recovered and/or corrected data (if any) is transferred with CHECK CONDITION status and RECOVERED ERROR Sense Key set at the end of the transfer.

no err The transfer length is exhausted.

soft err The transfer stops on the first soft error detected. The information in the sense data shall contain the logical block address of the block in error.

hard err Data transfer stops on the unrecoverable error. The unrecoverable error block is returned to the initiator. The file then creates the CHECK CONDITION status with the appropriate Sense Key.

2.5.5 Page 2 (Disconnect/Reconnect Parameters)

	BIT 7	6	5	4	3	2	1	0
BYTE 0	PS	RSVD=0	Page Code = 02h					
BYTE 1	Page Length = 2							
BYTE 2	Read Buffer Full Ratio							
BYTE 3	Write Buffer Empty Ratio							

Figure 2-16. Page 2

The disconnect / reconnect page provides the initiator the means to tune the performance of the SCSI bus.

An initiator may use the IDENTIFY message to grant the file the general privilege of disconnecting. (Disconnect requests may still be selectively rejected by the initiator by issuing a MESSAGE REJECT).

The file uses the disconnect/reconnect parameters to control reconnection during READ (operation code 08h and 28h) and WRITE (0Ah , 2Ah and 2Eh).

- **Read Buffer Full Ratio** is the numerator of a fraction whose denominator is 256. The fraction indicates how full the file data buffer should be before attempting to reconnect to the SCSI bus.
- **Write Buffer Empty Ratio** is the numerator of a fraction whose denominator is 256. The fraction indicates how empty the file data buffer should be before attempting to reconnect to the SCSI bus.

Changeable Parameter	Default Value
Read Buffer Full Ratio	30h
Write Buffer Empty Ratio	30h

2.5.5.1 Reconnection to a disconnected read command

For a read command, the reconnect is delayed relative to the availability of the first block in the file data buffer by the fraction of the file data buffer size. If the remaining data transfer length is less than the fraction of the file data buffer size, the file control program calculates the optimal reconnection point to complete the data transfer as early as possible while minimizing the time connected to the SCSI bus.

2.5.5.2 Reconnection to a disconnected write command

For a write command, the Write Buffer Ratio is significant only if the total data transfer length is greater than the size of the file data buffer. The fraction determines how empty the file data buffer should be before reconnecting to begin filling the buffer again.

2.5.5.3 Single block buffers calculation

The Single Block Buffers value is calculated using the following equation:

$$\text{Single Block Buffers} = \frac{N * \text{Ratio Number}}{256} \quad (+ 1 \text{ only if result is zero})$$

Where: N = Buffer Size/512

Note: A ratio value of 0 is supported on the file and will result in 100% of the buffer being filled/emptied.

2.5.6 Page 3 (Format Device Parameters)

	BIT 7	6	5	4	3	2	1	0
BYTE 0	RSVD = 0				Page Code = 03h			
BYTE 1	Page Length = 16h							
BYTE 2	(MSB) Track per Zone = 0001h							
BYTE 3	(LSB)							
BYTE 4	(MSB) Alternate Sectors per Zone = 0000h							
BYTE 5	(LSB)							
BYTE 6	(MSB) Alternate Tracks per Zone = 0000h							
BYTE 7	(LSB)							
BYTE 8	(MSB) Alternate Tracks per Logical Unit = 0008h							
BYTE 9	(LSB)							
BYTE 10	(MSB) Sectors per Track = 003Ch							
BYTE 11	(LSB)							
BYTE 12	(MSB) Data Bytes per Physical Sector = 0200h							
BYTE 13	(LSB)							
BYTE 14	(MSB) Interleave = 0000h							
BYTE 15	(LSB)							
BYTE 16	(MSB) Track Skew Factor = 000Fh							
BYTE 17	(LSB)							
BYTE 18	(MSB) Cylinder Skew Factor = 0016h							
BYTE 19	(LSB)							
BYTE 20	SSEC = 0	HSEC = 1	RMB = 0	SURF = 0	RESERVED = 0000b			
BYTE 21–23	RESERVED = 000000h							

Figure 2-17. Page 3

The format device page contains parameters which specify the medium foramat.

SSEC Zero. Indicates that the file does not support soft sector formatting.

HSEC One. Indicates that file support hard sector formatting.

RMB Zero. Indicates that the media is not support removable. Fixed Disk.

SURF Zero. Indicates that progressive address are assigned to all logical blocks a cylinder prior to allocating address within the next cylinder.

2.5.7 Page 4 (Rigid Disk Drive Geometry Parameters)

	BIT 7	6	5	4	3	2	1	0
BYTE 0	RSVD = 0				Page Code = 04h			
BYTE 1	Page Length = 16h							
BYTE 2	(MSB) Number of Cylinders = 000AD2h							
BYTE 4	(LSB)							
BYTE 5	Number of Heads							
BYTE 6	(MSB) Starting Cylinder—Write Precompensation = 000000h							
BYTE 8	(Not used) (LSB)							
BYTE 9	(MSB) Starting Cylinder—Reduced Write Current = 000000h							
BYTE 11	(Not used) (LSB)							
BYTE 12	(MSB) Drive Step Rate (Not used) = 0000h							
BYTE 13	(LSB)							
BYTE 14	(MSB) Landing Zone Cylinder (Not used) = 000000h							
BYTE 16	(LSB)							
BYTE 17	RESERVED = 00						RPL = 0	
BYTE 18	Rotational Offset (Not used) = 00h							
BYTE 19	RESERVED = 00h							
BYTE 20	(MSB) Medium Rotation Rate = 0ED8h							
BYTE 21	(LSB)							
BYTE 22	RESERVE = 0000h							
BYTE 23								

Figure 2-18. Page 4

The rigid disk drive geometric page specifies various parameters for the file.

Product ID	**Number of Heads**
DVAS-2810	6

RPL Zero. Indicates that the file does not support spindle synchronization.

2.5.8 Page 8 (Caching Parameters)

	BIT 7	6	5	4	3	2	1	0
BYTE 0	PS	RSVD=0	Page Code = 08h					
BYTE 1	Page Length = 2							
BYTE 2	RESERVED							RCD
BYTE 3	RESERVED							

Figure 2-19. Page 8

The caching parameters page defines parameters that affect the use of the cache.

- A Read Cache Disable (RCD) bit of zero indicates that the file may return data requested by a READ command by accessing either the cache or the Read Ahead Buffer, or media. A RCD bit of one indicates that the file shall transfer all data requested by a READ command by accessing the media (i.i., data cannot be transferred from the cache or Read Ahead Buffer).

Changeable Parameter	**Default Value**
RCD (Read Cache Disable)	0

2.5.9 Page 0D (Power Condition)

	BIT 7	6	5	4	3	2	1	0
BYTE 0	PS	RSVD=0	Page Code = 00h					
BYTE 1	Page Length = 0Ah							
BYTE 2	Reserved = 0							
BYTE 3	Reserved = 0						RSVD	Standby
BYTE 4	Reserved = 0							
BYTE 5								
BYTE 6								
BYTE 7								
BYTE 8	(MSB)							
BYTE 9	Standby Condition Timer = 0001A5E0h							
BYTE 10								
BYTE 11								(LSB)

Figure 2-20. Page 0D

The file will enter the standby condition automatically after the timer counts up to Standby Condition Timer. The timer will be reset when the file receives any command except Inquiry, Request Sense and Test Unit Ready command.

If Standby Condition Timer is set to zero, the file will enter Standby Condition immediately.

- **Standby.** A Standby bit of one indicates a target shall use the Standby Condition Timer to determine the length of inactivity time to wait before entering the Standby Condition. A Standby bit of zero indicates a target shall not enter the Standby condition.
- **Standby Condition Timer.** The Standby Condition Timer field indicates the inactivity time in 100 milli-second increments that the target shall wait before entering the Standby Condition.

Note: The resolution of the file's timer is minute, so the file will round off Standby Condition Timer less than one minute to the next whole number. And the file regards Standby Condition Timer more than 255 minutes as 255 minutes.

Changeable Parameter	**Default Value**
Standby	1
Standby Timer	1A5E0h (3 hours)

Note: These values are saved in the reserved area of the media and loaded during POR. So the file uses the default values during POR.

2.5.10 Page 38 (Standby Timer Parameters)

	BIT 7	6	5	4	3	2	1	0
BYTE 0	PS	RSVD=0	Page Code = 38h					
BYTE 1	Page Length = 04h							
BYTE 2	RESERVED = 00h							
BYTE 3	Auto Standby Time (Minutes) = B4h							
BYTE 4	RESERVED = 00h							
BYTE 5	RESERVED = 00h							

Figure 2-21. Page 38

The file will enter the standby condition automatically after the timer counts up to Auto Standby Time. The timer will be reset when the file receives any command except Inquiry, Request Sense and Test Unit Ready command. Zero of Auto Standby Time indicates that the file disables Auto Standby function.

Changeable Parameter	**Default Value**
Auto Standby Time	B4h(3 hours)

2.6 Mode Select (15)

	BIT 7	6	5	4	3	2	1	0
BYTE 0	Command Code = 15h							
BYTE 1	LUN			PF=1	RSVD = 0			SP
BYTE 2	RSVD = 0							
BYTE 3	RSVD = 0							
BYTE 4	Parameter List Length							
BYTE 5	VU = 0		RSVD = 0				FLAG	LINK

Figure 2-22. MODE SELECT (15)

The MODE SELECT command provides a means for the initiator to alter LUN or device parameters. Which includes;

- Error Recovery Option
- Formatting Option

There is only one set of mode select parameters shared by all initiators.

PF Page Format.

0 The MODE SELECT parameters following the header and block descriptors are structured as page of related parameters and are as specified in standard ANSI SCSI-2.

1 The MODE SELECT parameters are as specified in SCSI-1 (i.e. all parameters after block descriptors are vendor-specific).

SP Save Pages. This indicates;

0 The drive shall not save the saveable pages[2] which are sent during the Data Out Phase.

1 The drive shall save the saveable pages in the reserved area on the disk.

Parameter List Length

This specifies the number of bytes to be sent from the initiator. A parameter list length of zero suppresses data transfer and is not considered as an error.

The MODE SELECT parameter list contains a four-byte header, followed by zero or one block descriptor followed by zero or more pages as shown in the subsequent sections.

[2] Saveable Page is defined in 2.5, “MODE SENSE (1A)” on page 2-10.

2.6.1.1 Application Note

The initiator should issue a MODE SENSE command requesting all Changeable values (see PCF field in byte two of the CDB in 2.5, "MODE SENSE (1A)" on page 2-10) prior to issuing a MODE SELECT command. This is necessary to find out which pages are implemented by the file and the length of those pages. The file will return, in the Pages of the MODE SENSE command, the number of bytes supported for each Page. The Page Length set by the initiator in the MODE SELECT command must be the exact value as that returned by the file in MODE SENSE Page Length. If this is not true, the file will return CHECK CONDITION status with sense key of ILLEGAL REQUEST. See 2.5, "MODE SENSE (1A)" on page 2-10.

Note: If an initiator sends a MODE SELECT command that changes any parameters that apply to other initiators, the file shall generate an unit attention condition for all initiators except the one that issued the MODE SELECT command. The file shall set the additional sense code to PARAMETERS CHANGED (2Ah).

2.7 READ (08)

	BIT 7	6	5	4	3	2	1	0
BYTE 0	Command Code = 08h							
BYTE 1	LUN			(MSB)	LBA			
BYTE 2	LOGICAL BLOCK ADDRESS							
BYTE 3	LOGICAL BLOCK ADDRESS (LSB)							
BYTE 4	TRANSFER LENGTH							
BYTE 5	VU = 0		RSVD = 0				FLAG	LINK

Figure 2-23. READ (08)

The READ command requests the file to transfer the specified number of blocks of data to the initiator starting at the specified logical block address.

- **Logical block address** specifies the logical unit at which the read operation shall begin.
- **Transfer length** specifies the number of blocks to be transferred. A value of zero implies 256 blocks are to be transferred.[3]

Note: Error Recovery will be performed as specified by the MODE SELECT command.

[3] Block is 512 bytes in length.

2.8 READ CAPACITY (25)

	BIT 7	6	5	4	3	2	1	0
BYTE 0	Command Code = 25h							
BYTE 1	LUN			RSVD = 0				RelAdr
BYTE 2	(MSB)	Logical Block Address						
BYTE 3								
BYTE 4								
BYTE 5								(LSB)
BYTE 6	RSVD = 0							
BYTE 7	RSVD = 0							
BYTE 8	RSVD = 0							PMI
BYTE 9	VU = 0			RSVD = 0			FLAG	LINK

Figure 2-24. READ CAPACITY (25)

The READ CAPACITY command returns information regarding the capacity of the file.

- **RelAdr**. A Relative Address is not supported. Must be set to zero.
- **Logical Block Address** is used in conjunction with the PMI bit.
- **PMI**, Partial Medium Indicator indicates;

PMI	Description
0	The drive returns the last logical block address of the file.
1	The drive returns the last logical block address on the same track where the LBA in the command is located. This option provides the information the initiator needs to determine the amount of space available on the same track which is accessible without a head switch or seek.

Note: The file does not support PMI=1. So the file will return the last logical block address of the file even if PMI is set to one.

2.8.1.1 Returned Data Format

The data returned to the initiator in response to the READ CAPACITY command is described here. The data is returned in the DATA IN phase.

	BIT 7	6	5	4	3	2	1	0
BYTE 0	(MSB)		Logical Block Address					
BYTE 1								
BYTE 2								
BYTE 3								(LSB)
BYTE 4	(MSB)		Block Length					
BYTE 5								
BYTE 6						= 512		
BYTE 7								(LSB)

Figure 2-25. Format of READ CAPACITY command reply

- **Block Length** specifies the length in bytes of the block. It is set to 512.

2.9 READ DEFECT DATA (37)

	BIT 7	6	5	4	3	2	1	0
BYTE 0	COMMAND CODE = 37h							
BYTE 1	LUN			Rsvd = 0				0
BYTE 2	Rsvd = 0			Plist	Glist	Defect List Format		
BYTE 3 BYTE 4 BYTE 5 BYTE 6	Rsvd = 0							
BYTE 7 BYTE 8	Allocation length (MSB) (LSB)							
BYTE 9	VU = 0		RSVD = 0				FLAG	LINK

Figure 2-26. Read Defect Data (37)

The READ DEFECT DATA command requests that the Target transfers the medium defect data to the initiator. If the target is unable to access any medium defect data it will return a Check Condition status with the appropriate sense key. The sense key will be set to either Medium Error(03h) if a medium error occurred or No Sense(00h) if the list does not exists. Also the additional sense code of Defect List Error(19h) will be set.

The Primary Defect List (Plist) bit set to one indicates that the target returns the primary list of defects. A Plist bit of zero indicates that the target shall not return the Primary Defect list of defects.

The Grown Defect List (Glist) bit set to one indicates that the target returns the grown defect list. A Glist bit of zero indicates that the target shall not return the Grown Defect list of defects.

With both Plist and Glist bits set to one the target will return both the Primary and Grown defect lists.

With both Plist and Glist bits set to zero the target will return Defect List Header only.

The Defect List Format Field is used by the initiator to indicate the preferred format for the defect list. The Defect List Format of '000 (Block Format)' is supported by the file. If the requested format is not supported by the file, it will return the defect list in its default format '000'.

The file sends defect list (Defect Descriptors) in a eight byte Descriptor format which follows a four byte Defect List Header.

The target will transfer all of the Read Defect Data up to the number of bytes allocated by the initiator.

Note: The file will terminate the Data In phase when the Allocation Length has been transferred or when all available Defect Data has been transferred to the initiator, whichever is less.

The Read Defect Data contains a four byte header, followed by zero or more defect descriptors.

2.9.1 Defect List Header

	BIT 7	6	5	4	3	2	1	0
	Defect List Header							
BYTE 0	Rsvd = 0							
BYTE 1	Rsvd = 0				Plist	Glist	Defect List Format	
BYTE 2	Defect List Length (MSB)							
BYTE 3	(LSB)							

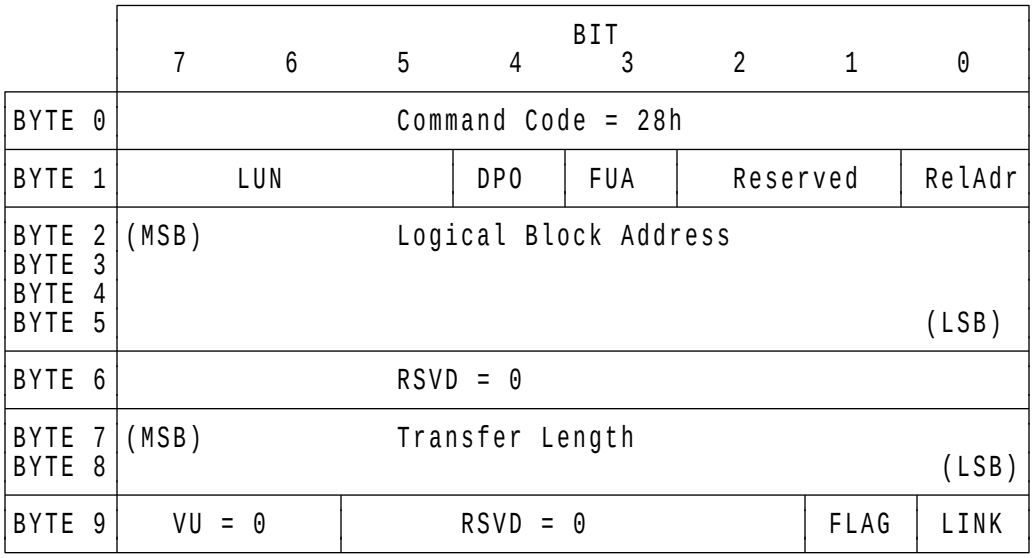
Figure 2-27. Defect List Header

2.9.2 Block Format (000b)

	Defect Descriptors
BYTE 0	(MSB)
BYTE 1	Absolute Block Address at Zone of Defect
BYTE 2	
BYTE 3	(LSB)

Figure 2-28. Defect Descriptors of Block Format

2.10 READ EXTENDED (28)



	BIT 7	6	5	4	3	2	1	0
BYTE 0	Command Code = 28h							
BYTE 1	LUN			DPO	FUA	Reserved		RelAdr
BYTE 2	(MSB)	Logical Block Address						
BYTE 3								
BYTE 4								
BYTE 5								(LSB)
BYTE 6	RSVD = 0							
BYTE 7	(MSB)	Transfer Length						
BYTE 8								(LSB)
BYTE 9	VU = 0		RSVD = 0				FLAG	LINK

Figure 2-29. Read Extended (28)

The READ EXTENDED command requests the file to transfer data to the initiator. The transfer length field permits larger than can be specified in the READ command.

DPO Disable page out. **Must be set to zero**, indicating that the data accessed by this command may be cashed.

FUA Force unit access. **Must be set to zero**, indicating that the data accessed by this command may be transferred from the cash or read from the media.

RelAdr Relative Block Address. **Must be set to zero**, indicating that the logical block address field specifies the first logical block of the range of logical blocks to be operated on by this command. Relative address is not supported.

Transfer length The number of contiguous blocks to be transferred. If zero is specified, no data transferred. This is not considered as an error.

2.11 READ BUFFER (3C)

	BIT 7	6	5	4	3	2	1	0
BYTE 0	Command Code = 3Ch							
BYTE 1	LUN			RSVD = 0		MODE		
BYTE 2	Buffer ID							
BYTE 3	(MSB)	Buffer Offset						
BYTE 4								
BYTE 5								(LSB)
BYTE 6	(MSB)	Allocation length						
BYTE 7								
BYTE 8								(LSB)
BYTE 9	VU = 0		RSVD = 0				FLAG	LINK

Figure 2-30. READ BUFFER (3C)

The READ BUFFER command is used in conjunction with the WRITE BUFFER command as a diagnostic function for testing the file's memory and the SCSI bus integrity. This command does not alter the medium.

The function of this command and the meaning of fields within the command descriptor block depend on the contents of the mode field.

MODE	Description
000	Read combined header and data
010	Data
011	Descriptor
All others	Not supported.

2.11.1 Combined Header And Data (Mode 000)

In this mode, a four byte header followed by data bytes are returned to the initiator during the DATA IN phase. The buffer ID and the buffer offset field are reserved.

The file terminates the DATA IN phase when allocation length bytes of header plus data have been transferred or when the header and all available data have been transferred to the initiator, whichever is less.

The four-byte READ BUFFER header (Figure 2-31 on page 2-40) is followed by data bytes from the file's data buffer.

	BIT 7	6	5	4	3	2	1	0
BYTE 0	RSVD = 0							
BYTE 1	(MSB)			Buffer Capacity				
BYTE 2								
BYTE 3								(LSB)

Figure 2-31. READ BUFFER Header

The buffer capacity specifies the total number of data bytes that are available in the file's data buffer. This number is not reduced to reflect the allocation length nor is it reduced to reflect the actual number of bytes written using the WRITE BUFFER command.

Following the READ BUFFER header, the file will transfer data from its data buffer.

2.11.2 Read Data (Mode 010b)

In this mode, the DATA IN phase contains buffer data.

Buffer ID This field must be set to zero, indicating the data transfer buffer If other value is specified, the command is terminated with CHECK CONDITION status. File shall set sense key to ILLEGAL REQUEST and additional sense code to ILLEGAL FIELD IN CDB.

Buffer Offset This specifies the offset of the memory space specified by the Buffer ID. The initiator should conform to the offset boundary requirements returned in the READ BUFFER descriptor. If the value exceeds the buffer specified, the command is terminated with CHECK CONDITION status. File shall set sense key to ILLEGAL REQUEST and additional sense code to ILLEGAL FIELD IN CDB.

Allocation Length The file terminates the DATA IN phase when allocation length bytes of data have been transferred or when the header and all available data have been transferred to the initiator, whichever is less.

2.11.3 Descriptor (Mode 011b)

In this mode, a maximum of four bytes of READ BUFFER descriptor information are returned. The file returns the descriptor information for the buffer specified by the buffer ID. (See 'READ DATA' mode for the buffer ID.)

Buffer ID If there is no buffer associated with the specified buffer ID, the file returns all zeros in the READ BUFFER descriptor.

Buffer Offset This field is reserved.

Allocation Length This must be set to four or greater. The file transfers the lesser of the allocation length or four bytes of READ BUFFER descriptor. The READ BUFFER descriptor is defined in Figure 2-32 on page 2-41.

	BIT 7	6	5	4	3	2	1	0
BYTE 0	Offset Boundary							
BYTE 1	(MSB)	Buffer Capacity						
BYTE 2								
BYTE 3								(LSB)

Figure 2-32. READ BUFFER DESCRIPTOR

The value contained in the Buffer Offset field of subsequent WRITE BUFFER and READ BUFFER commands should be a multiple of two to the power of the offset boundary. The offset boundary is always set to nine, which indicates Sector(512 bytes) Boundaries.

2.12 Read LONG (3E)

	BIT 7	6	5	4	3	2	1	0
BYTE 0	Command Code = 3Eh							
BYTE 1	LUN			Reserved			CORT	RelAdr
BYTE 2 BYTE 3 BYTE 4 BYTE 5	(MSB) LOGICAL BLOCK ADDRESS (LSB)							
BYTE 6	Reserved							
BYTE 7 BYTE 8	(MSB) Byte Transfer Length (LSB)							
BYTE 9	VU = 0			RSVD = 0			FLAG	LINK

Figure 2-33. READ LONG (3E)

The READ LONG command requests the file to transfer **one block** of data to the initiator. The transfer data includes;

- 512 bytes of data
- ECC field data
- **CORT**

  0 A corrected bit of zero causes the logical block to be read without any correction made by the file.

  1 Not supported by the file. (A corrected bit of one causes the data to be corrected by ECC before transferring the data to the initiator.)

- **RelAdr** Relative Block Address is not supported by the file.
- **LOGICAL BLOCK ADDRESS** field specifies the logical block at which the read operation shall occur.
- **Byte Transfer Length**. This field must exactly specify the number of bytes of data that are available for transfer. If a non-zero byte transfer length does not match the available data length, the target terminates the command with CHECK CONDITION status, the sense key is set to ILLEGAL REQUEST and an additional sense code set to INVALID FIELD IN CDB. The valid and ILI bits is set to one and the information field is set to the difference of the requested length minus the actual length in bytes. Negative values is indicated by two's complement notation.

2.13 REASSIGN BLOCKS (07)

	BIT 7	6	5	4	3	2	1	0
BYTE 0	Command Code = 07h							
BYTE 1	LUN			RSVD = 0				
BYTE 2	RSVD = 0							
BYTE 3	RSVD = 0							
BYTE 4	RSVD = 0							
BYTE 5	VU = 0		RSVD = 0				FLAG	LINK

Figure 2-34. REASSIGN BLOCKS (07)

The REASSIGN BLOCKS command requests the file to reassign a logical block to an available spare. The logical block address is transferred to the file during the DATA OUT phase. Only one block may be specified for relocation per REASSIGN BLOCKS command.

Execution of this command does NOT cause movement of data being reassigned.

Reassignment is complete upon the completion of the REASSIGN BLOCKS command. At this time, the defective logical block address has been added to the grown (“G” list) defect list.

This command copies the current grown defect list to the file's reserved area before updates the list. So if the command is interrupted (such as by a power outage) during the update of the grown defect list, the command will automatically put back the current list from the reserved area at the next power on or reset.

Data contained at the logical block address being reassigned is not preserved by the file.

The REASSIGN BLOCKS command attempts to allocate spare blocks on the reserved track for this command.

Following is the format of the data sent by the initiator during the DATA OUT phase:

	BIT 7	6	5	4	3	2	1	0
BYTE 0	RSVD = 0							
BYTE 1	RSVD = 0							
BYTE 2	(MSB) Defect list length = 4							
BYTE 3								(LSB)
BYTE 4	(MSB) Defective							
BYTE 5	Logical							
BYTE 6	Block							
BYTE 7	Address							(LSB)

Figure 2-35. Format of REASSIGN BLOCKS data

2.14 RELEASE (17)

	BIT 7	6	5	4	3	2	1	0
BYTE 0	Command Code = 17h							
BYTE 1	LUN			3dPty	3d Party ID			Ext=0
BYTE 2	Reservation Identification = 0							
BYTE 3	RSVD = 0							
BYTE 4	RSVD = 0							
BYTE 5	VU = 0		RSVD = 0				FLAG	LINK

Figure 2-36. RELEASE (17)

The RELEASE command is used to release a LUN previously reserved.

Note: It is not an error for an initiator to release a LUN that is not currently reserved.

- **3dPty** bit indicates that :

  1 This release process is for a third party which is specified by 3d Party ID.

  0 This release process is for the initiator itself.

- **3d Party ID** specifies the ID of the third party for which the LUN is reserved.[4]
- **Ext**ents must be 0. Extension is not supported by the file.
- **Reservation Identification** must be 0. Extension is not supported.
- **Extent List** length must be zero. Extension is not supported.

[4] Refer 2.16, “RESERVE (16)” on page 2-47

2.15 REQUEST SENSE (03)

	BIT 7	6	5	4	3	2	1	0
BYTE 0	Command Code = 03h							
BYTE 1	LUN			RSVD = 0				
BYTE 2	RSVD = 0							
BYTE 3	RSVD = 0							
BYTE 4	ALLOCATION LENGTH							
BYTE 5	VU = 0		RSVD = 0				FLAG	LINK

Figure 2-37. REQUEST SENSE (03)

The REQUEST SENSE command requests the file to transfer sense data.

The sense data shall be available when following conditions,

- The previous command to the specified I_T_L nexus terminated with CHECK CONDITION status.[5]
- An other information (e.g. medium position) is available in any fields.
- The previous command to the specified I_T_L nexus ended unexpected BUS FREE error.

If REQUEST SENSE command with a invalid LUN is received, file return GOOD status and report a sense key of ILLEGAL REQUEST and an additional sense code of LOGICAL UNIT NOT SUPPORTED.

If the file has no sense data available to return, it shall return a sense key of NO SENSE and an additional sense code of NO ADDITIONAL SENSE INFORMATION.

The sense data shall be preserved by the file for the initiator until retrieved by the REQUEST SENSE command or until any other command for the same I_T_L nexus. Sense data shall be cleared upon receipt subsequent command including REQUEST SENSE to the same I_T_L nexus.

Separate sense data is maintained by the device for each initiator. Therefore, there is no requirement for an initiator to expeditiously clear a CHECK CONDITION as this will not affect other initiators in a multi-initiator system.

The file will return the number of bytes in the allocation length or 32 bytes whichever is less.

[5] **I_T_L nexus .** A nexus which exists between an initiator, a target and a logical unit.

2.16 RESERVE (16)

	BIT 7	6	5	4	3	2	1	0
BYTE 0	Command Code = 16h							
BYTE 1	LUN			3rdPty	3rd Party ID			Ext=0
BYTE 2	Reservation Identification = 0							
BYTE 3	(MSB) Extent List = 0							
BYTE 4								(LSB)
BYTE 5	VU = 0			RSVD = 0			FLAG	LINK

Figure 2-38. RESERVE (16)

The RESERVE command is used to reserve a LUN for an initiator. This reservation can be either for;

- The initiator which sends this command.
- The third party which is specified in this command.

This command results in reserving the entire LUN for the initiator until one of the following occurs:

- The reservation is superseded by another valid RESERVE command from the initiator that made the reservation.
- The LUN is released by a RELEASE command from the same initiator.
- A hard reset condition occurs. (A SCSI bus Reset assertion)
- A BUS DEVICE RESET message is received from any initiator.
- Power off/on occurs.
- **3rdPty** bit is to indicates that :

  1 This reservation is for a third party which is specified by 3rd Party ID.

  0 This reservation is for the initiator itself.
- **3rd Party ID** specifies the ID of the third party for which the LUN is reserved.

  Note: The LUN may be only released by the initiator who sent the RESERVE command.
- **Ext**ents must be 0. Extension is not supported by the file.
- **Reservation Identification** must be 0. Extension is not supported.
- **Extent List** length must be zero. Extension is not supported.

2.16.1 Command Processing While Reserved

When a reservation for a LUN is made by an initiator for the same or a different initiator (Third Party option), the following rules apply.

- If the issuing initiator is the one that made the reservation and also the one to receive the reservation then :
  - All commands are permitted.

- If the issuing initiator is neither the one that made the reservation nor the one that receive the reservation then :
  - A REQUEST SENSE or INQUIRY command are permitted.
  - A RELEASE command is permitted but is ignored.
  - Any other command result in a RESERVATION CONFLICT status.
- If the issuing initiator is the one that made the reservation but is not the one to receive the reservation then :
  - A REQUEST SENSE, INQUIRY, RELEASE or RESERVE command is permitted.
  - Any other command result in a RESERVATION CONFLICT status.
- If the issuing initiator is not the one that made the reservation but is the one to receive the reservation then :
  - RESERVE command result in a RESERVATION CONFLICT status.
  - A RELEASE command is permitted but is ignored.
  - Any other command is permitted.

Note: A third party reservation (3rd pty bit equal to one) with the Third Party ID set equal to SCSI ID of the initiator that issued RESERVE command is not distinguishable from a RESERVE command with the Third Party bit equal to zero.

2.17 REZERO UNIT (01)

	BIT 7	6	5	4	3	2	1	0
BYTE 0	Command Code = 01h							
BYTE 1	LUN			RSVD = 0				
BYTE 2	RSVD = 0							
BYTE 3	RSVD = 0							
BYTE 4	RSVD = 0							
BYTE 5	VU = 0		RSVD = 0				FLAG	LINK

Figure 2-39. REZERO UNIT (01)

The REZERO UNIT command requests that the target seek to logical block address 0.

2.18 SEEK (0B)

	BIT 7	6	5	4	3	2	1	0
BYTE 0	Command Code = 0Bh							
BYTE 1	LUN			(MSB)		LBA		
BYTE 2	LOGICAL BLOCK ADDRESS							
BYTE 3	LOGICAL BLOCK ADDRESS (LSB)							
BYTE 4	Reserved							
BYTE 5	VU = 0		RSVD = 0				FLAG	LINK

Figure 2-40. SEEK (0B)

The SEEK command requests the file to seek to the specified logical block address.

2.19 SEEK EXTENDED (2B)

	BIT 7	6	5	4	3	2	1	0
BYTE 0	Command Code = 2Bh							
BYTE 1	LUN			RSVD = 0				0
BYTE 2 BYTE 3 BYTE 4 BYTE 5	(MSB) Logical Block Address							(LSB)
BYTE 6	RSVD = 0							
BYTE 7	RSVD = 0							
BYTE 8	RSVD = 0							
BYTE 9	VU = 0		RSVD = 0				FLAG	LINK

Figure 2-41. SEEK EXTENDED (2B)

The SEEK EXTENDED command requests the file to seek to the specified logical block address.

2.20 SEND DIAGNOSTIC (1D)

	BIT 7	6	5	4	3	2	1	0
BYTE 0	Command Code = 1Dh							
BYTE 1	LUN			RSVD = 0		SlfTst	DevOfl	UntOfl
BYTE 2	RSVD = 0							
BYTE 3	(MSB)	Parameter List Length						
BYTE 4								(LSB)
BYTE 5	VU = 0		RSVD = 0				FLAG	LINK

Figure 2-42. SEND DIAGNOSTIC (1D)

The SEND DIAGNOSTIC command requests the file to perform its self-diagnostic test.

- **SlfTst** must be 1, Indicating default self-tests.
- **DevOfl** must be 0, Indicating that the diagnostic operations don't effect subsequent command.
- **UntOfl** must be 0, Indicating that the diagnostic operations don't effect subsequent command.
- **Parameter List Length** must be set to zero.

Upon command completion, the following status is returned:

- GOOD status for successful test completion.
- CHECK CONDITION status for unsuccessful test completions.

2.21 START/STOP UNIT (1B)

	BIT 7	6	5	4	3	2	1	0
BYTE 0	Command Code = 1Bh							
BYTE 1	LUN			RSVD = 0				Immed
BYTE 2	RSVD = 0							
BYTE 3	RSVD = 0							
BYTE 4	RSVD = 0							Start
BYTE 5	VU = 0		RSVD = 0				FLAG	LINK

Figure 2-43. START/STOP Unit (1B)

The START/STOP UNIT command is used to spin up or stop the spindle motor.

- **Immed** bit is to specify

  0 Status is to be returned at the end of the operation.
  1 GOOD status shall always be returned immediately after command has been received. The TEST UNIT READY command may be used to determine when the file becomes ready after a spin-up.

- **Start** bit is to specify:

  0 Stop the spindle.
  1 Start the spindle.

  Note: Once the drive has become ready (after a power on) the Start/Stop UNIT command can be used without any errors, regardless of the state of the motor, stopped or spinning.

2.22 TEST UNIT READY (00)

	BIT 7	6	5	4	3	2	1	0
BYTE 0	Command Code = 00h							
BYTE 1	LUN				RSVD = 0			
BYTE 2	RSVD = 0							
BYTE 3	RSVD = 0							
BYTE 4	RSVD = 0							
BYTE 5	VU = 0		RSVD = 0				FLAG	LINK

Figure 2-44. TEST UNIT READY (00)

The TEST UNIT READY command allows the initiator to check if the file is READY. The SCSI specification defines READY as the condition where the device will accept a media-access command without returning CHECK CONDITION status.

The file will first verify that the motor is spinning at the correct speed.

- If the spindle motor is not spinning at the correct speed, CHECK CONDITION status is returned with sense key of NOT READY.
- If the motor is spinning at the correct speed, the file accepts normal media access commands.

The TEST UNIT READY command is not intended as a diagnostic. No self diagnostic is performed by the device as a result of this command.

The TEST UNIT READY command has special significance for power sequencing using the START UNIT command with an Immediate bit of 1. In this mode the START UNIT command returns COMMAND COMPLETE status before the completion of motor spin-up and expects the initiator to issue TEST UNIT READY commands to determine when the motor has reached the proper speed.

Note: The spindle automatically starts in automatic spin-up Mode.[6] The file does not execute any commands other than TEST UNIT READY, INQUIRY or REQUEST SENSE command until the the Power On sequence is complete. The file will return CHECK CONDITION status with NOT READY sense key and IN PROCESS OF BECOMING READY sense code for all other commands during the Power On period.

[6] Refer to 7.5, “Spindle mode at powering on” on page 7-6

2.23 VERIFY (2F)

	BIT 7	6	5	4	3	2	1	0
BYTE 0	Command Code = 2Fh							
BYTE 1	LUN			RSVD = 0			ByteChk	0
BYTE 2	(MSB)	Logical Block Address						
BYTE 3								
BYTE 4								
BYTE 5								(LSB)
BYTE 6	RSVD = 0							
BYTE 7	(MSB)	Transfer Length						
BYTE 8								(LSB)
BYTE 9	VU = 0			RSVD = 0			FLAG	LINK

Figure 2-45. VERIFY (2F)

The VERIFY command requests that the file verify the data written on the media. A verification length of zero indicates that no data will be transferred. This condition is not considered an error.

- **ByteChk** indicates;

  0 The verification is performed by ECC check. No data transfer from the initiator is performed in this case. If an ECC error is detected, CHECK CONDITION status is returned with sense key set to MEDIUM ERROR.

  1 Byte-by-byte comparison is not supported.

2.24 WRITE (0A)

	BIT 7	6	5	4	3	2	1	0
BYTE 0	Command Code = 0Ah							
BYTE 1	LUN			(MSB)	LBA			
BYTE 2	LOGICAL BLOCK ADDRESS							
BYTE 3	LOGICAL BLOCK ADDRESS (LSB)							
BYTE 4	TRANSFER LENGTH							
BYTE 5	VU = 0		RSVD = 0				FLAG	LINK

Figure 2-46. WRITE (0A)

The WRITE command requests the file to write the specified number of blocks of data from the initiator to the medium starting at the specified logical block address.

See 2.7, “READ (08)” on page 2-32 for the parameters.

2.25 WRITE EXTENDED (2A)

	BIT 7	6	5	4	3	2	1	0
BYTE 0	Command Code = 2Ah							
BYTE 1	LUN			DPO	FUA	RSVD		0
BYTE 2	(MSB) Logical Block Address							
BYTE 3								
BYTE 4								
BYTE 5								(LSB)
BYTE 6	RSVD = 0							
BYTE 7	(MSB) Transfer Length							
BYTE 8								(LSB)
BYTE 9	VU = 0		RSVD = 0				FLAG	LINK

Figure 2-47. WRITE EXTENDED (2A)

The WRITE EXTENDED command requests that the file write the data transferred from the initiator. This command is processed like the standard WRITE command except for the longer transfer length .

A transfer length of zero indicates that no data will be transferred. This condition is not considered an error.

DPO Disable page out. **Must be set to zero**, indicating that the data accessed by this command may be cashed.

FUA Force unit access. **Must be set to zero**, indicating that the data accessed by this command may be transferred from the cash or read from the media.

2.26 WRITE AND VERIFY (2E)

	BIT 7	6	5	4	3	2	1	0
BYTE 0	Command Code = 2Eh							
BYTE 1	LUN			RSVD = 0			BytChk	0
BYTE 2 BYTE 3 BYTE 4 BYTE 5	(MSB) Logical Block Address							(LSB)
BYTE 6	RSVD = 0							
BYTE 7 BYTE 8	(MSB) Transfer Length							(LSB)
BYTE 9	VU = 0			RSVD = 0			FLAG	LINK

Figure 2-48. WRITE AND VERIFY (2E)

WRITE AND VERIFY command requests that the file writes the data transferred from the initiator to the medium and then verify that the data is correct written.

- **ByteChk** the options:

ByteChk	Description
0	The data is read back from the disk and verified using ECC after the successful write operation. If an ECC error is detected in the verify process, CHECK CONDITION status is returned with sense key set to MEDIUM ERROR.
1	Not supported by the file.

2.27 WRITE BUFFER (3B)

	BIT 7	6	5	4	3	2	1	0
BYTE 0	Command Code = 3Bh							
BYTE 1	LUN			RSVD = 0		MODE		
BYTE 2	Buffer ID							
BYTE 3	(MSB) Buffer Offset							
BYTE 4								
BYTE 5								(LSB)
BYTE 6	(MSB) Parameter list length							
BYTE 7								
BYTE 8								(LSB)
BYTE 9	VU = 0		RSVD = 0				FLAG	LINK

Figure 2-49. WRITE BUFFER (3B)

The WRITE BUFFER command is used in conjunction with the READ BUFFER command as a diagnostic function for testing the file's memory and the SCSI bus integrity. This command does not alter the medium of the file. Additional modes are provided for downloading microcode and for downloading and saving microcode.

The function of this command and the meaning of fields within the command descriptor block depend on the contents of the mode field.

MODE Description

000 Write combined header and data

010 Data

100 Download Microcode

101 Download Microcode and Save

--- All other modes are not supported by the file.

2.27.1 Combined Header And Data (Mode 000b)

In this mode, the data to be transferred is preceded by a four-byte header.

Buffer ID This field must be zero. If another value is specified, no download function are performed and the command is terminated with CHECK CONDITION status. And File shall set sense key to ILLEGAL REQUEST and additional sense code to ILLEGAL FIELD IN CDB.

Buffer Offset This field must be zero. If another value is specified, no download function are performed and the command is terminated with CHECK CONDITION status. And File shall set sense key to ILLEGAL REQUEST and additional sense code to ILLEGAL FIELD IN CDB.

Parameter List Length This field specifies the number of bytes that shall be transferred during the DATA OUT phase. This number **includes** four bytes of header, so the data length to be stored in the file's buffer is transfer length minus four. If the length exceeds the buffer size, the command is terminated with CHECK CONDITION status. And File shall set sense key to ILLEGAL REQUEST and additional sense code to ILLEGAL FIELD IN CDB.

The four-byte header consists of all reserved bytes.

	BIT 7	6	5	4	3	2	1	0
BYTE 0	RSVD = 0							
BYTE 1	RSVD = 0							
BYTE 2	RSVD = 0							
BYTE 3	RSVD = 0							

Figure 2-50. WRITE BUFFER Header

2.27.2 Write Data (Mode 010b)

In this mode, the DATA OUT phase contains buffer data.

Buffer ID This field must be set to zero, indicating the data transfer buffer If other value is specified, the command is terminated with CHECK CONDITION status. File shall set sense key to ILLEGAL REQUEST and additional sense code to ILLEGAL FIELD IN CDB.

Buffer Offset This specifies the offset of the memory space specified by the Buffer ID. The initiator should conform to the offset boundary requirements returned in the READ BUFFER descriptor. If the value exceeds the buffer specified, the command is terminated with CHECK CONDITION status. File shall set sense key to ILLEGAL REQUEST and additional sense code to ILLEGAL FIELD IN CDB.

Parameter List Length This field specifies the Parameter List Length. It must be;

- less than the capacity of the buffer size.
- on a sector boundary. In other words, it must be a multiple of 512.

If a invalid value is specified, the command is terminated with CHECK CONDITION status. File shall set sense key to ILLEGAL REQUEST and additional sense code to ILLEGAL FIELD IN CDB.

2.27.3 Download Microcode (Mode 100b)

In this mode, vendor-unique microcode is transferred to the control memory space of the file. After a Power On Reset, the file operate with the newly downloaded condition.

Buffer ID	This field must be '01'x. If other value is specified, no download function is performed and the command is terminated with CHECK CONDITION status. File shall set sense key to ILLEGAL REQUEST and additional sense code to ILLEGAL FIELD IN CDB.
Buffer Offset	This specifies the starting address of the downloaded Microcode. It must be less than the code area size, and be on a sector boundary (multiple of 512 byte). If the invalid value is specified, the command is terminated with CHECK CONDITION status . File shall set sense key to ILLEGAL REQUEST and additional sense code to ILLEGAL FIELD IN CDB.
Transfer Length	Total Microcode length must be specified. It must be less than the code area size, and be on a sector boundary (multiple of 512 byte). If the invalid value is specified, the command is terminated with CHECK CONDITION status. File shall set sense key to ILLEGAL REQUEST and additional sense code to ILLEGAL FIELD IN CDB.

Note: This process generates a unit attention condition for MICROCODE HAS BEEN CHANGED.

2.27.4 Download Microcode and Save (Mode 101b)

In this mode, vendor-unique microcode is transferred to the file and saved into the System reserved area on the disk. The downloaded code becomes effective after each Power On Reset until it is supplanted in another download microcode and save option.

Refer 2.27.3, “Download Microcode (Mode 100b)” on page 2-60 for the parameters.

Note: This process generates a unit attention condition for MICROCODE HAS BEEN CHANGED.

2.28 WRITE LONG (3F)

	BIT 7	6	5	4	3	2	1	0
BYTE 0	Command Code = 3Fh							
BYTE 1	LUN			Reserved				RelAd
BYTE 2 BYTE 3 BYTE 4 BYTE 5	(MSB) LOGICAL BLOCK ADDRESS (LSB)							
BYTE 6	Reserved							
BYTE 7 BYTE 8	(MSB) Byte Transfer Length (LSB)							
BYTE 9	VU = 0			RSVD = 0			FLAG	LINK

Figure 2-51. WRITE LONG (3F)

The WRITE LONG command requests the file to write **one block** of data transferred from the initiator. The transfer data must include;

- 512 bytes of data
- 18 bytes of ECC data

Parameters are;

- **RelAd** (Relative Block Address). This is not supported by the file.
- **LOGICAL BLOCK ADDRESS** field specifies the logical block at which the read operation shall occur.
- **Byte Transfer Length**. This field must exactly specify the number of bytes of data that are available for transfer. If a non-zero byte transfer length does not match the available data length, the target terminates the command with CHECK CONDITION status, the sense key is set to ILLEGAL REQUEST and an additional sense code set to INVALID FIELD IN CDB. The valid and ILI bits is set to one and the information field is set to the difference of the requested length minus the actual length in bytes. Negative values is indicated by two's complement notation.

2.29 SET PASSWORD (F1)

	7	6	5	4	3	2	1	0
BYTE 0	Command Code = F1h							
BYTE 1	LUN			Reserved = 0				
BYTE 2 : BYTE 8	Reserved = 0							
BYTE 9	VU = 0		Reserved = 0				FLAG	LINK

Figure 2-52. Set Password (F1h)

The Set Password command requests to transfer 34 bytes data from the host including information specified in Figure 2-53. Set Password command update Password and Security Level. And if User Password is selected, the drive lock function will be enabled from the next power on. Setting Master Password does NOT affect to the drive lock function.

This command is not available in drive frozen mode.

If host set High level and User password is forgotten, the only Master Password can unlock the drive. If host sets Maximum level and User password is forgotten, only Erase Unit command is available.

	7	6	5	4	3	2	1	0
BYTE 0	Reserved = 0							Identifier
BYTE 1	Reserved = 0							Security Level
BYTE 2 : BYTE 33	Password							

Figure 2-53. Set Password Information

Identifier Zero indicates that drive regards Password as User Password. One indicates that drive regards Password as Master Password.

Security Level Zero indicates High level, one indicates Maximum level.

Password On shipping from drive MFG, all '20'h (blank in ASCII) are filled.

2.30 UNLOCK (F2)

	7	6	5	4	3	2	1	0
BYTE 0	Command Code = F2h							
BYTE 1	LUN			Reserved = 0				
BYTE 2 : BYTE 8	Reserved = 0							
BYTE 9	VU = 0		Reserved = 0				FLAG	LINK

Figure 2-54. Unlock (F2h)

The Unlock command requests to transfer 34 bytes data from the host including information specified in Figure 2-55. Then the drive compares transferred password and saved one. If User Password or Master Password is matched, the drive enters drive unlocked mode and enables all command. If neither passwords are not matched, the drive returns Check Condition status. If Unlock command fails 5 times, the drive rejects all command with Check Condition status until power off except Inquiry, Request Sense, and Test Unit Ready commands.

This command is not available in drive frozen mode.

The Unlock command will NOT allow Master Password if security level is maximum.

	7	6	5	4	3	2	1	0
BYTE 0	Reserved = 0							Identifier
BYTE 1	Reserved = 0							
BYTE 2 : BYTE 33	Password							

Figure 2-55. Unlock Information

Identifier Zero indicates that drive regards Password as User Password. One indicates that drive regards Password as Master Password.

2.31 ERASE UNIT (F4)

	7	6	5	4	3	2	1	0
BYTE 0	Command Code = F4h							
BYTE 1	LUN			Reserved = 0				
BYTE 2 : BYTE 8	Reserved = 0							
BYTE 9	VU = 0		Reserved = 0				FLAG	LINK

Figure 2-56. Erase Unit (F4h)

This command requests to transfer 34 bytes data from the host including information specified in Figure 2-57. This command executes erase all user data. It will take about 5 minites to complete erasure.

This command is not available in drive frozen mode.

If password is not matched, drive rejects this command with Check Condition status.

If host sets Maximum level and User password is forgotten, only Erase Unit command is available.

	7	6	5	4	3	2	1	0
BYTE 0	Reserved = 0							Identifier
BYTE 1	Reserved = 0							
BYTE 2 : BYTE 33	Password							

Figure 2-57. Erase Unit information

Identifier Zero indicates that drive regards Password as User Password. One indicates that drive regards Password as Master Password.

2.32 FREEZE LOCK (F5)

	7	6	5	4	3	2	1	0
BYTE 0	Command Code = F5h							
BYTE 1	LUN			Reserved = 0				
BYTE 2 : BYTE 8	Reserved = 0							
BYTE 9	VU = 0		Reserved = 0				FLAG	LINK

Figure 2-58. Freeze Lock (F5h)

The Freeze Lock Command make the drive enter drive frozen mode. And after this command completion, following commands which can update drive lock condition terminate with Check Condition status. This command is also not available in drive frozen mode.

- Set Password
- Unlock
- Erase Unit
- Freeze Lock
- Disable Password

Drive cannot quits frozen mode until power off.

2.33 DISABLE PASSWORD (F6)

	7	6	5	4	3	2	1	0
BYTE 0	Command Code = F6h							
BYTE 1	LUN			Reserved = 0				
BYTE 2 : BYTE 8	Reserved = 0							
BYTE 9	VU = 0		Reserved = 0				FLAG	LINK

Figure 2-59. Disable Password (F6h)

Disable Password command requests to transfer 34 bytes data from host including information specified in Figure 2-60. Then the drive compares transferred password. If User Password or Master Password is matched, the drive disables drive lock function. This command does not affect to User Password or Master Password.

This command is not available in drive frozen mode.

If password is not matched, drive rejects this command with Check Condition status.

This command will NOT allow Master Password if security level is maximum.

	7	6	5	4	3	2	1	0
BYTE 0	Reserved = 0							Identifier
BYTE 1	Reserved = 0							
BYTE 2 : BYTE 33	Password							

Figure 2-60. Password Information for Password disable command

Identifier Zero indicates that drive regards Password as User Password. One indicates that drive regards Password as Master Password.

3. PASSWORD COMMAND USAGE

3.1 Overview

3.1.1 Drive Lock

Drive Lock is powerful security feature. With a drive lock password, user can prevent unauthorized access to hard disk drive even if the drive is removed from the computer.

New commands are supported for this feature as below.

- Set Password ('F1'h)
- Unlock ('F2'h)
- Erase Unit ('F4'h)
- Freeze Lock ('F5'h)
- Disable Password ('F6'h)

3.1.2 Terminology

Term **Definition**

Drive Locked mode
In this mode, the drive disables media access commands. At powering on, automatically drive enters this mode if drive lock function is enabled. And drive quits this mode by Unlock command or Erase Unit command.

Drive Unlocked mode
In this mode, the drive enables all commands. Drive enter this mode by Unlock command.

Drive Frozen mode
In this mode, the drive enables all commands except commands which can update drive lock function. Drive enters this mode by Freeze Lock command. And drive cannot quits this mode until power off.

3.2 Operation

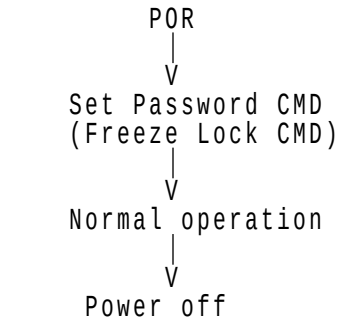
3.2.1 Default setting

Master Password is set as all ASCII blanks (20h) and the lock function is disabled on shipping from Drive MFG.

System manufacturer/dealer can set new Master Password by Set Password command, without enabling the lock function.

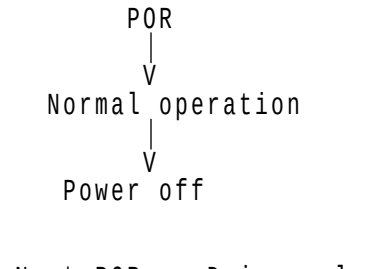
3.2.2 Initial Setting user password by System user

< Setting password >



Next POR –> Drive locked mode

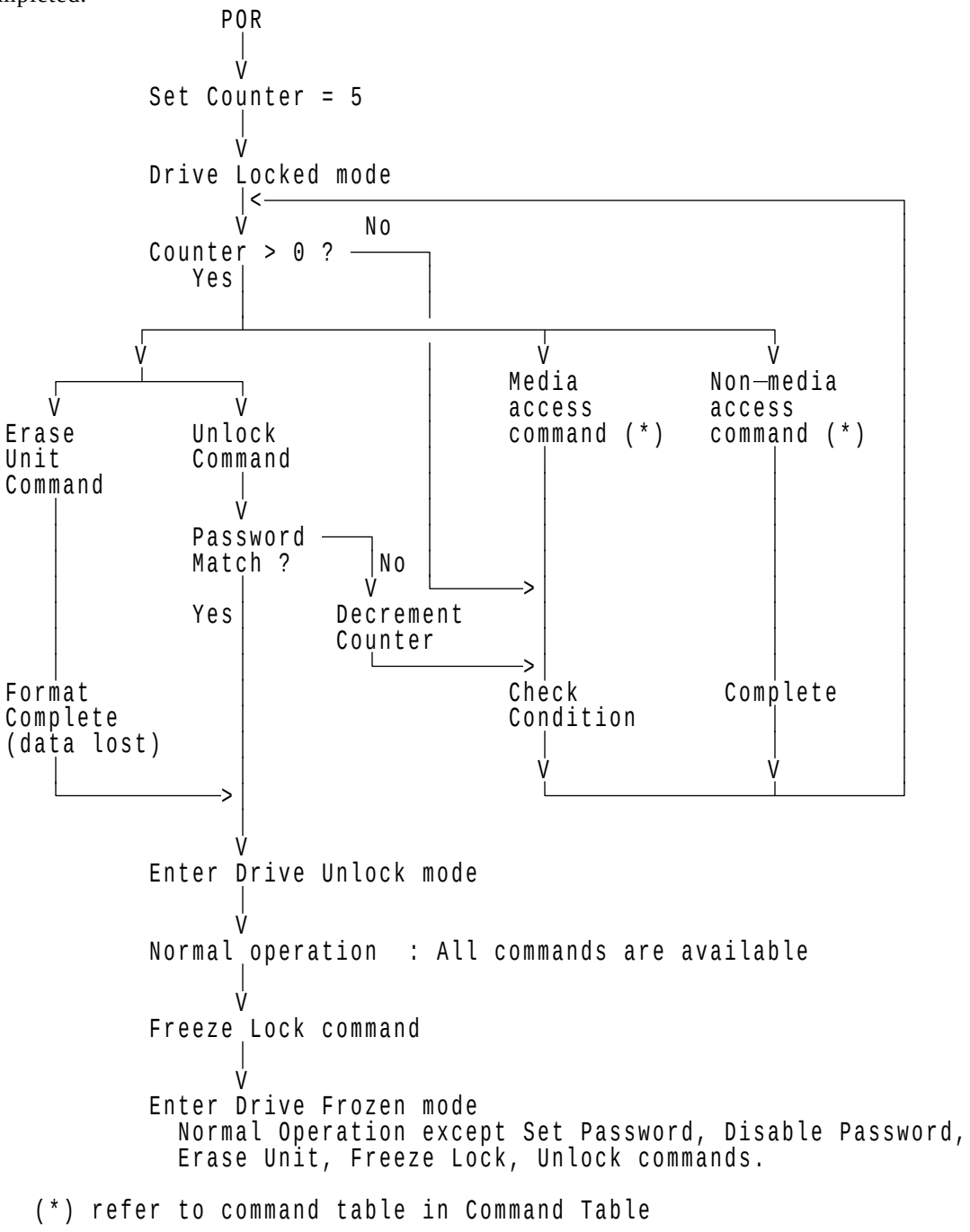
(Ref.)
< No setting password >



Next POR –> Drive unlocked mode

3.2.3 Operation from POR after User Password is set

When drive lock is enabled, the drive rejects media access command until an Unlock command is successfully completed.

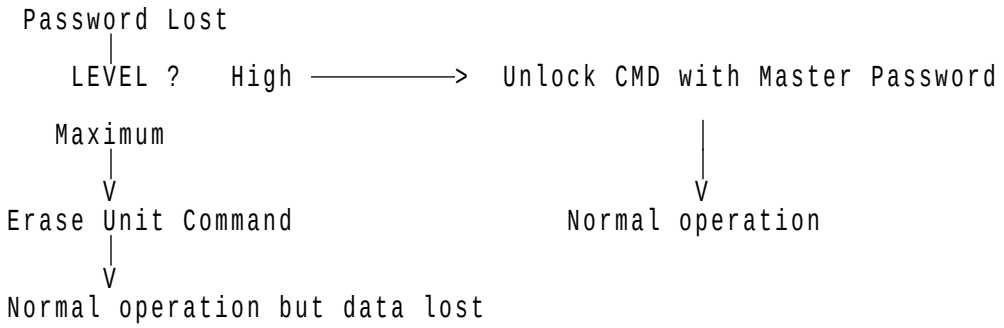


(*) refer to command table in Command Table

3.2.4 Password Lost

If the user password is forgotten and High security level is set, the user can't access any data. However the drive can be unlocked using the master password.

If a user forgets the user password and Maximum security level is set, data access is impossible. However the drive can be unlocked using the Erase Unit command to unlock the drive and erase all user data.



3.2.5 Command Table

This table shows drive's response for command when Drive lock function is enabled.

Command	Drive Locked Mode Power on to Unlock	Drive Unlock Mode unlock to freeze	Drive Frozen Mode freeze to Power off
Disable Password	X	O	X
Erase Unit	O	O	X
Format Unit	X	O	O
Freeze Lock	X	O	X
Inquiry	O	O	O
Mode Select	X	O	O
Mode Sense	X	O	O
Read	X	O	O
Read Buffer	X	O	O
Read Capacity	X	O	O
Read Defect Data	X	O	O
Read Extended	X	O	O
Read Long	X	O	O
Reassign Block	X	O	O
Release	X	O	O
Request Sense	O	O	O
Reserve	X	O	O
Rezero Unit	X	O	O
Seek	X	O	O
Seek Extended	X	O	O
Send Diagnostics	X	O	O
Set Password	X	O	X
Start/Stop Unit	O	O	O
Test Unit Ready	O	O	O
Unlock	O	O	X
Verify	X	O	O
Write	X	O	O
Write Buffer	X	O	O
Write Extended	X	O	O
Write Long	X	O	O
Write and Verify	X	O	O

o —— Drive executes command normally
x —— Drive terminates command with Check Condition

3.2.6 Inquiry Command data

The byte 96,97 of Inquiry Data indicates Drive Lock Information.

Byte	Description
96–97	Drive Lock Information Bit 0 : Capability ; 1– Support,0– Not support Bit 1 : Enable/Disable ; 1– Enable ,0– Disable Bit 2 : Lock ; 1– Locked ,0– Unlocked Bit 3 : Freeze ; 1– Frozen ,0– Not frozen Bit 4 : Expire ; 1– Expired,0– Not expired Bit 8 : Security Level ; 1– Maximum,0– High Bit 9–15 : Reserved ;

Figure 3-1. Inquiry Command Data (Additional)

Capability Zero indicates Not support drive lock function. One indicates support drive lock function.

Enable/Disable Zero means drive lock function is disabled. One means drive lock function is enabled.

Lock Zero means currently mode is drive unlocked. One means currently mode is drive locked mode.

Freeze Zero indicates Not drive frozen mode. One indicates drive frozen mode.

Expire Zero indicates retry count is not expired. One indicates retry count is expired.

Security Level Zero indicates High level, one indicates Maximum level.

If auto spin-up function is disabled, the drive cannot load saved parameters from the disk until Start command completes successfully. In this case, only bit 0 is available and from bit 1 to bit 15 are reserved which value is 0.

3.2.7 Command Error Table

This table shows drive's response when Drive terminates with Check Condition.

Command	Password	Security Level		Mode	
		Maximum	High	Locked	Frozen
Set Password (F1h)	Master	o	o	Err1	Err2
	User	o	o		
Unlock (F2h)	Master	Err3	o	o	Err2
	User	o	o		
Erase Unit (F4h)	Master	o	o	o	Err2
	User	o	o		
Freeze Lock (F5h)	Master	o	o	Err1	Err2
	User	o	o		
Disable Password (F6h)	Master	Err3	o	Err1	Err2
	User	o	o		

o ——— Drive executes command normally

Figure 3-2. Command Error Table

	Sense Key	Sense Code	Description
Err1	05h	8200h	Drive is locked.
Err2	05h	8201h	Drive is frozen.
Err3	05h	8205h	Security level is maximum.
Err4	05h	8203h	Incorrect Password.
Err5	05h	8204h	Password is expired.
Err6	03h	8202h	Password table error. The drive fails to save password and lock information to disk.

Figure 3-3. Command Error Code List

4. SCSI Status Byte

Upon the completion of a command, a status byte is sent to the initiator. Additional sense information may also be available depending on the contents of the status byte. The following section describes the possible values for the status byte and sense data.

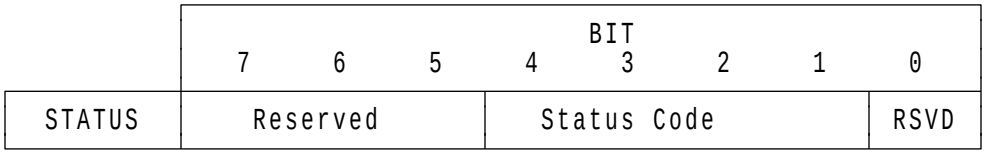


Figure 4-1. SCSI Status Byte. Format of the SCSI STATUS byte. The reserved (R) and vendor unique (VU) fields is set to zero.

STATUS BYTE Description

00h GOOD
The command has been successfully completed.

02h CHECK CONDITION
An error, exception, or abnormal condition has been detected. The sense data is set by the file. The REQUEST SENSE command should be issued to determine the nature of the condition.

08h BUSY
This condition is returned when disconnect privilege is not granted while the file is BUSY processing the other command for the other initiator. The normal initiator recovery action is to issue the command at a later time, or reissue the command and grant the disconnect privilege.

10h INTERMEDIATE
This status is returned for every command in a series of linked commands (except the last command), unless an error, exception, or abnormal condition causes a CHECK CONDITION status or a RESERVATION CONFLICT status to be set. If this status is not returned, the chain of linked commands is broken, and no further commands in the series are executed.

18h RESERVATION CONFLICT
This status is returned whenever an SCSI device attempts to access the file, but it has been reserved by another initiator. (See 2.16, “RESERVE (16)” on page 2-47.)

5. SCSI SENSE DATA

5.1 SCSI Sense Data Format

Format of the sense data returned by the file in response to the REQUEST SENSE command.

	BIT 7	6	5	4	3	2	1	0
BYTE 0	Valid	Error Code (70h or 71h)						
BYTE 1	RSVD = 0							
BYTE 2	0			ILI	0	Sense Key		
BYTE 3 BYTE 4 BYTE 5 BYTE 6	(MSB) Information Bytes							(LSB)
BYTE 7	Additional Sense Length							
BYTE 8 BYTE 9 BYTE 10 BYTE 11	(MSB) Command Specific Information							(LSB)
BYTE 12	Additional Sense Code							
BYTE 13	Additional Sense Code Qualifier							
BYTE 14	FRU = 0							
BYTE 15	SKSV	Sense–Key Specific Bits						
BYTE 16 BYTE 17	Sense–Key Specific Bytes							
BYTE 18 –31	Vender Unique							

Figure 5-1. Format of Sense Data. Format of the Sense Data returned by the file in response to the REQUEST SENSE command

5.1.1 Sense Data Description

5.1.1.1 Valid Bit

Bit 7 of byte 0

0 The Information Bytes are not defined.

1 The Information Bytes contain a valid logical block address.

5.1.1.2 Error Code

Bit 6 - 0 of byte 0.

70h Current Error. This indicates an error for the current command.

71h Deferred Error. This indicates that the error is for a previous command that already returned a GOOD status. Such commands are associated with the immediate bit, or command buffering. FORMAT UNIT command is an example of a command that may return a deferred error.

5.1.1.3 Sense Key

Bit 3 - 0 of byte 2.

The sense key provides generic categories in which error and exception conditions can be reported. Initiators would typically use sense keys for high level error recovery procedures.

0 NO SENSE
There is no sense key information to be reported for the logical unit.

1 RECOVERED ERROR
The last command completed successfully with some recovery action performed by the file. More detailed information is available in the Additional Sense Code.

2 NOT READY
The logical unit addressed cannot be addressed. More detailed information is available in the Additional Sense Code.

3 Medium Error
The command terminated with an unrecoverable error condition caused by a flaw in the media or an error in the recorded data. More detailed information is contained in the Additional Sense Code.

4 HARDWARE ERROR
The file detected a unrecoverable hardware error while performing a command or during a diagnostic test. More detailed information is contained in the Additional Sense Code.

5 ILLEGAL REQUEST
There was an illegal parameter in the command descriptor block or additional parameter supplied as data. If an invalid parameter is found in the CDB, then the command is terminated without altering the medium. If an invalid parameter is found in parameters supplied as data, then the file might have altered the medium.

6 UNIT ATTENTION
Indicates that the file entered in the 'Unit Attention Condition'. (See 7.3, “Unit Attention Condition” on page 7-5.)

7-A Not used

B ABORTED COMMAND
The file aborted the command.

C-D Not Implemented

E MISCOMPARE
Not used.

F Reserved

5.1.1.4 Information Bytes

Byte 3 - 6
This field is only valid when Valid Bit is one, and contains the unsigned LBA associated with the sense key.

5.1.1.5 Additional Sense Length

Byte 7
Indicates the remaining number of bytes in the sense data. (It is set to 18h in the file.)

5.1.1.6 Command Specific Information

Byte 8 - 11
Not Used

5.1.1.7 Additional Sense Code/Qualifier

Byte 12 / 13

12	13	Description
00	**00**	No additional sense information.
01	**00**	No index or sector
02	**00**	No seek complete
03	**00**	Write fault
04	**00**	Drive not ready. Cause not reportable.
04	**01**	Drive not ready. In process of becoming ready.
04	**02**	Drive not ready. Initializing command required. (Start Motor)
04	**04**	Format in progress.
08	**00**	Communication failure
08	**01**	Communication time out
08	**02**	Communication parity error
09	**00**	Track following error
10	**00**	ID CRC error
11	**00**	UNRECOVERED read error
14	**01**	Record not found
15	**00**	Seek positioning error
15	**02**	Data synchronization mark error
17	**00**	Recovered read data without ECC applied.
18	**00**	Recovered read data with ECC applied.
19	**00**	Defect list error A defect list error occurs when a data error is detected while reading the manufacturing defect list or while reading or writing the grown defect list.

19 01 Defect list not available

1A 00 Parameter list length error
The number of parameters supplied is not equal to the value the command allows.

1B 00 Synchronous data transfer error

1C 00 Defect List not found

1D 00 Miscompare during verify operation.

20 00 Invalid command operation code
This code is also returned when an unsupported command code is received.

21 00 Logical block address out of range

24 00 Invalid field in CDB

25 00 Unsupported LUN
The file supports LUN 0 only.

26 00 Invalid field in the parameter list

26 01 Parameter not supported

26 02 Parameter value invalid

29 00 Power on reset or Bus device reset occurred

2A 00 Mode Select parameters changed

31 00 Medium Format Corrupted
A format operation was interrupted (power down, reset) prior to completion of a Format Unit command. The Format Unit command should be re-issued and must complete successfully for this error condition to be removed.

31 01 Format command failed

32 00 No defect spare location available
A no defect spare location available sense code indicates that the Reassign Block command can not proceed the process because all available spare sectors have been used, or it will exceed Implementation Limitation of Defect Handling of the file.[1]

3D 00 Invalid bits in identify message

3F 01 Microcode has been changed

40 80 Diagnostic failure on RAM

42 00 Power On or Diagnostics Error

43 00 Message reject error
A message reject error occurs when an inappropriate or unexpected message reject is received from the initiator or the initiator rejects a message twice.

44 00 Internal controller error
An internal controller error occurs when the control microprocessor detects incorrect status or receives an illegal request from the device electronics.

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[1] Refer to 7.11, “Media Defect Strategy” on page 7-10.

45 00 Select/Re-select failed
A select/re-select error occurs when the initiator fails to respond to a re-selection within 250 milliseconds after the file gains bus arbitration. The re-selection is attempted a second time before setting select/re-select failed status.

47 00 SCSI parity error

48 00 Initiator detected error message received
An initiator detected error occurs when the initiator detects an error, sends a message to retry, detects the error again, and sends the retry message a second time. The file then sets check condition status with Initiator Detected Status.

49 00 Inappropriate/illegal message
An inappropriate or illegal message occurs when the initiator sent a message that either is not supported or is not in a logical sequence.

4A 00 Command phase error

4B 00 Data phase error

4C 00 LUN failed self-configuration

4E 00 Overlapped commands attempted

80 01 Time out hang during read/write

80 0F Bank RAM code error

81 00 Overlay read fail

81 01 Invalid overlay version

81 02 Improper overlay sector

81 0F Invalid overlay requested

82 00 Drive is locked

82 01 Drive is frozen

82 02 Password table error

82 03 Incorrect Password

82 04 Password is expired

82 05 Security level is maximum

5.1.1.8 FRU (Field Replaceable Unit)

Byte 14
The FRU (Field Replaceable Unit) field value will always be zero.

5.1.1.9 Sense Key Specific

Byte 15 - 17
The definition of this field is determined by the value of the sense key field.

5.1.1.9.1 Illegal Request Case: Error filed pointer is returned.

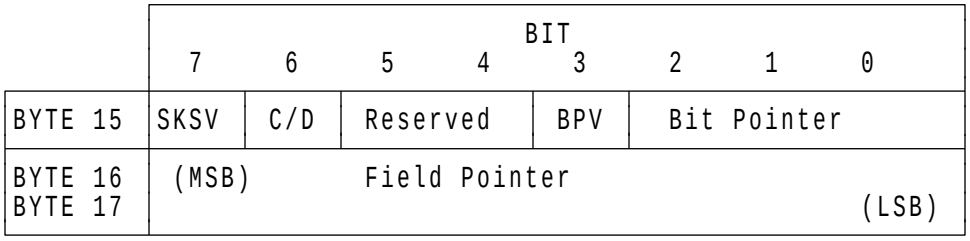

Figure 5-2. Field Pointer Bytes

SKSV Sense-key specific valid

C/D Command/Data

0 Indicates that the illegal parameter is in the data parameters sent by the initiator during DATA OUT phase

1 Indicates that the illegal parameter in the command descriptor block.

BPV Bit Pointer Valid

0 Indicates the bit pointer field is not valid.

1 Indicates the bit pointer field is significant.

Bit Pointer Bit Pointer indicates which bit of the byte number reported in Field Pointer is the bit in error. When a multiple-bit field is in error, the pointer point to the most significant bit of the field.

Field Pointer Indicates which bytes of the command descriptor block or of the parameter data was in error. Bytes are numbered starting from zero, as shown in the tables describing the commands and parameters. When a multiple-byte field id in error, the pointer point to the most significant byte of the field.

5.1.1.9.2 Recovered, Hardware or Medium Error Case: Actual Retry Count is reported.

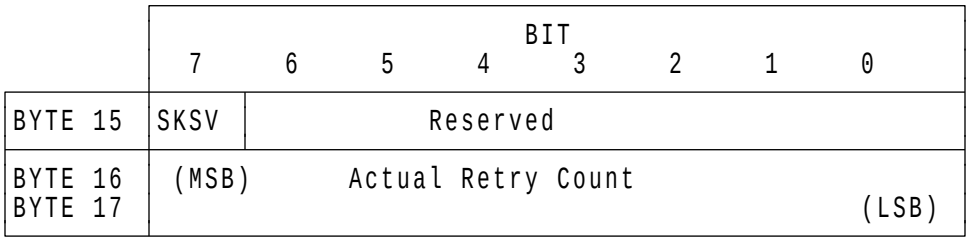

Figure 5-3. Actual Retry Count Bytes

SKSV Sense-key specific valid

0 Indicates that Actual Retry Count is not valid.

1 Indicates that Actual Retry Count is valid.

Actual Retry Count Actual number of retries used in attempting to recover from the error condition.

5.1.1.9.3 Not Ready Case: Progress indication is returned. These fields are only defined for the FORMAT UNIT command with the Immediate bit set to one.

	BIT 7	6	5	4	3	2	1	0
BYTE 15	SKSV	Reserved						
BYTE 16 BYTE 17	(MSB)	Progress Indication						(LSB)

Figure 5-4. Format Progress Indication Bytes

SKSV Sense-key specific valid

0 Indicates that Progress Indication is not valid.

1 Indicates that Progress Indication is valid.

Progress Indication Indicates a percent complete in which the returned value is the numerator that has 10000h as its denominator.

5.2 Priority of Error Reporting

Multiple errors can occur during the execution of a command. Since only one error is reported in the sense data, a priority scheme for determining which error to report is used. Following are the rules for reporting sense data:

5.2.1 Hard Errors

- An unrecovered (hard) error will always be reported in place of any soft error that may have occurred during the same operation.
- If multiple hard error conditions exist, the first hard error detected will be reported.

5.2.2 Soft Errors

- When PER=0 , recovered data and non-data errors are not reported.
- When PER=1 , the last recovered data or non-data error is reported, unless a unrecovered error occurs. In this case, the unrecovered error will be reported.

6. SCSI MESSAGE SET

6.1 Supported Messages

The message supported by the file is shows in Figure 6-1.

MESSAGE	CODE (hex)	Direction		Negate ATN Before last ACK
COMMAND COMPLETE	00	IN		———
SYNCHRONOUS DATA TRANSFER REQUEST	010301	IN	OUT	Yes
SAVE DATA POINTER	02	IN		———
RESTORE POINTERS	03	IN		———
DISCONNECT	04	IN		———
DISCONNECT	04		OUT	Yes
INITIATOR DETECTED ERROR	05		OUT	Yes
ABORT	06		OUT	Yes
MESSAGE REJECT	07	IN	OUT	Yes
NO OPERATION	08		OUT	Yes
MESSAGE PARITY ERROR	09		OUT	Yes
LINKED COMMAND COMPLETE	0A	IN		———
LINKED COMMAND COMPLETE (w/FLAG)	0B	IN		———
BUS DEVICE RESET	0C		OUT	Yes
IDENTIFY	80—FF	IN		———
IDENTIFY	80—FF		OUT	No

Key: IN = Target to Initiator, OUT = Initiator to target.
YES = Initiator shall negate ATN before last ACK of message.
NO = Initiator may or may not negate ACK before last ACK of message.
——— = Not applicable

Figure 6-1. Supported Messages

If an unsupported message is received, the file will send the *MESSAGE REJECT* message to the initiator.

6.1.1 COMMAND COMPLETE (00)

The file sends this message to the initiator to indicate that the execution of a command has terminated and that valid status has been sent to the initiator. After successfully sending this message, the file releases all bus signals and goes to BUS FREE phase.

6.1.1.1 SYNCHRONOUS DATA TRANSFER REQUEST (01,03,01H)

Byte	Value	Description
0	01H	Extended message
1	03H	Extended message length
2	01H	SYNCHRONOUS DATA TRANSFER REQUEST code
3	TP	Transfer period (TP times 4 nanoseconds)
4	xH	REQ/ACK offset

Figure 6-2. Synchronous Data Transfer Request.

A pair of Synchronous Data Transfer Request (SDTR) messages shown in Figure 6-2 are exchanged between an initiator and a Target to establish the synchronous data transfer mode between the two devices. The message exchange establishes the permissible transfer period and REQ/ACK offset for a synchronous data transfer between the two devices. The initiator may initiate a synchronous data transfer negotiation at any time after the LUN has been identified. The file will initiate a synchronous transfer negotiation A Synchronous Data Transfer Request message exchange shall be initiated by an SCSI device whenever a previously arranged data transfer agreement may have become invalid. *The agreement becomes invalid after any condition which may leave the data transfer agreement in an indeterminate state such as;*

1. after a hard reset condition
2. after a Bus Device Reset message
3. after a power on cycle.

TP The transfer period is the minimum time allowed between leading edges of successive REQ pulses and of successive ACK pulses to meet the device requirements for successful reception of data. The file supports 25 or higher, which implies the minimum transfer period of 100 nsec. The data transfer rate at this rate is 10 Mbytes/sec.

REQ/ACK Offset
The ACK/REQ offset is the maximum number of REQ pulses allowed to be outstanding before the leading edge of its corresponding ACK pulses is received at the file. A REQ/ACK offset value of zero indicate asynchronous data transfer mode. The file supports up to 15 offset.

If ATN is negated before all bytes of a multiple-byte extended message is received, the file will go to **BUS FREE** to signal a catastrophic error.

6.1.2 SAVE DATA POINTER (02)

This message is sent from the file to direct the initiator to copy the active data pointer to the saved data pointer. The SAVE DATA POINTER message is only sent if the initiator has previously indicated the ability to accommodate disconnection and reconnection via the IDENTIFY message .

The file will send the SAVE DATA POINTER message to the initiator prior to sending a DISCONNECT message to the initiator if a data phase has occurred and another data phase is required to successfully complete the command.

6.1.3 RESTORE POINTERS (03)

This message is sent from the file to direct an initiator to copy the most recently saved pointers to the corresponding command, data, and status pointers. Command and status pointers should be restored to the beginning of the present command and status areas. The data pointer should be restored to the value at the beginning of the data area in the absence of a SAVE DATA POINTER message or to the value at the point at which the last SAVE DATA POINTER message occurred. Also see 7.2, “SCSI Bus Related Error Handling Protocol” on page 7-2.

6.1.4 DISCONNECT (04)

This message is sent from the file to inform an initiator that the present connection is going to be broken. A later reconnect will be required in order to complete the current command. The disconnection is to free the SCSI bus while the file performs a relatively long operation that does not require the bus. These messages are only sent if the initiator previously indicated (via the IDENTIFY message) the ability to accommodate disconnection and reconnection.

The DISCONNECT message may also be sent from the initiator to the file to disconnect from the SCSI bus. If the file supports disconnecting at the time the DISCONNECT message is received from the initiator, the file will switch to the MESSAGE IN phase, send a DISCONNECT message to the initiator (possibly preceded by a SAVE DATA POINTER message), and then go to the BUS FREE phase. The file will not participate in another ARBITRATION phase for at least a disconnection delay. If the file does not support disconnecting at the time the Disconnect message is received from the initiator, the file will respond by sending a MESSAGE REJECT message to the initiator.

6.1.5 INITIATOR DETECTED ERROR (05)

This message is sent from an initiator to inform the file that an error has been detected that does not preclude the file from retrying the previous COMMAND, DATA and STATUS phase. The source of the error may be either related to previous activities on the SCSI bus or may be internal to the initiator and unrelated to any previous SCSI bus activity

If the initiator intends to send this message, the initiator must assert the ATN signal prior to its release of ACK for the last byte transferred in the information phase that is to be retried. This provides an interlock so the file can determine which information phase to retry.

After receiving this message, the file may retry the previous phase by sending a RESTORE POINTERS message to the initiator and then repeating the previous COMMAND, DATA, or STATUS phase.

6.1.6 ABORT (06)

This message is sent from the initiator to direct the file to clear the present operation for this initiator and logical unit, including queued command(s). If a logical unit has been identified, then all pending data and status for the issuing initiator and this logical unit will be cleared and the file will go to the BUS FREE phase. Pending data and status for other logical unit and initiators will not be cleared. If a logical unit has not been identified, the file will go to the BUS FREE phase without affecting an operation on any logical unit for this initiator or any other initiator. In either case, no status or ending message will be sent to the initiator for this operation. It is not an error to send the ABORT message to a logical unit that is not currently performing an operation for the initiator.

Note: It is permissible for an initiator to select the file/LUN after the file has disconnected from the initiator, for the purpose of sending an IDENTIFY message followed by an ABORT message. This will abort the command on the specified logical unit.

6.1.7 MESSAGE REJECT (07)

This message is sent from either the initiator or the file to indicate that the last message received was inappropriate or has not been implemented.

If the initiator intends to send this message, the initiator must assert the ATN signal prior to its release of ACK for the REQ/ACK handshake of the message byte that is to be rejected. This provides an interlock so the file can determine which message is rejected.

If the file intends to send this message, the file will change to the MESSAGE IN phase and send the MESSAGE REJECT message to the initiator prior to transferring any additional message bytes (or any other information phase bytes) from the initiator regardless of ATN signal. This provides an interlock so the initiator can determine which message is rejected. After the file sends a MESSAGE REJECT message and if ATN signal is still asserted then it shall return to the MESSAGE OUT phase. the subsequent MESSAGE OUT phase shall begin with first byte of a message.

6.1.8 NO OPERATION (08)

This message is sent from the initiator to the file when the initiator does not currently have any other valid message to send. This message is ignored by the file and will not affect any operation.

6.1.9 MESSAGE PARITY ERROR (09)

This message is sent from the initiator to inform the file that the last message byte received had a parity error.

If the initiator intends to send this message, the initiator must assert the ATN signal prior to its release of ACK for the REQ/ACK handshake of the message byte that has the parity error. This provides an interlock so the file can determine which message byte has the parity error.

If the file receives this message under any other circumstance, the file will change to BUS FREE to signal a catastrophic error. After receiving this message, the file will retry sending the previous message to the initiator.

6.1.10 LINKED COMMAND COMPLETE (0A)

The file sends this message to the initiator to indicate that execution of a linked command (with flag bit equal to zero) has completed and that valid status has been sent to the initiator. After successfully sending this message, the file goes to COMMAND phase to receive the next command.

6.1.11 LINKED COMMAND COMPLETE WITH FLAG (0B)

The file sends this message to the initiator to indicate that the execution of a linked command with flag bit set to one has completed and that valid status has been sent to the initiator. After successfully sending this message, the file goes to COMMAND phase to receive the next command.

6.1.12 BUS DEVICE RESET (0C)

This message is sent from an initiator to direct the file to clear all current commands. This message forces a hard reset condition which will reset the file to an initial state with no operations pending for any initiator. After receiving this message, the file will go to the BUS FREE phase.

6.1.13 IDENTIFY (80 - FF)

This message is set by either the initiator or the file to establish the logical path connection between the two devices.

The IDENTIFY message is defined as follows:

Bit 7 This bit is always set to one to distinguish the IDENTIFY message from other messages.

Bit 6 This bit is only set to one by the initiator to grant the file the privilege of disconnecting. If this bit is zero, the file will not disconnect, unless the initiator instructs the file to disconnect by sending a DISCONNECT Message to the file. This bit is set to zero when the file sends an IDENTIFY message to the initiator.

Bits 5-3 These bits are reserved and must be zero for an IDENTIFY message.

Note: If an invalid Identify message is received with these bits not equal to zero, then the file sends a MESSAGE REJECT message to the initiator and go to the BUS FREE phase with sense key set to ILLEGAL REQUEST and additional sense code set to INVALID BITS IN IDENTIFY MESSAGE.

Bits 2-0 These bits specify the logical unit number (LUN).

Only one LUN may be identified for any one selection sequence. If the file receives an IDENTIFY message with a new LUN after the LUN had previously been identified, the file will go to the BUS FREE phase to signal a catastrophic error. The initiator may send more than one Identify message during a selection sequence in order to toggle disconnect/reconnect permission if the specified LUN remains the same.

When the IDENTIFY message is sent from the file to the initiator during reconnection, an implied RESTORE POINTERS message must be performed by the initiator.

7. SCSI SYSTEM Implementation Information

The protocol in the file is fully compliant with the ANSI SCSI architecture. Special note is made for the specific SCSI items that are not implemented by this SCSI file.

The implementation of the supported messages will also include the following functions.

- Retry SCSI Command, DATA IN, DATA OUT, or STATUS phase
  The retry will be caused by the following error condition.
  - The file receives INITIATOR DETECTED ERROR MESSAGE during or at the conclusion of an information transfer phase (Command, Data In, Data Out or Status Phase)

    Note: The initiator may send the INITIATOR DETECTED ERROR message as a result of an initiator detected SCSI Bus parity error or an internal error.
- Retry MESSAGE IN phase
  - The retry will be caused by the receipt of a MESSAGE PARITY ERROR message immediately following a MESSAGE IN phase.

    Note: The Initiator may send the MESSAGE PARITY ERROR message as a result of an Initiator detected SCSI Bus parity error during the Message In phase.
- Receipt of multiple Identify message
  - The initiator is allowed to send a multiple IDENTIFY message out in order to toggle the disconnect/reconnect permission bit. This may be used to selectively enable or disable disconnect/reconnect permission during portion of a command. Note that this function does not effect the operation of the Forced Disconnect function.
- MESSAGE REJECT during Target Disconnection
  - If the Initiator rejects the SAVE DATA POINTER message, the file will disable disconnect/reconnect permission. This is equivalent to receiving an IDENTIFY message with bit 6 equal to zero. This will cause to file to inhibit the pending disconnection.
  - If the initiator rejects the DISCONNECT message, the file will not disconnect but may attempt to disconnect at a later time. This function may be used to selectively disable disconnection during portions of a command.

7.1 Attention Condition

The attention condition allows an initiator to inform the file that a MESSAGE OUT phase is desired. The initiator may create the attention condition by asserting the ATN signal at any time except during the ARBITRATION or BUS FREE phases.

The initiator must create the attention condition by asserting the ATN signal least two deskew delays before releasing ACK for the last byte transferred in a bus phase to guarantee that the attention condition will be honored before transition to a new bus phase. This will guarantee a predictable file response to message received during the MESSAGE OUT phase for this attention condition. If the ATN signal is asserted later, it might be honored in the current bus phase or the next bus phase and then may not result in the expected action.

After the initiator asserts the ATN signal, the file will respond with the MESSAGE OUT phase as follows:

Current Phase	Response
COMMAND	Message Out phase will occur after part or all of the Command Descriptor Block has been transferred to the file. The initiator must continue REQ/ACK handshakes during the Command phase until the file enters the MESSAGE OUT phase.
DATA	The MESSAGE OUT phase will occur after part or all of the data bytes have been transferred and not necessarily on a logical block boundary. The initiator must continue REQ/ACK handshakes (asynchronous transfer) until it detects the phase change. **Note:** In synchronous transfer, the initiator must continue sending ACK pulses to reach an offset of zero.
STATUS	The MESSAGE OUT phase will occur after the REQ/ACK handshake of the status byte has been completed.
MESSAGE IN	The MESSAGE OUT phase will occur before the file sends another message.
SELECTION	If ATN occurs during a SELECTION phase and before the initiator releases the BSY signal, the MESSAGE OUT phase will occur immediately after that SELECTION phase.
RESELECTION	The MESSAGE OUT phase will occur after the file has sent its IDENTIFY message for that RESELECTION phase. (First the file tries to complete the reselection.)

The initiator must keep the ATN signal asserted if more than one message byte is to be transferred during the MESSAGE Out phase. The file will process each message byte (multiple-bytes for an extended message) prior to receive the next message from the initiator. The file will continue to handshake and process byte(s) in the MESSAGE OUT phase until ATN goes false unless one of the following condition occurs:

1. The file receives an illegal or inappropriate message and goes to the MESSAGE IN phase to send a MESSAGE REJECT message.
2. The file detects a catastrophic error condition and goes to the BUS FREE phase.

7.2 SCSI Bus Related Error Handling Protocol

7.2.1 Unexpected BUS FREE Phase Error Condition

There are several error conditions that will cause the file to immediately change to the BUS FREE phase, regardless of the state of the ATN signal. The file will not attempt to reconnect to the initiator to complete the operation that was in progress when the error condition was detected. The initiator should interpret this as a catastrophic error condition.

If the LUN was identified by the file prior to the error condition, then the file will abort the active command for this initiator/LUN and generate sense data for this initiator/LUN to describe the cause of the catastrophic error. The initiator may retrieve this sense data by issuing a REQUEST SENSE command to this LUN. Note however, that the REQUEST SENSE command may fail if the catastrophic error condition persists.

If the LUN was not identified by the file prior to the error condition, then the file will not affect the sense data or the operation of any currently executing command for this initiator or any other initiator.

7.2.2 MESSAGE OUT Phase Parity Error

If the file detects a parity error during the MESSAGE OUT phase, the file will retry the MESSAGE OUT phase one time as follows:

1. Continue the REQ/ACK handshakes until the initiator drops ATN. The file will ignore all the remaining MESSAGE OUT phase bytes received after the parity error.
2. Assert the REQ signal prior to changing to any other phase. After detecting this condition, the initiator must resend all of the previous message byte(s) sent during this MESSAGE OUT phase.
3. Repeat the transfer of the MESSAGE OUT phase bytes(s). If the file receives all of the message byte(s) successfully, the file will change to:
   - Any other information transfer phase and transfer at least one byte.
   - BUS FREE phase if the message received was ABORT or BUS DEVICE RESET.

   If a second parity error is detected, the target will abort the current command with CHECK CONDITION status and sense data of ABORTED COMMAND / SCSI PARITY ERROR .

7.2.3 MESSAGE IN Phase Parity Error (Message Parity Error)

If the file receives a MESSAGE PARITY ERROR message, it is considered a retrievable error. The file will do the following one time if no previous retrievable error and if a MESSAGE IN phase has just occurred:

1. Change phase to MESSAGE IN.
2. Send the last message again.

If this is the second retrievable error, the file will terminate the current command as follows:

1. Change to the BUS FREE phase, regardless of the state of the ATN signal.
2. Abort the active command for this initiator/LUN and set the sense data to ABORTED COMMAND / SCSI PARITY ERROR.

7.2.4 COMMAND Phase Parity Error

1. Change phase to MESSAGE IN and send a RESTORE POINTERS message.
2. If RESTORE POINTERS message is accepted, then change phase to COMMAND OUT and receive the command again.

If a second parity error is detected, the target will abort the current command with CHECK CONDITION status and sense data of ABORTED COMMAND / SCSI PARITY ERROR .

7.2.5 DATA OUT Phase Parity Error

If the file detects a parity error during DATA OUT phase, it will do the following one time:

1. Change phase to MESSAGE IN and send a RESTORE POINTERS message.
2. If RESTORE POINTERS is accepted, then change phase to DATA OUT and receive the data again.

7.2.6 INITIATOR DETECTED ERROR Message

An INITIATOR DETECTED ERROR message is valid after a COMMAND, DATA IN/OUT or STATUS phase has occurred. If the other phase has occurred, the message is rejected.

The recovery consists of:

1. Change phase to MESSAGE IN and send a RESTORE POINTERS message

2. Repeat previous information phase .

If a second INITIATOR DETECTED ERROR message is received in the same selection, the target will abort the current command with CHECK CONDITION status and a Sense key of ABORTED COMMAND with additional sense code of INITIATOR DETECTED ERROR .

7.2.7 MESSAGE REJECT Message

The file will take the following actions after receiving the MESSAGE REJECT message in response to messages listed below.

DISCONNECT The file will not disconnect but remains connected.

COMMAND COMPLETE No error, continue to bus free.

IDENTIFY Command aborted - bus freed - Sense data set to MESSAGE REJECT ERROR.

LINKED CMD CMPLT Command aborted - link broken - bus freed - sense data set to MESSAGE REJECT ERROR.

MESSAGE REJECT Command aborted - STATUS phase executed with CHECK CONDITION - sense data set to MESSAGE REJECT ERROR.

RESTORE POINTERS Command aborted - status set to CHECK CONDITION - sense will be set with the error that caused the RESTORE POINTERS message to be issued. (Assuming that error recovery is in progress)

SAVE DATA POINTER The file will not disconnect from the SCSI bus. It will not be considered an error.

No previous Msg The command is aborted, the bus freed, and Sense data is set to MESSAGE REJECT ERROR. This occurs when the file has not sent a message, but gets a MESSAGE REJECT from the initiator.

7.2.8 Invalid LUN in Identify Message

There are three different circumstances defined within the SCSI protocol when the response to an invalid LUN will occur. Each of these result in a different response.

7.2.8.1 Case 1 - Selection message sequence with Inquiry command

The INQUIRY command is a special case in SCSI. It is used to configure the bus when file IDs and LUNs are not known. The proper response is to return the inquiry data with a peripheral drive type of 1Fh which indicates that the specified LUN is not supported.

7.2.8.2 Case 2 - Selection message sequence with any other command

Any other commands, except REQUEST SENSE, return CHECK CONDITION status when an invalid LUN is specified in the message sequence following selection. In response to a REQUEST SENSE command the target shall return sense data. The sense key shall be set to ILLEGAL REQUEST and the additional sense code shall be set to LOGICAL UNIT NOT SUPPORTED.

7.2.8.3 Case 3 - After selection message sequence

It is permissible for the initiator to issue multiple IDENTIFY messages during a single command sequence provided to LUN remains the same. If the LUN is altered, the file goes to a Bus Free Phase.

7.2.9 Reselection Timeout

When the file attempts to reselect the initiator and the initiator does not respond within a Selection Timeout Delay, the file continue asserting the SEL and I/O signals and release all DATA BUS signals. If the file has not detected the BSY signal to be true after at least a selection abort time plus two deskew delays, the file shall release SEL and I/O signals allowing SCSI bus go to BUS FREE phase. The initiator that respond to the RESELECTION phase shall ensure that reselection was still valid within a selection abort time of assertion of the BSY signal. The file will retry this process After 250 ms from the file goes to BUS FREE phase.

7.3 Unit Attention Condition

The file will generate a unit attention condition for each initiator whenever:

- The file has been reset.

  This includes Power On Reset, SCSI Bus Reset, SCSI BUS DEVICE RESET message.
- The mode parameters in effect for this initiator has been changed by another initiator.
- The microcode has been changed.

  WRITE BUFFER command has been executed to download microcode.

  In this case, a unit attention condition is generated for all initiators except the one that issued the command.

The unit attention condition persists for each initiator until that initiator clears the condition as described in the following paragraphs.

If the file receives a command from each initiator before reporting a CHECK CONDITION status for a pending unit attention condition for that initiator , the file's response varies with the command as follows.

INQUIRY The file executes the command with GOOD status and preserves the unit attention condition.

REQUEST SENSE

If the file has an available pending sense data for the initiator, the file sends the pending sense data and preserves the unit attention condition for the initiator.

If the file does not have an available pending sense data for the initiator, the file sends sense data for the unit attention condition and clear the unit attention condition for the initiator.

ALL OTHER The file terminates the command with a CHECK CONDITION status and preserve the unit attention condition.

If The file receives a command form each initiator after reporting a CHECK CONDITION status for a pending unit attention condition for that initiator , the file's response varies with the command as follows.

REQUEST SENSE The file sends the sense data for a pending unit attention condition and returns GOOD status. And the file clear the unit attention condition for the initiator.

ALL OTHER The file execute the command with GOOD status and clear the unit attention condition unless another unit attention condition exists. And then the sense data for the unit attention condition is lost.

7.4 Degraded Mode

There are certain errors or conditions which may impair the file's ability to function normally. Rather than fail hard, the file is designed to be as responsive as possible. Also, in most cases, some action on the part of the initiator may be used to restore normal operation. This mode of limited operation is called Degraded Mode. Following list shows the various operation mode.

Operation Mode	Reason entering Mode	Function Supported	Action to be taken.
Non Functional	Fatal error is detected during POR.	File is not operational. No response from the file can not be expected.	
ROM	waiting for Initializing mode Fail to load micro	REQUEST SENSE INQUIRY WRITE BUFFER START/STOP UNIT TEST UNIT READY READ BUFFER	Send START UNIT Down-load microcode
Error	FORMAT aborted REASSIGN BLOCK Aborted	FORMAT UNIT Non data area access commands Reassign starts automati-cally.	Reissue Format Wait for completion

Figure 7-1. Degraded Operation Modes

7.5 Spindle mode at powering on

The file has two modes that the spindle motor spins up automatically or not at power on. These modes are selectable by hardware switch.

- **Automatic Spin-Up mode**

  The spindle motor spin up automatically at powering on.

  When the file receives a command in this mode until becoming drive ready the file's response varies with the command as follows:

  REQUEST SENSE The file sends a sense data and returns appropriate status.

  INQUIRY The file sends a inquiry data and returns appropriate status.

  ALL OTHER The file terminates the command with CHECK CONDITION status, sense key of NOT READY and additional sense code of POWERING ON.

- **Waiting for Initializing mode**

  The spindle motor does not spin up automatically at powering on. Initiator need issue a START/STOP UNIT command with start option before issuing media access commands.

  When the file receives a command in this mode until becoming drive ready the file's response varies with the command as follows:

  REQUEST SENSE The file sends a sense data and returns appropriate status.

INQUIRY The file sends a inquiry data and returns appropriate status. But part of the data is not valid until the START UNIT command is completed with success. Following data is not available because these are saved on the media.

- Product ID
- Unit Serial Number
- RAM microcode Parts Number
- Plant of Manufacture
- Date of Manufacture
- Password Status (except bit 0)

TEST UNIT READY The file terminates the command with CHECK CONDITION status, sense key of NOT READY and additional sense code of INITIALIZING COMMAND REQUIRED.

WRITE BUFFER The file terminates the command with CHECK CONDITION status, sense key of ILLEGAL REQUEST and additional sense code of INVALID COMMAND OPERATION CODE.

READ BUFFER The file terminates the command with CHECK CONDITION status, sense key of ILLEGAL REQUEST and additional sense code of INVALID COMMAND OPERATION CODE.

START UNIT The file executes the commands and returns appropriate status.

And the file's response is as same as automatic spin-up mode from receiving START UNIT command and until drive ready

STOP UNIT The file terminates the command with CHECK CONDITION status, sense key of ILLEGAL REQUEST and additional sense code of INVALID COMMAND OPERATION CODE.

ALL OTHER The file terminates the command with CHECK CONDITION status, sense key of ILLEGAL REQUEST and additional sense code of INVALID OPERATION CODE.

7.6 Power Save Function

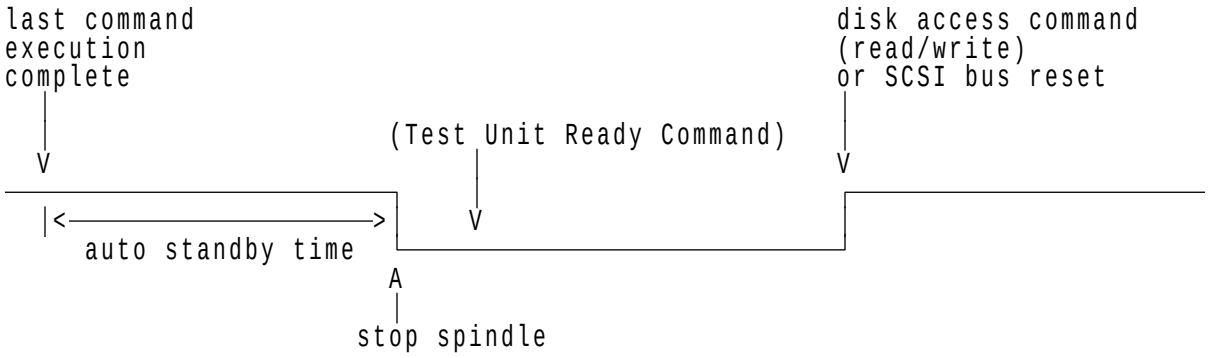

Figure 7-2. Power Save Function

The spindle stops automatically when the auto standby time goes after last command execution complete. Then the spindle starts when the disc access command or SCSI bus reset is issued.

If Test Unit Ready, Request Sense and Inquiry command is issued during standby, the file returns Good Status and not start spindle.

7.7 Overlapped Commands to an Active LUN

The file does not support receiving a second command from the same initiator for the same LUN before the current command in progress has terminated. If this protocol is violated, the file will respond as follows:

The execution of both commands is stopped internally and the second command is terminated with CHECK CONDITION status. The sense key generated will be ABORTED COMMAND and the additional sense code will specify OVERLAPPED COMMAND ATTEMPTED.

Note: Only one status is returned for both commands.

7.8 Read Ahead

The Read Ahead function consists of reading data that the Initiator has not yet requested to the file buffer. This function is intended to improve performance for an initiator that frequently accesses sequential data with successive SCSI read commands. The Read Ahead function works when the read cache disable bit of read cache page is set to 0.

The file will continue to read subsequent logical blocks into its buffer until:

- the buffer becomes full.

  The Read Ahead operations continue across all physical boundaries (such as tracks and cylinders). The target will overwrite the data in the data buffer which has already been sent to the initiator and any data remaining from a previous Read Ahead operation.

- the target receives another command except:
  - INQUIRY
  - REQUEST SENSE
  - TEST UNIT READY

- an error is encountered.

  The error will not be reported to the Initiator. None of the data including good data stored will be used.

If the next command is a READ command which accesses some of the blocks contained in the buffer, the file supplies the requested data from the buffer.

7.9 Multiple Initiator Environment

7.9.1 Sense Data

Separate sense data is reserved for each initiator. Each initiator's sense data is maintained independent of commands from other initiators.

7.9.2 Initiator Mode Select/Mode Sense Parameters

A single shared copy of the Mode Select/Mode Sense parameters is maintained by the file. This includes both the current and saved parameters.

7.9.3 Initiator Data Transfer Mode Parameter

A separate data transfer mode parameters area is reserved and maintained for each initiator.

7.10 Error Recovery Procedures

7.10.1 Data Error Recovery

7.10.1.1 Read Operations

In the event of an ID or data field ECC check when reading data, or other related errors such as ID Address Mark Not Found or Data Address Mark Not Found (e.g., byte sync detection errors), the controller performs the following error recovery;

- Retries by reading the same track (on track)
- Retries by reading the same track with track-offset
- ECC correction

The track offsets may be restored to zero at the conclusion of the error recovery process.

If all the retries are exhausted, and the error persists, then the sector in error is a candidate for inclusion in the defect map. (Defects are added to the defect map under host initiative only, using the Reassign Blocks command; the controller does not add the defect to the map on its own).

When retries are disabled (via the MODE SELECT command to do so), the above listed recovery steps are not taken. For ID errors, this means that only one revolution of the disk is allowed to locate the target ID.

7.10.1.2 Write Operations

In the event of an ID ECC check, or related error such as ID Address Mark Not Found (i.e., byte sync detection error), when writing data, the controller performs the following error recovery;

- Retries by writing on the same track

If all the retries are exhausted, and the error persists, then the sector in error is a candidate for inclusion in the defect map. (Defects are added to the defect map under host initiative only, using the Reassign Blocks command; the controller does not add the defect to the map on its own).

When retries are disabled (via the MODE SELECT command), the above listed recovery steps are not taken. For ID errors, this means that only one revolution of the disk is allowed to locate the target ID.

7.10.1.3 Positioning Error Recovery

The file only attempts positioning retries (Recalibrates and Seeks) if the file positively determines that it is on the wrong track by comparing the target LBA to the LBA values from the sector ID.

In the event that those sector IDs cannot be read, then the data error recovery procedures are invoked until the target ID is found, and it is determined that the target sector is not on the cylinder, or retries are exhausted.

7.11 Media Defect Strategy

Media defects are skipped by a single block basis utilizing both a "bad block bit" mechanism in the ID field and a push down formatting technique.

7.12 File Format

The files format is subdivided into the following areas:

- User Data Area
- CE Cylinder

  System work area
- Primary Defect Map

  The map is a list of defective sectors or blocks, as identified by the drive manufacturer. This map is used during format operation but is never altered.
- Secondary Defect Map

  The reserved area also a grown defect map. This map is empty at time of manufacture. Defect locations defined by the initiator with the REASSIGN BLOCKS are maintained in this map.
- SCSI Parameters List

  Configuration, Products data, MODE SENSE and Controller data is saved in this area.
- Microcode

  The file microcode load is contained in the Reserved Area.

8. SCSI PHYSICAL INTERFACE

8.1 SCSI Interface Connector Pin Assignments

Signal Name	Pin Number		Signal Name
+5	1	2	+5
RET	3	4	RET
GND	5	6	−DB(0)
GND	7	8	−DB(1)
GND	9	10	−DB(2)
GND	11	12	−DB(3)
GND	13	14	−DB(4)
GND	15	16	−DB(5)
KEY	17	18	−DB(6)
GND	19	20	−DB(7)
GND	21	22	−DB(P)
GND	23	24	TERMPWR
−ATTN	25	26	−BSY
GND	27	28	−ACK
−RST	29	30	−MSG
GND	31	32	−SEL
−I/O	33	34	−C/D
GND	35	36	−REQ
RET	37	38	RET
+5	39	40	+5

Figure 8-1. SCSI Drive Cable Signal Lines.

Note:

- The minus sign next to a signal indicates active low.

8.1.1 Signal Line Descriptions

The SCSI bus consists of nine control and nine data lines. Each line is described below.

Name	Description
BSY	BUSY indicates that the bus is in use.
SEL	SELECT is used by an Initiator to select a Target or by a Target to reselect an Initiator.
C/D	CONTROL DATA indicates whether control (1) or data (0) information is on the bus.
I/O	INPUT/OUTPUT indicates whether the data on the bus is an input (1) to the Initiator or an output (0) to the Target. This line is also used to differentiate between SELECTION phase (0) and RESELECTION phase (1).
MSG	MESSAGE is driven by Target and indicates a message phase.
REQ	REQUEST is driven by Target and indicates a request for a REQ/ACK data transfer handshake.
ACK	ACKNOWLEDGE is driven by the Initiator and indicates an acknowledgement of a REQ/ACK data transfer handshake.
ATN	ATTENTION is driven by an Initiator to inform a Target that the Initiator has a message ready.

RST RESET clears all SCSI devices from the bus and resets them.

Note: The target will not drive this line.

DB(n) 8 data bits are used to transfer data over the bus. DB(7) is the most significant.

DB(P) PARITY bit associated with DB(7-0). Data parity is odd.

8.1.2 Driver/Receiver Specification

The file supports single ended drivers and receivers.

8.1.2.1 Output Characteristics.

Each signal driven by the file will have the following output characteristics when measured at the file connector:

Signal assertion 0.0 volt DC to 0.5 volt DC

Minimum driver output capability 48 milliamps (sinking) at 0.5 volt DC

Signal negation 2.5 volt DC to 5.25 volt DC at 250 micro ampere (open collector)

8.1.2.2 Input Characteristics.

Each signal received by the file will have the following input characteristics when measured at the file's connector:

Signal true 0.0 volt DC to 0.8 volt DC

Maximum total input load -0.4 milliamps at 0.5 volt DC

Signal false 2.0 volt DC to 5.25 volt DC

Minimum input hysteresis 0.2 volt DC

8.1.3 SCSI Bus Cable

The maximum cable length from the host system to the drive is limited to 6 inches with external 1 K-ohm pull up resistors.

In case that appropriate termination resistors are externally equipped to the interface lines, the cable length can be extended.

The stub length is less than 0.1 meter.

8.1.4 Signal Termination

The file does not have termination nor pull up resistors for SCSI interface.

8.1.5 Device Address Selection

To set the SCSI device address for the file to 0 through 7, the host system must have a equipment to control ID signal. This address setting is read during processing

- Power Up
- RST on SCSI BUS (RESET).

This value is used by the file firmware as the device ID to

- respond to selection
- place the device ID on the bus during reconnection.

Note: Changing the ID setting after Power On is neglected until RST or another Power On. The default ID of the shipped file is 0.

8.1.6 Parity Implementation

The file supports odd parity. Parity checking may not be turned off. When a Parity Error is detected, the file notifies to the initiator to retry the last operation once. If the error persists, the file will go into Bus Free Phase. (See 7.2, “SCSI Bus Related Error Handling Protocol” on page 7-2 for more detail.)

8.1.7 SCSI Bus Timings

The file conforms to the timings as specified in the ANSI SCSI-2 October 17, 1991.

8.1.8 Reset Implementation

The file implements the Hard Reset option as defined in the SCSI-2 standard.

The file responds to RST by

1. Clear all commands for all initiators, including commands in the queue.
2. Release all SCSI device reservations
3. Generate Unit Attention Condition
4. Restore Mode Parameters to last saved values
5. Go into Bus Free Phase

Note: If a reset occurs during a write operation, the file will complete the write operation for the current sector. This is to protect the sector from being partially updated, which will later cause ECC error.

The RST line should be held active for at least 25 usec to reset the file. The file, however, may respond to a reset which is active for less than 25 usec.

ACTION	TYPE	SELF–TEST	CLEAR COMMAND	CLEAR QUEUE	UNIT ATTN
RST	Hardware	no	yes	yes	yes
Power On	Hardware	yes	yes	yes	yes
BUS DEVICE RESET	Message	no	yes	yes	yes
ABORT	Message	no	yes	no	no
SEND DIAGNOSTICS	Command	yes	no	no	no

Figure 8-2. Matrix of resets/abort and self test actions

8.1.9 Multi-Initiator Support

The file implements 'Untagged Queuing' as specified in SCSI-2 to support the multiple initiator environment.

The actual implementation is described as following;

- Only one command for each Initiator may be accepted at a time. If the second command is received, the file will respond with CHECK CONDITION status and sense data of OVERLAPPED COMMANDS ATTEMPTED. Both commands are aborted.

- If the disconnect privilege is not granted for the command other than listed below from an initiator while one or more commands are in progress from different initiator(s), the file responds with BUSY status.
  - TEST UNIT READY
  - INQUIRY
  - REQUEST SENSE
- The priority of execution is described as following;
  1. TEST UNIT READY , INQUIRY or REQUEST SENSE command will be executed immediately without disconnect.
  2. All other commands will be queued in the drive internal stack, and will be executed in FIFO fashion.
  3. When a linked command has been executed, the file wait for the the command from the linked initiator instead of processing command from other initiators stacked in the drive command queue.
  4. Separate request sense data is provided for each initiator.
  5. Separate synchronous data period and offset are supported for each initiator by means of the SYNCHRONOUS DATA TRANSFER REQUEST message.

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