DEVELOPMENT STANDARD

QIC 157
Revision D
13 Dec 95

COMMON SCSI/ATAPI COMMAND SET FOR STREAMING TAPE

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Important Notices

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I. Revision History

Changes for Revision D:

- remove majority of ATAPI protocol section and reference SFF-8020i revision 2.5 and SFF-8028i revision 1.0.
- increase scope of specification to cover SCSI devices in addition to ATAPI devices.
- remove optional fields from LOAD and READ POSITION.
- add SCSI capability fields to INQUIRY.
- add disconnect detection to Mechanical Status Mode Page.
- reference QIC 95-101 for medium type and density code information.

Changes for Revision C:

- non-media access commands sent when DSC clear may not complete immediately.
- Pg. 3: indicate check condition can occur with DSC off at EOM.
- task file Drive/Head register initialized to A0h after reset.
- clarify ATA SRST effect on DSC, DRDY, and BSY
- The ready state of the buffer memory (DSC) does not default to write mode.

Changes for Revision B:

Many clarifications and simplifications were made throughout the specification. Usage of drive seek complete (DSC) bit plus byte count register have been clarified. All transfer lengths are a multiple of 4 bytes. The incomplete floppy backward compatible model has been removed. Physical block addressing has been removed. The read position command has been simplified. Various mode pages have been removed and only current values are reportable. Various log pages have been removed and logging capabilities have been eliminated such as save parameters and various page control options. It should be noted that items not documented in this specification can be implemented, but are not considered a required element of an ATAPI drive.

1. Specification Overview

The purpose of this specification is to provide a common command set definition for streaming tape devices attached to the SCSI or ATAPI interface. Additional commands or capabilities required by a particular Device that are not provided for in this specification should be implemented per QIC-121.

1.1. Differences between SCSI and ATAPI devices

- All ATAPI Command Descriptor Blocks (CDB's) are 12 bytes in length, rather than the 6, 8, 10 or 12-byte packets of the SCSI Standard. This specification shows the CDB's using the SCSI lengths. When issuing a CDB to a ATAPI device, the CDB will be zero padded to 12 bytes in length. CDB extension is typically performed by low level drivers.
- Reserved bits, fields, bytes, and code values are set aside for future standardization. Their use and interpretation may be specified by future extensions to this or other specifications. A reserved bit, field, or byte shall be set to zero, or in accordance with a future extension to this specification. For ATAPI devices, the recipient shall not check reserved fields.
- For legacy ATAPI devices not supporting ATAPI overlap, commands are always immediate meaning good status may be returned before the command actually completes. Furthermore, command completion will occur as soon as the CDB has been validated, possibly before all buffered commands have completed execution. This is the case even if an Immediate bit exists and is set to 0. Command completion can be determined by either reading DSC from the ATAPI status register or by issuing a READ POSITION command. The following commands are immediate on such drives: ERASE, LOAD, LOCATE, REWIND, SPACE, and WRITE FILEMARK. Note that UNLOAD will always be immediate on these devices because it is illegal to issue READ POSITION after UNLOAD.
- For legacy ATAPI devices not supporting ATAPI overlap, implementation of READ/WRITE 0 blocks and setting the READ/WRITE data transfer length are important for efficient use of the IDE bus. See *ATAPI Read and Write Commands and DSC* on page 3 for details.

2. SCSI Protocol

The protocol for SCSI Tape Devices is defined in QIC-121.

3. ATAPI Protocol

The protocol for ATAPI Tape Devices is defined in SFF-8020i revision 2.5 (ATA Packet Interface for CD-ROMs). This section contains additions and implementors notes for Tape Devices.

3.1. ATAPI Identify Device

General Configuration (Word 0): The Device Type is 1 (Streaming Tape) and the Command Packet Size is 00b (12 bytes). However, 16-byte ATAPI Command Packets are defined for future Devices, allowing Host Device Drivers to determine the size of the Command Packets before issuing an ATAPI Command Packet. Note that Command Packets are synonymous to Command Descriptor Blocks.

Identify Device Data - Capabilities (Word 49): If the Overlap Operation Supported bit is set to 0, the Device uses DSC for overlap operation as described in the following section. When set to 1, the Device is capable of ATAPI overlap in addition to DSC overlap.

3.2. ATAPI Command Protocol and DSC Handling

The purpose of the DSC handling defined in this section is to provide efficient use of the IDE bus by allowing overlapped commands to be sent to the other IDE Device on the same cable while the Tape Device is executing a command. The usage of DSC described in this section is for legacy Tape Devices. It is recommended Tape Devices implement the ATAPI overlap protocol defined in SFF 8020i for the following reasons:

1. ATAPI overlap is an interrupt driven operation.
2. ATAPI overlap is likely to become the industry standard across peripheral types and thus be more likely to be implemented by low level drivers.
3. ATAPI overlap allows transparent non-immediate command operation.
4. ATAPI overlap allows applications to use any Read/Write transfer length without imposing delays on the IDE bus and alleviates the need to issue Read/Write 0 commands.

3.2.1. ATA Commands and DSC

ATA commands will be executed immediately, regardless of the state of DSC.

3.2.2. ATAPI Media Access Commands and DSC

All ATAPI media access commands return a completion status with DSC set to 0 upon validation of the packet command and transfer of any associated data. When the drive completes, it will set DSC to 1 to indicate completion. This frees up the IDE bus so the Host can send commands to another IDE device on the same cable. After DSC is set to 1, the Host can send a Request Sense to check for any errors that might have occurred.

If another media access command is issued while DSC is 0, the device will go BSY until the previous command is complete.

If an error condition occurs for any command in progress, then any new command received will be aborted and a deferred error will be reported.

Writes beyond EOM may report check condition with EOM set, regardless of DSC, which would be in buffer available mode. This is the only case that a check condition can be reported when DSC is 0.

3.2.3. ATAPI Non-media Access Commands and DSC

ATAPI non-media access commands are executed immediately if DSC is 1. If a non-media access command is executed while DSC is 0, the device may go BSY until the previous command is complete or the device may execute the command immediately and any error status (if needed) is set, before returning completion status. DSC is unaffected by these commands.

If an error condition occurs for any command in progress, then any new command received will be aborted and a deferred error will be reported.

3.2.4. ATAPI Read and Write Commands and DSC

ATAPI Read and Write commands use DSC to indicate buffer availability instead of command completion. An initial Read or Write of 0 blocks is used to switch DSC handshake from completion mode to buffer available mode. Any media access command other than read or write will switch DSC back to completion mode.

Once DSC is in buffer available mode, DSC set to 1 indicates that a specified amount of data can be transferred to/from a drive's buffer without the overhead of tape motion. The amount that can be transferred is specified in the Continuous Transfer field in mode page 2Ah.

The Host should only attempt to send read or write commands when the data buffer is able to immediately transfer the data, indicated by DSC set to 1. Otherwise, the command will wait for data to be transferred between the internal buffer and the medium and prevent the IDE bus from being used by a different device.

A read operation is initiated by a READ command with a zero transfer length to start filling the buffer with read-ahead data without holding the bus. The DSC bit within the Status Register will be set when the number of blocks, as determined by the Capabilities and Mechanical Status Page, are ready to be transferred with a read operation.

A WRITE FILEMARK command will not set DSC until all buffered write blocks and filemarks are transferred to the medium. Upon successful completion of this process, which is called a synchronize operation, no blocks or filemarks remain in the data buffer. A synchronize operation has no effect on a data buffer which contains only read-ahead data.

4. Streaming Tape Device Model

Streaming Tape Devices optimize their use in storing or retrieving user data sequentially. Since access is sequential over a long medium, position changes typically take a long time, when compared to direct-access Devices with a short medium.

The recording medium is tape cartridges or cassettes of various lengths of a flexible substrate coated with a semi-permanent magnetic material. The recording medium is encapsulated into cartridges containing both a supply peel and a take-up reel. Several American National Standards and QIC (Quarter-Inch Cartridge) standards exist covering the construction of cassettes and cartridges for interchange as well as recording techniques for many of the formats or density combinations.

A complete unit composed of the recording medium and its physical carrier is called a volume. Volumes have an attribute of being mounted or demounted on a suitable transport mechanism.

Mounted is the state of a volume when the Device is physically capable of executing commands that cause the medium to be moved. A volume is demounted when it is being loaded, threaded, unloaded, unthreaded, or when not attached to the Device.

Ready is the state of the Device when medium access and non-medium access commands can be executed. The Device is not ready when no volume is mounted or, from the Host's perspective, whenever all medium access commands report “Check Condition” status and a NOT READY Sense Key. Some Devices may have a separate switch function that places the Device in a not ready state even when a volume is mounted.

The write enabled or write protected state determines when the Host may write information on a volume. This attribute is usually controlled by the user of the volume through manual intervention (e.g., thumb wheel switch).

4.1. Medium Attributes

The recording medium has two physical attributes called **beginning-of-medium** (**BOM**) and **end-of-medium** (**EOM**). **Beginning-of-medium** is at the end of the medium that is attached to the take-up reel. **End-of-medium** is at the end of the medium that is attached to the supply reel. In some cases, the medium is permanently affixed to one or both of the reel hubs.

The entire physical length of medium is not usable for recording data. For most volumes, a length of the medium is reserved before the **beginning-of-medium** and after the **end-of-medium** position. This is done to provide sufficient tape wraps onto the reel hub(s) and to ensure that recording starts in an undamaged section of the medium.

The position on the medium where a pattern of recorded signal may be written by one write component is called a track. A Device may write or read from one or more tracks at a time, depending on the format.

On a new volume, recording of one or more tracks begins after mounting the volume and moving from **beginning-of-medium** toward **end-of-medium**. The number of tracks written at one time is called a track group. For recorded volumes, reading in the forward direction follows the same course of tracks as when writing.

If not all tracks are recorded at the same time, and the Device reverses direction when approaching **end-of-medium** and begins writing on remaining tracks, the recording method is called serpentine. For serpentine Devices that record only one track at a time, each physical track represents one track group.

Some multi-track Devices have only one track group, using a parallel storage format that supports the simultaneous recording of all available tracks.

The serpentine and parallel recording formats define tracks as longitudinal patterns of recorded information.

For most recording formats, an area at **beginning-of-medium** contains a format identification as a tone burst or some other recognizable pattern. User data is not recorded in this area. The format identification is an attribute of a volume used for interchange purposes and is defined in applicable standards.

4.1.1. Early Warning

When writing, the Host needs an indication that it is approaching the end of the permissible recording area. This position, called **early-warning** (**EW**), is typically reported to the Host at a position early enough for the Device to write any buffered data to the medium while still leaving enough room for additional recorded labels or filemarks. Some American National Standards include physical requirements for a marker placed on the medium to be detected by the Device as **early-warning**.

For Devices that implement large data buffers, the **early-warning** position defined by a physical marker may be too close to the end of the recording region to permit emptying the data buffer(s). For these Devices, a logical concept of **early-warning** shall be used to signal the Host at an appropriate location prior to the physical marker.

4.1.2. Partitions

Another attribute of a volume is called a partition. Partitions consist of one or more non-overlapped mini-volumes, each with its own beginning and ending points, occupying a single physical volume. Each partition (x) within a volume has a defined **beginning-of-partition** (**BOP**x), an **early-warning** position (**EW**x), and an **end-of-partition** (**EOP**x).

All volumes have a minimum of one partition called partition zero, the default data partition. For Devices that support only one partition, the **beginning-of-partition** zero (**BOP**0) may be equivalent to the **beginning-of-medium** and the **end-of-partition** zero (**EOP**0) may be equivalent to the **end-of-medium**.

When a volume is mounted, it is logically positioned to beginning of the default data partition (**BOP**0). When a REWIND command is received in any partition (x), the Device positions to the **beginning-of-partition** (**BOP**x).

Partitions on a volume do not need to be recorded in any defined order, nor do all partition numbers in a sequence need to be present on a volume. It is sufficient for a Device to be able to locate a partition, given its code value, or determine that it does not exist on the volume. For interchange, information about which partitions are present on a volume may be stored on the volume in a Device-defined area (possibly unavailable to the Host) or the information may be an intrinsic attribute of the Device implementation.

4.2. Quick File Access

Partitions MUST start on track boundaries at the physical **BOT** end of the tape. Partitions shall be used to support the implementation of QFA (Quick File Access). QFA is a feature that provides support for two partitions on the tape cartridge, a directory partition and a data partition. For this specification, the partitions are defined by the Device.

Implementation of QFA allows the Host to partition a tape into two partitions. Note that the default configuration for a tape is a single partition. Devices supporting QFA shall allocate the two partitions as follows:

Partition	Use
0	Data
1	Directory

The partitions are created when the Host issues a Mode Select command using the Medium Partition Page. If the fixed data partitions bit (FDP) is set to one, partition 1 (the directory track) shall be allocated according to a format-specific allocation..

For defining a partition, the FDP bit in the Medium Partition Page is the only field that is to be used by this specification. The remaining fields apply to additional partitions that are not defined by this specification. QIC QFA Devices do not permit the definition of additional partitions.

4.2.1. Changing Partitions

The Host can issue a Locate command with the change partition bit (CP) set to one to select the active partition. The partition byte in the Locate command indicates which partition is to become the active partition.

4.2.2. Automatic Format Detection

As most Streaming Tape Devices are capable of reading and writing many different formats, some formats now include MODE SENSE data within the tape header to identify the different format options. Normally, a MODE SELECT issued prior to a read or write operation would explicitly define the format options. If a MODE SELECT command had not been made since the mounting of the volume or with no volume mounted, the Device shall follow these set rules to select the density and block size that will be used implicitly:

1. If no volume is mounted and a MODE SENSE command is issued, the Device shall report its default block size and its native format in the density code field.
2. If a blank or erased tape cartridge is inserted, and a MODE SENSE command is issued after the load process is complete, the Device shall report the default block size and the highest density supported for the cartridge.

If no MODE SELECT command has been made since the mounting of the volume with recorded data, the Device shall follow these set rules to select the density and block size that will be used implicitly:

1. MODE SENSE command is issued after the load process is complete will reflect MODE data written in the tape header if present.
2. If MODE data is not present, the Device will detect the density from the reference burst and use the first data block found on the tape to determine block length.
3. A MODE SENSE, SPACE to EOD, or READ command issued after the load process is complete implicitly sets the density and block size.
4. If no MODE SELECT, MODE SENSE, SPACE to EOD, or READ command is issued prior to a WRITE command, the Device shall write at the settings for a blank tape. The Device will have already retrieved the MODE data or determined the density and block size but shall not use this information in this case.

4.3. Logical Elements within a Partition

The area between **BOP**x and **EOP**x on a typical recorded volume contains at least two types of Host accessible elements, data blocks and tape marks. These elements are controlled and transferred between the Host and the medium using READ, WRITE, and WRITE FILEMARK commands.

4.3.1. Blocks

A unit of data supplied or requested by the Host is called a logical block. Logical blocks are stored according to the specifications of the format for the volume and may be recorded as one or more physical blocks on the medium. When the physical block and the logical block are not recorded in a one-to-one relationship, it is the responsibility of the Device to perform all blocking, de-blocking, padding, stripping, splitting or rebuilding of the logical data block(s) sent by the Host.

For SCSI standards, the device may have been capable of supporting fixed or variable length blocks. The concept of fixed or variable mode for writing and reading blocks only indicates the method by

which the Host specifies the size of a logical block for transfer and not the method of recording physical blocks on the medium. However, for this specification, Devices only support either fixed-length physical or logical blocks of 512 or 1024 bytes. The length of a logical block is always described in bytes. The length of a physical block may or may not be recorded as an exact byte count, depending on the format but the data shall be in blocks of 512 or 1024 bytes.

4.3.2. Filemarks

Filemarks are special recorded elements containing no user data. The filemark format is defined in some American National Standards. Hosts traditionally use filemarks to separate user data from labels and logical groupings of data from each other. Since some format standards do not define an explicit **end-of-data** (**EOD**), Host software has often used conventions with filemarks to represent an **EOD** indication. At least one American National Standard specifically defines filemark use for this purpose.

4.3.3. Gaps

Inter-block gaps, the gaps between blocks and filemarks, are introduced on the medium at the time a block or mark is written without explicit action by the Host. Minimum and maximum lengths for inter-block gaps are defined in some American National Standards.

An erase gap may be a length of erased medium or a recorded pattern not distinguishable as a block or mark. Minimum and maximum lengths for erase gaps are defined in some American National Standards while some Devices may have no implementation of an erase gap. For this specification, gaps are defined by the Device.

4.3.4. Blank

After writing data from **BOP**x, the medium is considered to be a contiguous grouping of blocks, filemarks, and gaps. Certain American National Standards define gap lengths which, if exceeded, are to be considered as having reached blank medium. Depending on the format, this blank medium may be treated as an **end-of-data** indication or an unrecoverable medium error causing an interchange error. Unrecorded volumes (new or erased) may exhibit blank medium characteristics if an attempt is made to read or space the volume before data has been written.

4.4. Data Buffering

Devices have a temporary storage area capable of holding one or more logical blocks - a data buffer. A Streaming Tape Device data buffer may include any combination of blocks and filemarks in the process of being written to the medium, or it may contain read-ahead data blocks transferred from the medium.

A Device will return “Good” status for read and write operations when all data has been successfully transferred to/from the Host from/to the Device data buffer.

Should an unrecoverable write error occur, the Device generates an error condition to the current active command. If no command is active, the error shall be reported on the next applicable operation as a deferred error. Any data within the Device's buffer not written will be lost but this is only after a catastrophic write failure.

A Device with read-ahead data blocks in the data buffer does not report an unrecoverable read error until the data block in error is requested by the Host.

4.5. Recorded Element Descriptors (Block Identifiers)

Some recording formats specify that recorded elements (blocks and filemarks) have identifiers included in the recorded information to help determine write sequence and also to help detect Device positioning errors. The identifier values are unique within a partition and may be unique within a volume.

The use of the term block identifier may imply some arithmetic sequence applied to the assignment of recorded elements. The block identifier assignment algorithm may be defined in an applicable format standard.

For some pre-formatted volumes, the identifiers are associated with physical blocks. In variable-block size implementations, the identifier can be associated with a physical block when the logical block and the physical block have a one-to-one relationship on the medium.

Some formats may carry both physical and logical block identifiers recorded on the medium. When a logical block is split over more than one physical block, or multiple logical blocks are concatenated to form a physical block, the logical block identifier and the physical block identifier are not the same. Filemarks may or may not have recorded identifiers, but if identifiers are used in the format, then each mark is assigned a value even if it is not explicitly recorded.

4.6. Positioning

The READ POSITION and LOCATE commands use four-byte fields to hold these format dependent identifiers. For some implementations, this value may correspond to a real physical location; however, it is sufficient for the Device to map the identifier to a value representing the unique recorded element. With this capability, the READ POSITION command may be used to report a Device-defined block identifier and the Host may use this value with a LOCATE command to position to the same location at some future time (provided the volume has not been rewritten in the interim).

4.6.1. Direction and Position Definitions

For Devices, positioning has the connotation of logically being in, at, before, or after some defined place within a volume. This definition means the position is capable of being repeated under the same circumstances. The orientation of usage for the four words (in, at, before, or after) is in one direction, from **BOP**x toward **EOP**x. All positioning defined below is worded from this perspective.

The forward direction is defined as logically progressing from **BOP**x toward **EOP**x. The reverse direction is defined as logically progressing from **EOP**x toward **BOP**x. In serpentine Devices, the logical forward or reverse direction has an alternating relationship to the physical motion of the medium.

The concept of being “in” some position means not being outside a defined region. The definition allows the position to be on the boundary of a defined region. When a volume is first loaded, the logical position is always at the beginning of the default data partition (**BOP**0). Whenever a volume is mounted and the medium motion is stopped, the position is in some partition. While moving between partitions, there is no stable position.

The concept of being “at” some position indicates being positioned to a logical or physical extremity of a partition. A Streaming Tape Device may be positioned at **beginning-of-medium**, at **BOP**x, at **end-of-data** (**EOD**), at **EOP**x, or at **end-of-medium** (**EOM**), since these are stable positions at extremities of a partition.

The concept of being “before” some position indicates that there is some element (data block, filemark, or other defined point) which may be encountered when moving toward **EOP**x, if the proper commands are issued. Being positioned before a particular data block means that if the Device receives a valid READ command, the data block is transferred to the Host. This position may also be before **EW**x and **EOP**x, since these are defined points within any partition. However, if data has not been written to the **end-of-partition**, these points may not be accessible by the Host.

The concept of being “after” some position indicates that there is some element (data block, filemark, or other defined point) on the **BOP**x side of the current position that may be encountered if the proper commands are issued. When a READ command for a single data block has been successfully executed, the logical position is after the transferred data block.

4.7. Error Reporting

If any of the following conditions occurs during the execution of a command, the Device shall return "Check Condition" status. The appropriate Sense Key and Additional Sense Code should be set.

In the case of an unrecoverable read or write error, the error recovery is vendor specific.

In the case of an unrecoverable read error, the Valid bit shall be set to one and the Information field shall be set to the difference (residue) of requested transfer length minus the actual number of blocks read (not including the unrecoverable block). Upon termination, the logical position shall be after the unrecoverable block.

In the case of an unrecoverable write error, the Valid bit shall be set to one and the Information field shall be set to the difference (residue) of the sum of the pending requested transfer lengths minus the actual number of blocks and filemarks written. The value in the Information field may exceed the transfer length for the last command. For formats able to restart a write operation, upon termination, the logical position shall be after the unrecoverable block.

5. Streaming Tape Command Descriptor Blocks (CDB)

5.1. CDB Implementation Requirements

The first byte of all CDB's shall contain an operation code as defined in this Specification. Devices shall implement all commands with mandatory operation codes. All command pages are mandatory unless stated otherwise.

5.1.1. Reserved

For ATAPI Devices, reserved bits, fields, bytes, and code values are set aside for future standardization. Their use and interpretation may be specified by future extensions to this or other specifications. A reserved bit, field, or byte shall be set to zero, or in accordance with a future extension to this specification. The recipient shall not check reserved fields.

For SCSI Devices, reserved bits, fields, bytes, and code values are set to zero and verified to be zero.

5.2. CDB Description

An command is communicated by sending a CDB to the Device. For several commands, the CDB is accompanied by a list of parameters sent following the CDB. See the specific commands for detailed information.

For all commands, if there is an invalid parameter in the CDB, the Device shall abort the command without altering the medium.

Table 5-1 Typical CDB for Most Commands

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Reserved							
2								
3	Reserved							
4	Allocation Length, Parameter List Length, or Mode							
5	(MSB) Parameter Pointer							
6	(LSB)							
7	(MSB) Allocation Length or Parameter List Length							
8	(LSB)							
9	Reserved							

Table 5-2 Typical CDB for Read or Write Operations

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	Reserved							1 (BT)
2	(MSB)							
3	Transfer Length							
4								(LSB)
5	Reserved							

5.2.1. Operation Code

The operation code of the CDB has a group code field and a command code field. The three-bit group code field provides for eight groups of command codes. The five-bit command code field provides for thirty-two command codes in each group. Thus, a total of 256 possible operation codes exists. Operation codes are defined in the subsequent sections.

Table 5-3 Operation Code

Bit	7	6	5	4	3	2	1	0
	Group Code			Command Code				

Note that the Group/Command code fields have been kept for backward compatibility and are not used in this specification.

5.2.2. Logical Block Address

The logical block address shall begin with block zero and be contiguous up to the last logical block.

5.2.3. Transfer Length

The Transfer Length Field specifies the amount of data to be transferred, usually the number of blocks. For several commands the transfer length indicates the requested number of bytes to be sent as defined in the command description. For these commands the Transfer Length Field may be identified by a different name. See the following descriptions and the individual command descriptions for further information.

In commands that use multiple bytes for the transfer length, a transfer length of zero indicates that no data transfer shall take place. A value of one or greater indicates the number of blocks that shall be transferred.

5.2.4. Parameter List Length

The Parameter List Length is used to specify the number of bytes to be sent to the Device. This field is typically used in CDB's for parameters that are sent to a Device (e.g. mode parameters, diagnostic parameters, etc.). A parameter length of zero indicates that no data shall be transferred. This condition shall not be considered as an error.

5.2.5. Allocation Length

The Allocation Length Field specifies the maximum number of bytes that the Host computer has allocated for returned data. An allocation length of zero indicates that no data shall be transferred. This condition shall not be considered as an error. The Device shall terminate the data transfer when allocation length bytes have been transferred or when all available data have been transferred to the Host, whichever is less. The allocation length is used to limit the maximum amount of data (e.g. sense data, mode data, etc.) returned to the Host.

5.3. Command Processing Considerations and Exception Conditions

The following sections describe some exception conditions and errors associated with command processing and the sequencing of commands.

5.3.1. Parameter Rounding

Certain parameters sent to the Device with various commands contain a range of values. Devices may choose to implement only selected values from this range. When the Device receives a value that it does not support, it either rejects the command ("Check Condition" status with ILLEGAL REQUEST Sense Key) or it rounds the value received to a supported value. The Device shall reject unsupported values unless rounding is permitted in the description of the parameter.

Rounding of parameter values, when permitted[1], shall be performed as follows - A Device that receives a parameter value that is not an exact supported value shall adjust the value to one that it supports and shall return "Check Condition" status with a Sense Key of RECOVERED ERROR. The Additional Sense Code shall be set to ROUNDED PARAMETER. The Host is responsible for issuing an appropriate command to learn what value the Device has selected.

5.4. Unit Attention Condition

The Device shall generate a unit attention whenever the Device has been reset by a hard reset condition, or by a power-on reset. The Device shall also generate a unit attention condition whenever one of the following events occurs:

1. A removable medium may have been changed;
2. The version or level of microcode has been changed;
3. The mode parameters in effect have been restored from non-volatile memory;
4. Any other event occurs that requires the attention of the Host.

The Device may queue unit attention conditions. After the first unit attention condition is cleared, another unit attention condition may exist (e.g. a power on condition followed by a microcode change condition).

The unit attention condition shall persist, until the Host clears the condition as described in the following paragraphs.

If an INQUIRY command is received from the Host with a pending unit attention condition, the Device shall perform the INQUIRY command and shall **not** clear the unit attention condition.

If a REQUEST SENSE command is received from the Host with a pending unit attention condition, then the Device shall report the unit attention condition, may discard any pending sense data, and clear the unit attention condition.

If the Host issues a command other than INQUIRY or REQUEST SENSE while a unit attention condition exists, the Device shall **not** perform the command and shall report "Check Condition" status unless a higher priority status as defined by the Device is also pending (e.g. BUSY).

5.5. Commands and Parameters

The Streaming Tape commands are derived from the QIC-121 command set.

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[1]. Generally, the Device should adjust maximum-value fields down to the next lower supported value than the one specified by the Host Computer. Minimum-value fields should be rounded up to the next higher supported value than the one specified by the Host Computer. In some cases, the type of rounding (up or down) is explicitly specified in the description of the parameter.

The interface uses logical rather than physical addressing for all data blocks. Each Device may be interrogated to determine how many blocks it contains.

Commands are classified as mandatory, optional, or vendor-specific. Devices are required to implement all mandatory commands and may implement other commands as well. Devices contain commands that facilitate the writing of self-configuring software Drivers that can discover all necessary attributes without prior knowledge of specific peripheral characteristics.

5.6. CDB's for Streaming Tape Devices

Table 5-4 Packet Commands Supported by Streaming Tape Devices

Command Description	Opcode	Type	Media Access	Reference
ERASE	19h	M	Yes	5.6.1 on page 14
INQUIRY	12h	M		5.6.2 on page 15
LOAD/UNLOAD	1Bh	M	Yes	5.6.3 on page 18
LOCATE	2Bh	M	Yes	5.6.4 on page 20
LOG SELECT	4Ch	M		5.6.5 on page 21
LOG SENSE	4Dh	M		5.6.6 on page 22
MODE SELECT	15h	M		5.6.7 on page 28
MODE SENSE	1Ah	M		5.6.8 on page 29
READ	08h	M	Yes	5.6.9 on page 40
READ POSITION	34h	M	Yes	5.6.10 on page 42
REQUEST SENSE	03h	M		5.6.11 on page 44
REWIND (Rezero Unit on CD-ROM)	01h	M	Yes	5.6.12 on page 52
SPACE	11h	M	Yes	5.6.13 on page 53
TEST UNIT READY	00h	M		5.6.14 on page 55
WRITE	0Ah	M	Yes	5.6.15 on page 56
WRITE FILEMARK	10h	M	Yes	5.6.16 on page 57
M = command implementation is mandatory. O = command implementation is optional.				

[**Editor's Note:** Many unused bit fields contain fixed values, with parenthetical names that are not defined. (i.e. 0 (SP). These explicitly indicates which fields from QIC-121 are not supported by this specification.]

5.6.1. Erase Command

The ERASE command causes part or all of the medium to be erased beginning at the current position. As used here, “erased” means either the medium shall be erased or a pattern shall be written on the medium that indicates the end of recorded data.

Table 5-5 Erase Command

Bit Byte	7	6	5	4	3	2	1	0
0	Operation code (19h)							
1	Reserved						Immed	1 (Long)
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							

Some Devices may reject an ERASE command if not at **beginning-of-partition**.

An **Immed** (immediate) bit of zero indicates the Device shall not return status until the operation has completed. An **Immed** bit of one indicates that the target shall return status as soon as all buffered commands have completed execution and the CDB has been validated. If CHECK CONDITION status is returned when the **Immed** bit is set to one, the operation shall not be performed.

Table 5-6 Recommended Sense Key, ASC and ASCQ for ERASE Errors

Sense Key	ASC	ASCQ	Description of Error
02	04	00	NOT READY, CAUSE NOT REPORTABLE
02	3A	00	MEDIUM NOT PRESENT
03	51	00	ERASE FAILURE (FORMAT FAILURE)
05	20	00	INVALID COMMAND OPERATION CODE
05	24	00	INVALID FIELD IN CDB
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON RESET OR DEVICE RESET OCCURRED
06	2A	01	MODE PARAMETERS CHANGED
07	27	00	WRITE PROTECTED

5.6.2. INQUIRY Command

The INQUIRY command requests that information regarding parameters of the Device be sent to the Host. An option allows the Host to request additional information about the Device.

Table 5-7 INQUIRY Command

Bit Byte	7	6	5	4	3	2	1	0
0	Operation code (12h)							
1	Reserved							Reserved (EVPD)
2	Reserved (Page Code)							
3	Reserved							
4	Allocation Length							
5	Reserved							

The INQUIRY command shall return “Check Condition” status only when the Device cannot return the requested INQUIRY data. The INQUIRY data should be returned even though the Device may not be ready for other commands.

If an INQUIRY command is received with a pending unit attention condition (i.e. before the Device reports “Check Condition” status), the Device shall perform the INQUIRY command and shall not clear the unit attention condition.

5.6.2.1.Standard INQUIRY Data

The standard INQUIRY data contains 36 required bytes, followed by a variable number of vendor-specific parameters. Bytes 56 through 95, if returned, are reserved for future standardization.

Table 5-8 INQUIRY Data Format

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved (Peripheral Qualifier)			Peripheral Device Type				
1	RMB	Reserved						
2	ISO Version		ECMA Version			ANSI Version (02)		
3	Reserved (AENC)	Reserved (TrmIOP)	Reserved		Response Data Format (02)			
4	Additional Length (n-4)							
5	Reserved							
6	Reserved							
7	Reserved (RelAdr)	WBus32	WBus16	Sync	Reserved (Linked)	Reserved	Reserved (CmdQue)	Reserved (SftRe)
8-15	Vendor Identification							
16-31	Product Identification							
32-35	Product Revision Level							
36-55	Vendor-specific							
56-95	Reserved							
Reserved (Vendor Specific Parameters)								
96								
n								

The Device-type field identifies the Device. It is defined in Table 5-9 Peripheral Device Types on page 16.

[**Editor's Note:** Due to hardware restrictions all pages should be padded to a multiple of 4 length.]

5.6.2.2. Using the INQUIRY Command

The INQUIRY command may be used by the Host to determine the configuration of the Device. Devices respond with information that includes their type and Specification level and may include the vendor's identification, model number and other useful information.

Table 5-9 Peripheral Device Types

Code	Description
00h	Direct-access Device (e.g. magnetic disk)
01h	Streaming Tape Device (this specification)
02h - 04h	Reserved
05h	CD-ROM Device
06h	Reserved
07h	Optical memory Device (e.g. some optical disks)
08h - 1Eh	Reserved
1Fh	Unknown or no Device type

The Peripheral Device Type shall be set to 01h to indicate a Streaming Tape Device.

A **R**emovable **M**edium **B**it (**RMB**) of zero indicates that the medium is not removable. A **RMB** bit of one indicates that the medium is removable. Streaming Tape Devices should always report "Removable".

The usage of non-zero code values in the **ISO Version** and **ECMA Version** fields are defined by the International Organization for Standardization and the European Computer Manufacturers Association, respectively.

The **ANSI Version** field must contain a 02h to comply with this version of this Specification.

A **Response Data Format** value of 02h indicates that the data shall be in the format specified in this Specification. Other **Response Data Format** values are reserved.

The **Additional Length** field shall specify the length in bytes of the parameters. If the allocation length of the CDB is too small to transfer all of the parameters, the additional length shall not be adjusted to reflect the truncation.

ASCII data fields shall contain only graphic codes (i.e. code values 20h through 7Eh). Left-aligned fields shall place any unused bytes at the end of the field (highest offset) and the unused bytes shall be filled with space characters (20h). Right-aligned fields shall place any unused bytes at the start of the field (lowest offset) and the unused bytes shall be filled with space characters (20h).

A relative addressing (**RelAdr**) bit of one indicates that the device supports the relative addressing mode for this logical unit. If this bit is set to one, the linked command (**Linked**) bit shall also be set to one; since relative addressing can only be used with linked commands. A **RelAdr** bit of zero indicates the device does not support relative addressing for this logical unit.

A wide bus 32 (**WBus32**) bit of one indicates that the device supports 32-bit wide data transfers. A value of zero indicates that the device does not support 32-bit wide data transfers.

A wide bus 16 (**WBus16**) bit of one indicates that the device supports 16-bit wide data transfers. A value of zero indicates that the device does not support 16-bit wide data transfers.

A synchronous transfer (**Sync**) bit of one indicates that the device supports synchronous data transfer. A value of zero indicates the device does not support synchronous data transfer.

The **Vendor Identification** field contains 8 bytes of ASCII data identifying the vendor of the product[2]. The data shall be left aligned within this field.

The **Product Identification** field contains 16 bytes of ASCII data as defined by the vendor. The data shall be left-aligned within this field.

The **Product Revision Level** field contains 4 bytes of ASCII data as defined by the vendor. The data shall be left-aligned within this field.

Table 5-10 Recommended Sense Key, ASC and ASCQ for INQUIRY Errors

Sense Key	ASC	ASCQ	Description of Error
05	20	00	INVALID COMMAND OPERATION CODE
05	24	00	INVALID FIELD IN CDB

[2]. It is intended that this field provide a unique vendor identification of the manufacturer of the Device. In the absence of a formal registration procedure, QIC maintains a list of vendor identification codes in use. Vendors are requested to voluntarily submit their identification codes to QIC to prevent duplication of codes.

5.6.3. LOAD/UNLOAD Command

The LOAD/UNLOAD command requests that the Device enable or disable further media access operations. Media access commands are defined in Table 5-4 Packet Commands Supported by Streaming Tape Devices. This command may also be used to request a re-tension function. Prior to performing the load or unload operation, the Device shall ensure that all buffered data, and filemarks have been transferred to the medium.

Table 5-11 Load/Unload Command *6. 6. 6. 6. 6. 6.*

Bit Byte	7	6	5	4	3	2	1	0
0	Operation code (1Bh)							
1	Reserved							Immed
2	Reserved							
3	Reserved							
4	Reserved						Re-Ten	Load
5	Reserved							

An **Immed** (immediate) bit of zero indicates the Device shall not return status until the operation has completed. An **Immed** bit of one indicates that the Device shall return status as soon as all buffered commands have completed execution and the CDB has been validated. If CHECK CONDITION status is returned when the **Immed** bit is set to one, the operation shall not be performed.

A **Re-Ten**sion (**Re-Ten**) bit of one indicates that the medium on the Device shall be correctly tensioned. Implementation of the re-tensioning function is Device specific that typically consists of one end-to-end pass on the cartridge.

If the **Load** bit is set to one, the medium shall be loaded and positioned to the **beginning-of-partition** zero. If the **Load** bit is zero, the medium in the Device shall be positioned for removal at the extreme position along the medium. Following successful completion of an unload operation, the Device shall return “Check Condition” status with the Sense Key set to NOT READY for all subsequent medium-access commands until a new volume is mounted or a load operation is successfully completed.

Table 5-12 Load and Retension Bit Combinations

Load	Re-Ten	Meaning
0	0	unload
0	1	retension then unload at **BOT**
1	0	load
1	1	load and retension

Implementor's Note: *Following a hard reset or a cartridge insertion, an implied or automatic load may be performed by the Device.*

Table 5-13 Recommended Sense Key, ASC and ASCQ for LOAD/UNLOAD Errors

Sense Key	ASC	ASCQ	Description of Error
02	04	00	NOT READY, CAUSE NOT REPORTABLE
02	3A	00	MEDIUM NOT PRESENT
04	53	00	MEDIA LOAD EJECT FAILED
05	20	00	INVALID COMMAND OPERATION CODE
05	24	00	INVALID FIELD IN CDB
05	53	02	MEDIUM REMOVAL PREVENTED
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON RESET OR DEVICE RESET OCCURRED
06	2A	01	MODE PARAMETERS CHANGED

5.6.4. LOCATE Command

The LOCATE command causes the Device to position to the specified block address in a specified partition. Upon completion, the logical position shall be before the specified location. Prior to performing the locate operation, the Device shall ensure that all buffered data, and filemarks have been transferred to the medium.

Table 5-14 Locate Command *6. 6. 6. 6. 6. 6. 6.*

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation code (2Bh)							
1	Reserved						CP	Reserved
2	Reserved							
3	(MSB)							
4	Block Address							
5								
6								(LSB)
7	Reserved							
8	Partition							
9	Reserved							

A **C**hange **P**artition (**CP**) bit of one indicates that a change to the partition specified in the partition field is to occur prior to positioning to the block specified in the **Block Address** field. A **CP** bit of zero indicates no partition change is to be made and the partition field is to be ignored.

The **Block Address** field specifies the logical block address to which the Device shall position the medium. See the *Blocks* section on page 6 for information on blocks.

The **Partition** field specifies which partition to select if the **CP** bit is one.

Table 5-15 Recommended Sense Key, ASC and ASCQ for LOCATE Errors *6. 6. 6.*

Sense Key	ASC	ASCQ	Description of Error
02	04	00	NOT READY, CAUSE NOT REPORTABLE
02	3A	00	MEDIUM NOT PRESENT
04	15	00	RANDOM POSITIONING ERROR
05	20	00	INVALID COMMAND OPERATION CODE
05	24	00	INVALID FIELD IN CDB
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON RESET OR DEVICE RESET OCCURRED
06	2A	01	MODE PARAMETERS CHANGED

5.6.5. LOG SELECT Command

The LOG SELECT command provides a means to manage statistical information maintained by the Device about the Device. Structures as log parameters within log pages are defined as a way to manage the log data. The LOG SELECT command provides for sending zero or more log pages of data. This specification defines the format of the log pages, but does not define the exact conditions and events that are logged.

Table 5-16 Log Select Command *6. 6. 6. 6. 6. 6. 6.*

Bit Byte	7	6	5	4	3	2	1	0
0	Operation code (4Ch)							
1	Reserved						PCR	0 (SP)
2	1(PC)		Reserved					
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	(MSB)	Parameter List Length						
8								(LSB)
9	Reserved							

A **P**arameter **C**ode **R**eset (**PCR**) bit of one and a parameter list length of zero shall cause all implemented parameters to be set to zero. If the **PCR** bit is one and a the parameter list length is greater than zero, the command is terminated with "Check Condition" status. The Sense Key shall be set to ILLEGAL REQUEST and the Additional Sense Code shall be set to INVALID FIELD IN CDB. A **PCR** bit of zero specifies that the log parameters shall not be reset.

[Implementor's Note: LOG SENSE commands should be issued prior to issuing LOG SELECT commands to determine supported pages and page lengths**.]**

Table 5-17 Recommended Sense Key, ASC and ASCQ for LOG SELECT Errors *6. 6. 6.*

Sense Key	ASC	ASCQ	Description of Error
02	04	00	NOT READY, CAUSE NOT REPORTABLE
02	3A	00	MEDIUM NOT PRESENT
05	1A	00	PARAMETER LIST LENGTH ERROR
05	20	00	INVALID COMMAND OPERATION CODE
05	24	00	INVALID FIELD IN CDB
05	26	00	INVALID FIELD IN PARAMETER LIST
05	26	01	PARAMETER NOT SUPPORTED
05	26	02	PARAMETER VALUE INVALID
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON RESET OR DEVICE RESET OCCURRED
06	2A	01	MODE PARAMETERS CHANGED

5.6.6. LOG SENSE Command

The LOG SENSE command provides a means to retrieve statistical information maintained by the Device about the Device. It is a complementary command to the LOG SELECT command.

Table 5-18 Log Sense Command *6. 6. 6. 6. 6. 6. 6.*

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation code (4Dh)							
1	Reserved						Reserved (PPC)	Reserved (SP)
2	1(PC)		Page Code					
3	Reserved							
4	Reserved							
5	(MSB) Parameter Pointer							
6								(LSB)
7	(MSB) Allocation Length							
8								(LSB)
9	Reserved							

The parameter values returned by a LOG SENSE command are determined as follows:

1. The specified parameter values at the last update (in response to a LOG SELECT or LOG SENSE command or done automatically by the Device for cumulative values).
2. The default values if an update has not occurred since the last power-on, hard RESET condition, or Device reset.

The **Page Code** field identifies which page of data is being requested. If the **Page Code** is reserved or not implemented, the Device shall terminate the command with "Check Condition" status. The Sense Key shall be set to ILLEGAL REQUEST with the Additional Sense Code set to INVALID FIELD IN CDB.

The **Parameter Pointer** field allows requested parameter data to begin from a specific parameter code to the maximum **Allocation Length** or the maximum parameter code supported by the Device, whichever is less. If the value of the **Parameter Pointer** field is larger than the largest available parameter code that can be returned by the Device on the specified page, the Device shall terminate the command with "Check Condition" status. The Sense Key shall be set to ILLEGAL REQUEST and the Additional Sense Code shall be set to INVALID FIELD IN CDB.

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

Table 5-19 Recommended Sense Key, ASC and ASCQ for LOG SENSE Errors *6. 6. 6.*

Sense Key	ASC	ASCQ	Description of Error
02	04	00	NOT READY, CAUSE NOT REPORTABLE
02	3A	00	MEDIUM NOT PRESENT
04	15	00	RANDOM POSITIONING ERROR
05	20	00	INVALID COMMAND OPERATION CODE
05	24	00	INVALID FIELD IN CDB
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON RESET OR DEVICE RESET OCCURRED
06	2A	01	MODE PARAMETERS CHANGED

5.6.6.1.Log Parameters

This section defines the descriptors and pages for log parameters that may be used with Devices.

The log page codes for Devices are defined in Table 5-20.

Table 5-20 Log Page Codes

Page Code	Description	Reference
00h	Supported Log Pages	5. 6. 6.2 on page 24
01h	Reserved	
02h	Error Counter Page (Write) Page	5. 6. 6.3 on page 25
03h	Error Counter Page (Read) Page	5. 6. 6.3 on page 25
04h - 30h	Reserved	
31h	Tape Capacity Page	5. 6. 6.4 on page 27
32h - 3Eh	Vendor Specific	
3Fh	Reserved	

This section describes the log page structure and the log pages that are applicable to all Devices. Each log page begins with a four-byte page header followed by zero or more variable-length log parameters defined for that page.

Table 5-21 Log Page Format ***6. 6. 6. 6. 6. 6. 6.***

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved		Page Code					
1	Reserved							
2	(MSB)		Page Length (n-3)					
3								(LSB)
	Log Parameter(s)							
4	Log Parameter (First)							
x+3	(Length x)							
n-y	Log Parameter (Last)							
n	(Length y)							

The **Page Code** field identifies which log page is being transferred.

The **Page Length** field specifies the length in bytes of the following log parameters. If the Host sends a **Page Length** that results in the truncation of any parameter, the command shall terminate with "Check Condition" status. The Sense Key shall be set to ILLEGAL REQUEST with the Additional Sense Code set to INVALID FIELD IN PARAMETER LIST.

[**Editor's Note:** Due to hardware restrictions all pages should be padded to a multiple of 4 length.]

Most log pages contain one or more special data structures called log parameters. Log parameters are data counters that record a count of a particular event (or events).

Table 5-22 Log Parameter *6. 6. 6. 6. 6. 6. 6.*

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB) Parameter Code							
1								(LSB)
2	0 (DU)	1 (DS)	0 (TSD)	0 (ETC)	00 (TMC)		Reserved	0 (LP)
3	Parameter Length (n-3)							
4	Parameter Value							
n								

Each log parameter begins with a four-byte parameter header followed by one or more bytes of **Parameter Value** data.

[**Editor's Note:** Due to hardware restrictions all parameter values should be padded to a multiple of 4.]

The **Parameter Code** field identifies which log parameter is being transferred for that log page.

A **D**isable **S**ave (**DS**) bit of one indicates that the Device does not support saving that log parameter in response to a LOG SELECT command with a SP bit of one.

The **Parameter Length** field specifies the length in bytes of the following parameter value. If the Host sends a **Parameter Length** value that results in the truncation of the **Parameter Value**, the Device shall terminate the command with "Check Condition" status. The Sense Key shall be set to ILLEGAL REQUEST with the Additional Sense Code set to INVALID FIELD IN PARAMETER LIST.

Implementor's Note: For log page codes 02h and 03h, the parameter length field shall be set to 4 and thus the **Parameter Value** shall be 4 bytes long.

5.6.6.2.Supported Log Pages Code 00h

The supported log page returns the list of log pages implemented. Devices that implement the LOG SENSE command shall implement this log page.

Table 5-23 Supported Log Page *6. 6. 6. 6. 6. 6. 6.*

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved		Page Code (00h)					
1	Reserved							
2	(MSB) Page Length (n-3)							
3								(LSB)
4	Supported Page List							
n								

This page is not defined for the LOG SELECT command. This log page returns the list of supported log pages.

The page length field specifies the length in bytes of the following supported page list,

The supported page list field shall contain a list of all log page codes implemented by the Device in ascending order beginning with page code 00h.

The supported page list should be padded with zeros such that the entire page size is a multiple of four bytes. The page length includes the pad bytes.

5.6.6.3.Error Counter Pages Codes 02, 03

This section defines the optional error counter pages for write errors (page code 02h), and read errors (page code 03h). Table 5-22 defines the page format for these pages. A page can return one or more log parameters which record events defined by the parameter codes.

[Implementor's Note: Devices shall only reset its error counters at power-on or on command from the Host. Support of each log parameter is optional.]

5.6.6.3.1.Error Counter Page (Read)

This section defines the parameter codes for the Error Counter Page (Read), page code 03h. Table 5-24 defines the counters and their use.

The following techniques can be used to attempt to recover bad blocks when reading from tape.

1. ECC. An ECC algorithm is applied to the data blocks and parity blocks within a frame in order to correct the bad blocks. This technique can only be used when a minimum number of bad blocks are detected in a frame.
2. Tape re-positions. The tape is re-positioned so that the frame read operation can be repeated.
3. Head adjustments. The head position in relation to the track is slightly modified. Head adjustments are done in combination with tape re-positions.
4. Signal threshold changes. The read amplitude dc values are modified slightly to capture more signal transitions. Signal threshold changes are made in combination with tape re-positions.

Table 5-24 Parameter Codes for Error Counter Page (Read) - Page Code 03h

Code	Description
0000h	Number of blocks recovered by ECC alone.
0001h	Number of blocks recovered without using ECC. This count is incremented when blocks are recovered due to: - tape re-positioning alone - combination of tape re-positioning and head adjustments - combination of tape re-positioning and signal threshold changes. However, no additional ECC processing is required.
0002h-8003h	Reserved
8004h-FFFFh	Vendor Specific

Implementor's Note:

1. The term "blocks" refers to physical blocks on tape.
2. A block read error is only counted as being in error on the first attempt to read the block.

5.6.6.3.2.Error Counter Page (Write)

This section defines the parameter codes for the Error Counter Page (Write), page code 02h). Table 5-25 defines the counters and their use.

The following techniques can be used to correct errors detected when writing to tape.

1. Rewrites. If a bad block is detected during the read after write operation, the block will be rewritten until it reads correctly or until the maximum rewrite count is reached. Note that the maximum rewrite count is defined by the physical tape format. Rewrites facilitate tape streaming.
2. Tape re-positioning. Re-positioning during write errors applies only to rewritable data frames.

NOTE: The distance between the write and the read heads may be large compared to the data blocks, therefore, there may be several blocks between the block that is accessed by the write head and the block

that is accessed by the read head. This means that for a write retry without re-positioning several blocks may be discarded.

Table 5-25 Parameter Codes for Error Counter Page (Write) - Page Code 02h

Code	Description
0000h	Number of rewrites. Blocks that follow the bad block but precede the last block written will also be re-written, however, these blocks shall not be included in this count.
0002h	Number of re-positions. This count is incremented when tape re-positioning is performed due to an error when attempting to write a re-writable frame. This counter is only used with tape formats which support overwrite.
0003h	Total number of blocks recovered.
00004h-0005h	Reserved
0006h	Number of physical blocks not recovered.
0007h-8003h	Reserved
8004h-FFFFh	Vendor Specific

NOTES: A frame is in error if any one block, or any number of blocks within the frame cannot be read. The term "blocks" refers to physical blocks on tape.

5.6.6.4.Tape Capacity Page Code 31h

Table 5-26 Tape Capacity Page Code 31h

Bit / Byte	7	6	5	4	3	2	1	0
0	Page Code (31h)							
1	Reserved							
2	(MSB) Page Length (32)							
3								(LSB)
4	(MSB) Parameter Code 1h							
5								(LSB)
6	0 (DU)	1 (DS)	0 (TSD)	0 (ETC)	0 (TMC)		Reserved	0 (LP)
7	Parameter Length (4)							
8	(MSB) Remaining Capacity, Partition 0							
11								(LSB)
12	(MSB) Parameter Code 2h							
13								(LSB)
14	0 (DU)	1 (DS)	0 (TSD)	0 (ETC)	0 (TMC)		Reserved	0 (LP)
15	Parameter Length (4)							
16	(MSB) Remaining Capacity, Partition 1							
19								(LSB)
20	(MSB) Parameter Code 3h							
21								(LSB)
22	0 (DU)	1 (DS)	0 (TSD)	0 (ETC)	0 (TMC)		Reserved	0 (LP)
23	Parameter Length (4)							
24	(MSB) Maximum Capacity, Partition 0							
27								(LSB)
28	(MSB) Parameter Code 4h							
29								(LSB)
30	0 (DU)	1 (DS)	0 (TSD)	0 (ETC)	0 (TMC)		Reserved	0 (LP)
31	Parameter Length (4)							
32	(MSB) Maximum Capacity, partition 1							
35								(LSB)

For single partition tapes, **Partition 1** values shall always be zero.

The **Remaining Capacity** for non-current partitions shall be the same as the **Maximum Capacity** for that partition.

The **Maximum Capacity** values are valid only after the load operation is completed. **Remaining Capacity** is valid after a SPACE to **EOD,** WRITE, or WRITE FILEMARK. Following LOCATE, REWIND, SPACE Block or Filemark, READ, LOAD and MODE SELECT the **Remaining Capacity** reflects a progress value as a ratio of **Remaining** and **Maximum Capacity**.

Capacities are multiplied by 1024 to determine the number of bytes. These values are estimates and, where compression is implemented, they assume a 1:1 compression ratio and allow for typical write retries. Allowances for frame grouping, system log areas, **EOD** and **EOP** areas, and headers are not included in these capacity values to ensure a conservative estimate.

5.6.7. MODE SELECT Command

The MODE SELECT command provides a means to specify medium or Device parameters. MODE SENSE should be issued prior to MODE SELECT to determine supported pages, page lengths, and other parameters.

Table 5-27 Mode Select Command *6. 6. 6. 6. 6. 6. 6.*

Bit Byte	7	6	5	4	3	2	1	0
0	Operation code (15h)							
1	Reserved			1 (PF)	Reserved			0 (SP)
2	Reserved							
3	(MSB) Parameter List Length							
4								(LSB)
5	Reserved							

The **Parameter List Length** field specifies the length in bytes of the MODE SELECT parameter list that shall be transferred to the Device as data. A **Parameter List Length** of zero indicates that no data shall be transferred. This condition shall not be considered as an error. A **Parameter List Length** that results in the truncation of any descriptor, header or page of parameters shall cause the Device to terminate the command with "Check Condition" status. The Sense Key shall be set to ILLEGAL REQUEST, and the Additional Sense Code shall be set to PARAMETER LIST LENGTH ERROR.

[Implementor's Note: In some situations where there is a conflict between the information in the command descriptor block and the information in the parameter list, one of several additional sense codes may apply. As a guide, INVALID FIELD IN CDB or PARAMETER LIST LENGTH ERROR should be used if the error is detected prior to any operations that alter the mode parameters. INVALID FIELD IN PARAMETER LIST should be used if the mode parameters have been altered.]

The Device shall terminate the MODE SELECT command with "Check Condition" status, set the Sense Key to ILLEGAL REQUEST and set the Additional Sense Code to INVALID FIELD IN PARAMETER LIST for the following conditions:

1. If an attempt to send an unsupported value in the MODE SELECT header, block descriptor, or any page header.
2. If an attempt to send a page with a length not equal to the parameter length reported for that page by the MODE SENSE command.
3. If an attempt to send a value for a parameter that is outside the range supported by the Device and rounding is not implemented for that parameter.

Table 5-28 Recommended Sense Key, ASC and ASCQ for MODE SELECT Errors *6. 6. 6.*

Sense Key	ASC	ASCQ	Description of Error
02	04	00	NOT READY, CAUSE NOT REPORTABLE
05	1A	00	PARAMETER LIST LENGTH ERROR
05	20	00	INVALID COMMAND OPERATION CODE
05	24	00	INVALID FIELD IN CDB
05	26	00	INVALID FIELD IN PARAMETER LIST
05	26	01	PARAMETER NOT SUPPORTED
05	26	02	PARAMETER VALUE INVALID
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON RESET OR DEVICE RESET OCCURRED

5.6.8. MODE SENSE Command

The MODE SENSE command provides a means for a Device to report parameters. It is a complementary command to the MODE SELECT command.

Table 5-29 Mode Sense Command *6. 6. 6. 6. 6. 6. 6.*

Bit Byte	7	6	5	4	3	2	1	0
0	Operation code (1Ah)							
1	Reserved				DBD	Reserved		
2	0(PC)		Page Code					
3	(MSB) Allocation Length							
4								(LSB)
5	Reserved							

A **D**isable **B**lock **D**escriptors (**DBD**) bit of zero indicates that the Device shall return one block descriptor in the returned MODE SENSE data. A **DBD** bit of one specifies that the Device shall not return any block descriptors in the returned MODE SENSE data.

The **Page Code** specifies which page or pages to return. Page code usage is defined in Table 5-31.

If a MODE SENSE command is attempted with a page code value not implemented, the Device shall return "Check Condition" status and shall set the Sense Key to ILLEGAL REQUEST and the Additional Sense Code to INVALID FIELD IN CDB.

A page code of 3Fh indicates that all pages implemented by the Device shall be returned. Page 00h, if implemented, shall be returned after all other pages. Devices that implement more than 255 bytes of mode page parameter data and block descriptors shall return "Check Condition" status to a MODE SENSE request of 3Fh in the page code field. The Sense Key shall be set to ILLEGAL REQUEST and the Additional Sense Code shall be set to INVALID FIELD IN CDB. This limitation ensures compatibility with the SCSI standard.

The Device returns the current parameter values for the specified page code. The current values returned are:

1. The parameters set in the last successful MODE SELECT command.
2. The default values if a MODE SELECT command has not been executed since the last power-on, hard RESET condition, or Device reset, or not ready to ready transition.

Table 5-30 Recommended Sense Key, ASC and ASCQ for MODE SENSE Errors *6. 6. 6.*

Sense Key	ASC	ASCQ	Description of Error
02	04	00	NOT READY, CAUSE NOT REPORTABLE
05	20	00	INVALID COMMAND OPERATION CODE
05	24	00	INVALID FIELD IN CDB
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON RESET OR DEVICE RESET OCCURRED

5.6.8.1. Mode Parameters

This section describes the block descriptors and the pages used with MODE SELECT and MODE SENSE commands that are applicable to Devices.

Table 5-31 Mode Page Codes

Page Code	Description	Reference	Type
00h	Vendor specific (do not require page format)		
01h - 0Eh	Reserved		
0Fh	Data Compression Page	5.6.8.3 on page 34	
10h	Vendor specific (page format required)		
11h	Medium Partition Page	5.6.8.4 on page 37	Mandatory for QFA
15h - 29h	Vendor Specific (page format required)		
2Ah	Capabilities and Mechanical Status	5.6.8.5 on page 38	
2B-3Eh	Vendor Specific (page format required)		
3Fh	Returns all pages (valid only for the MODE SENSE command)		

The mode parameter list shown in Table 5-32 contains a header, followed by zero or more block descriptors, followed by zero or more variable-length pages

Table 5-32 Mode Parameter List ***6. 6. 6. 6. 6. 6. 6.***

Bit Byte	7	6	5	4	3	2	1	0
0 - n	Mode Parameter Header							
0 - n	Block Descriptor(s)							
0 - n	Page(s)							

Table 5-33 Mode Parameter Header ***6. 6. 6. 6. 6. 6. 6.***

Bit Byte	7	6	5	4	3	2	1	0
0	Mode Data Length							
1	Medium Type							
2	Device-Specific Parameter							
3	Block Descriptor 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 itself. When using the MODE SELECT command, this field is reserved.

Refer to QIC 95-101 for **Medium Type** information.

The block descriptor length specifies the length in bytes of all the block descriptors. It is equal to the number of block descriptors times eight and does not include pages or vendor-specific parameters, if any, that may follow the last block descriptor. A block descriptor length of zero indicates that no block descriptors are included in the mode parameter list. This condition shall not be considered an error.

Table 5-34 Mode Parameter Block Descriptor *6. 6. 6. 6. 6. 6. 6.*

Bit Byte	7	6	5	4	3	2	1	0
0	Density Code							
1	(MSB) Number of Blocks							
2								
3								(LSB)
4	Reserved							
5	(MSB) Block Length							
6								
7								(LSB)

Block descriptors specify some of the medium characteristics. The block descriptor contains a **Density Code** field, a **Number of Blocks** field, and a **Block Length** field. Block descriptor values are always current (i.e., saving is not supported).

Refer to QIC 95-101 for **Density Code** information.

The **Number of Blocks** field specifies the number of logical blocks on the medium to which the density code and block length fields apply. A value of zero indicates that all of the remaining logical blocks of the Device shall have the medium characteristics specified.

Implementor's Note: *There may be implicit association between parameters defined in the pages and block descriptors. In this case, the Device may change parameters not explicitly sent with the MODE SELECT command. A subsequent MODE SENSE command would reflect these changes.*

The **Block Length** specifies the current length in bytes of each logical block described by the block descriptor for the current medium. For QIC Streaming Tape Devices, two block sizes supported may be of either 512 or 1024 bytes per block.

The mode page format is defined in Table 5-35.

Table 5-35 Mode Page Format *6. 6. 6. 6. 6. 6. 6.*

Bit Byte	7	6	5	4	3	2	1	0
0	0 (PS)	Reserved	Page Code					
1	Page Length (n - 1)							
2 - n	Mode Parameters							

[**Editor's Note:** Due to hardware restrictions all mode parameters should be padded to a multiple of 4 bytes.]

Each mode page contains a page code, a page length, and a set of mode parameters. The page codes are defined in Table 5-34.

The **Page Code** field identifies the format and parameters defined for that mode page.

When using the MODE SENSE command, if page code 00h (vendor-specific page) is implemented, the Device shall return that page last in response to a request to return all pages (page code 3Fh). When using the MODE SELECT command, this page should be sent last.

The **Page Length** field specifies the length in bytes of the mode parameters that follow. If the Host does not set this value to the value that is returned for the page by the MODE SENSE command, the Device shall terminate the command with “Check Condition” status. The Sense Key shall be set to ILLEGAL REQUEST with the Additional Sense Code set to INVALID FIELD IN PARAMETER LIST.

The mode parameters for each page are defined in the following sub-sections. Mode parameters not implemented by the Device shall be set to zero.

5.6.8.2.Mode Parameters

This section defines the descriptors and pages for mode parameters used with Devices.

For the MODE SENSE command, the medium-type code field reflects the characteristics of the cartridge currently installed in the Device. For some Devices, the default medium type code value returned in response to a MODE SENSE command may change dynamically to match the most recently inserted medium-type. **Error! Reference source not found.** defines the medium-type code values

The medium-type code value returned in response to a MODE SENSE command shall be as described below:

1. Following a UNIT ATTENTION condition for a power on or hard reset condition, while not ready, the Device shall report the default or only medium-type.
2. Following a UNIT ATTENTION condition for a not-ready-to-ready transition, the Device shall:
   a) report the default or only medium-type if no attempt has been made by the Device to determine the medium-type.
   b) report the default or only medium-type if the Device cannot automatically determine the medium-type.
   c) report the current recorded medium-type if the Device can automatically determine the medium-type.
3. Following a successful read operation at or after **beginning-of-medium**, the Device shall report a medium-type code value reflecting the installed cartridge. For some implementations, the Device may automatically determine this value. For Devices not capable of automatic medium-type determination, the medium-type code value is provided by the preceding MODE SELECT command.
4. Following an unsuccessful read operation or a successful write operation, while at **beginning-of-partition**, the Device shall:
   a) report a medium-type value as described for item (2) if no preceding MODE SELECT command has been issued for the currently loaded cartridge.
   b) report a medium-type value as provided by the last successful MODE SELECT command for the currently loaded cartridge.
5. Following a successful unload operation, while not ready, the Device shall report the most recent medium-type code value as determined by items (2) through (4) above.

Table 5-36 Device-Specific Parameter ***6. 6. 6. 6. 6. 6.***

Bit	7	6	5	4	3	2	1	0
	WP	1(Buffered Mode)			Speed			

For the MODE SENSE command, a write protect (**WP**) bit of zero indicates that the medium is write enabled. A **WP** bit of one indicates that the medium is write protected. For the MODE SELECT command, this field is ignored.

Table 5-37 Speed Field Assignments

0h	Default (Use the peripheral Device's default speed).
1h	Use the peripheral Device's lowest speed.
2h - Fh	Use increasing peripheral Device speeds.

Implementor's Note: *It is recommended that the default value for the speed field be 0h. This is the minimum support required. Note that the default speed should consider the Device characteristics, the cartridge specifications, and the tape format.*

For the MODE SELECT command, the density code field indicates the density selected by the Host for use in subsequent read and write operations. For Devices capable of automatic density recognition, the density code selected by the Host may be overridden by the Device for a subsequent read operation if the selected value does not match the current recorded density of the medium.

For the MODE SENSE command, the density code field reflects the current operating density of the Device. For some Devices, the default density code value returned in response to a MODE SENSE command may change dynamically to match the most recently selected density. The density code value returned in response to a MODE SENSE command shall be as described below:

1. Following a UNIT ATTENTION condition for a power on or hard reset condition, while not ready, the Device shall report the default density.
2. Following a UNIT ATTENTION condition for a not-ready-to-ready transition, the Device shall:
   a) report the default density if no attempt has been made by the Device to determine the density.
   b) report the default density if the Device cannot automatically determine the density from the medium.
   c) report the current recorded density if the Device can automatically determine the density from the medium.
3. Following a successful read operation at or after **beginning-of-medium**, the Device shall report a density code value reflecting the recorded density of the medium. For some implementations, the Device may automatically determine this value from the medium. For Devices not capable of automatic density determination, the default density is reported if the density code value is not provided by the preceding MODE SELECT command.
4. Following an unsuccessful read operation or a successful write operation, while at **beginning-of-partition**, the Device shall:
   a) report a density code value as described for item (2) if a previous MODE SELECT command has not established a density code for the currently loaded cartridge.
   b) report a density code value as provided by the last successful MODE SELECT command for the currently loaded cartridge.
5. Following a successful unload operation the Device shall report the most recent density code value as determined by items (2) through (4) above.

5.6.8.3.Data Compression Page Code 0Fh

Table 5-38 Data Compression Page *6. 6. 6. 6. 6. 6. 6.*

Bit Byte	7	6	5	4	3	2	1	0
0	PS	Reserved	Page Code (0Fh)					
1	Page Length (0Eh)							
2	DCE	DCC	Reserved					
3	DDE	RED		Reserved				
4	(MSB) Compression Algorithm							
5								
6								
7								(LSB)
8	(MSB) Decompression Algorithm							
9								
10								
11								(LSB)
12	Reserved							
13	Reserved							
14	Reserved							
15	Reserved							

This page specifies the parameters for the control of data compression in a Device.

A **D**ata **C**ompression **E**nable (**DCE**) bit of one indicates that the data compression is to be enabled. When this bit is set, data sent to the Device by the Host shall be processed using the selected compression algorithm before being written to the medium. A **DCE** bit of zero indicates that data compression is disabled.

A **D**ata **C**ompression **C**apable (**DCC**) bit of one indicates that the Device supports data compression and shall process data sent to it for transferal to the medium using the selected compression algorithm when the **DCE** bit is one. A **DCC** bit of zero indicates that the Device does not support data compression. This shall be a non-changeable field.

A **D**ata **D**ecompression **E**nable (**DDE**) bit of one indicates that data decompression is to be enabled. A **DDE** of zero indicates that data decompression is disabled.

Implementor's Note: *When the **DDE** bit is zero, all decompression algorithms are deemed unsupported by the Device.*

The **R**eport **E**xception on **D**ecompression (**RED**) field indicates the Device's response to certain boundaries it detects in the data on the medium. There are a number of boundaries that may occur on the medium between compressed and uncompressed data. These boundaries are shown in Table 5-39.

Table 5-39 Possible data compression boundaries

Prior Data	Current Data
uncompressed	compressed (unsupported algorithm)
uncompressed	compressed (supported algorithm)
compressed (supported algorithm)	uncompressed
compressed (supported algorithm)	compressed (unsupported algorithm)
compressed (supported algorithm A)	compressed (supported algorithm B)
compressed (unsupported algorithm)	uncompressed
compressed (unsupported algorithm)	compressed (supported algorithm)
compressed (unsupported algorithm A)	compressed (unsupported algorithm B)

A **RED** field of zero indicates that the Device shall return a "Check Condition" status when data is encountered on the medium during a read operation that the Device cannot decompress. This is the case at the boundaries shown in Table 5-40.

Table 5-40 Boundaries that generate a "Check Condition" when RED field is zero

Prior Data	Current Data	Sense Key
uncompressed	compressed (unsupported algorithm)	MEDIUM ERROR
compressed (supported algorithm)	compressed (unsupported algorithm)	MEDIUM ERROR
compressed (unsupported algorithm A)	compressed (unsupported algorithm B)	MEDIUM ERROR

A **RED** field of one indicates that the Device shall return a "Check Condition" status when data is encountered on the medium during a read operation that requires different handling by the Host than the data most recently encountered during a prior read operation. This is the case in the boundaries shown in Table 5-41.

Table 5-41 Boundaries that generate a "Check Condition" when RED field is one

Prior Data	Current Data	Sense Key
uncompressed	compressed (unsupported algorithm)	MEDIUM ERROR
compressed (supported algorithm)	compressed (unsupported algorithm)	MEDIUM ERROR
compressed (unsupported algorithm)	uncompressed	NO SENSE
compressed (unsupported algorithm)	compressed (supported algorithm)	RECOVERED ERROR
compressed (unsupported algorithm A)	compressed (unsupported algorithm B)	MEDIUM ERROR

At each of these boundaries, the data sent to the Host is of a fundamentally different nature from that which was previously sent.

A **RED** field of two indicates that the Device shall return a "Check Condition" status when data is encountered on the medium during a read operation that has been processed using a different algorithm from that data most recently encountered during a prior read operation. This is the case at the boundaries shown in Table 5-42.

Table 5-42 Boundaries that generate a "Check Condition" when RED field is zero

Prior Data	Current Data	Sense Key
uncompressed	compressed (unsupported algorithm)	MEDIUM ERROR
uncompressed	compressed (supported algorithm)	RECOVERED ERROR
compressed (supported algorithm)	uncompressed	NO SENSE
compressed (supported algorithm)	compressed (unsupported algorithm)	MEDIUM ERROR
compressed (supported algorithm A)	compressed (supported algorithm B)	RECOVERED ERROR
compressed (unsupported algorithm)	uncompressed	NO SENSE
compressed (unsupported algorithm)	compressed (supported algorithm)	RECOVERED ERROR
compressed (unsupported algorithm A)	compressed (unsupported algorithm B)	MEDIUM ERROR

On any of the boundary conditions that results in a "Check Condition" status, the Additional Sense Code shall be set to either DECOMPRESSION EXCEPTION SHORT ALGORITHM ID OF NN (id the algorithm identifier & 255) or DECOMPRESSION EXCEPTION LONG ALGORITHM ID. The Device shall, in both cases, set the decompression algorithm field to the algorithm identifier of the compression algorithm used to process the encountered data. The Device shall be positioned on the **EOP** side of the encountered data, and the Command-Specific Information field in the sense data shall contain the count of the number of data blocks contained within the encountered data.

Implementor's Note: *When compressed data is encountered on the medium that the Device cannot decompress, the Device should treat the data as uncompressed. In the sense data, the Valid bit, the ILI bit, and the Information field should be set to reflect the uncompressed block information.*

A **RED** field of 3 is undefined and shall result in a "Check Condition" status with the Sense Key set to ILLEGAL REQUEST.

The **Compression algorithm** field indicates the compression algorithm the Device shall use to process the data sent to it by the Host when the DCE bit is set to one. If the Host selects an algorithm the Device does not support the Device shall return a "Check Condition" status. The Sense Key shall be set to ILLEGAL REQUEST. A value of zero shall indicate that no compression algorithm is currently selected.

For the MODE SELECT command, the **Decompression Algorithm** field indicates the decompression algorithm selected by the Host for use in subsequent decompression of data encountered on the medium. For Devices capable of the automatic recognition of the compression algorithm used to process data encountered on the medium, the decompression algorithm selected by the Host may be ignored, or overridden by the Device for a subsequent read operation if the selected value does not match the compression algorithm detected by the Device, which was used to process the data encountered on the medium.

For the MODE SENSE command, the **Decompression Algorithm** field reflects the algorithm selected by the Host. For some Devices, the **Decompression Algorithm** value returned in response to a MODE SENSE command may change dynamically to match the compression algorithm, detected by the Device, which was used to process the data most recently encountered on the medium, during a read operation. A value of zero shall indicate the data encountered on the medium during the most recent read operation was

uncompressed. Table 5-43 shows the compression algorithm identifiers registered under the International Register of Processing Algorithms [to be] established by ISO/IEC JTC1.

Table 5-43 Compression Algorithm Identifier

Algorithm Identifier	Description
00h	No Algorithm Selected (Identifies uncompressed data)
01h	Unused
02h - 0Fh	Not assigned
10h	IBM IDRC Data Compaction Algorithm
11h - 1Fh	Not assigned
20h	DCLZ Data Compaction Algorithm
21h - FDh	Not assigned
FEh	Reserved
FFh	Unregistered Algorithm
100h - FFFFFFFFh	Reserved

5.6.8.4.Medium Partition Page Code 11h

Table 5-44 Medium Partition Page ***6. 6. 6. 6. 6. 6.***

Bit Byte	7	6	5	4	3	2	1	0
0	PS	Reserved	Page Code (11h)					
1	Page Length (6)							
2	0 (Maximum Additional Partitions)							
3	0 (Additional Partitions Defined)							
4	FDP	0 (SDP)	0 (IDP)	00 (PSUM)		Reserved		
5	Medium Format Recognition							
6	Reserved							
7	Reserved							

This page is used to specify the medium partitions.

A **F**ixed **D**ata **P**artitions (**FDP**) bit of one indicates that the Device assigns partitions based on its fixed definition of partitions. Setting this bit to one may only be valid at **beginning-of-partition**.

Implementor's Note:

1. *The **FDP** bit is used to indicate that the Device will assign partitions based on a pre-defined (format-specific) definition of the data and directory partitions.*
2. *If the **FDP** bit is set to one, the Device shall implement a maximum of two partitions for the QFA function (a data partition 0 and a directory partition 1).*
3. *The **FDP** bit cannot be changed when the tape is positioned away from **BOT**.*
4. *Devices indicate support for QFA through the Capabilities and Mechanical Status page.*
5. *If the Device can detect that an inserted cartridge has been previously recorded as a QFA tape, the Device shall report the **FDP** bit as a one in Mode Sense. If the Host issues a write command from the BOT position without first issuing a Mode Select or Mode Sense, the **FDP** bit is reported as a zero and the tape will not be partitioned. This may require new bursts be written.*

***Implementor's Note:** Since defining partitions may require re-formatting the medium for some implementations, an implicit write to the medium may occur as a result of a MODE SELECT command that supplies any of these parameters.*

The **Medium Format Recognition** field is a Device-defined value indicating the Device's capability to automatically identify the medium format and partition information when reading an unknown volume.

Table 5-45 Medium Format Recognition Field

Value	Meaning
00h	Incapable of format or partition recognition.
01h	Capable of format recognition only.
02h	Capable of partition recognition only.
03h	Capable of format and partition recognition.
04h-FFh	Reserved.

Implementor's Note: *If a Device indicates that it is not capable of medium format recognition, the Host must supply all necessary parameters for the Device to identify the specific format. The value in this field may be different following a medium change.*

5.6.8.5.Capabilities and Mechanical Status Page Code 2Ah

Table 5-46 Capabilities and Mechanical Status Page ***6. 6. 6. 6. 6. 6. 6.***

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved		Page Code (2Ah)					
1	Page Length (12h)							
2	Reserved							
3	Reserved							
4	Reserved	Reserved	SPREV	Reserved	Reserved	Reserved	Reserved	RO
5	Reserved	Reserved	QFA	Reserved	EFMT	Reserved	Reserved	Reserved
6	CMPRS	ECC	Reserved	DISCONNECT	EJECT	PREVENT	LOCKED	LOCK
7	Reserved	Reserved	Reserved	Reserved	Reserved	BLK1024	BLK512	Reserved
8	(MSB) Maximum Speed Supported (in KBps)							
9								(LSB)
10	Reserved							
11								
12	(MSB) Continuous Transfer Limit (in blocks)							
13								(LSB)
14	(MSB) Current Speed Selected (in Kbps)							
15								(LSB)
16	(MSB) Buffer Size (in 512 bytes)							
17								(LSB)
18	Reserved							
19								

If the **SPREV** bit is set, the Devices supports SPACE in the reverse direction.

If the **RO** bit is set, the Device is operating in a read only mode. This bit does not reflect the state of the write protect mechanism of the cartridge which is indicated by the WP bit in the Mode Page Header.

If the **QFA** bit is set, the Device supports a two partition format which may be used for quick file access.

If the **EFMT** bit is set, the Device supports ERASE command initiated formatting.

If the **CMPRS** bit is set, the Device supports data compression.

If the **ECC** bit is set, the Device performs error correction.

If the **DISCONNECT** bit is set to one, the Device can efficiently break up data transfers without the need to restrict transfer lengths to the **Continuous Transfer Limit**.

If the **EJECT** bit is set, the Device can mechanically unload the volume with the LOAD/UNLOAD command.

If the **PREVENT** bit is set, the Device defaults in the Prevent state after power up.

If the **LOCKED** bit is set, the volume is locked.

If the **LOCK** bit is set, the Device supports locking the volume using the ALLOW/PREVENT MEDIUM REMOVAL command which are optional commands not listed in this specification.

If the **BLK1024** bit is set, the Device is capable of using a 1024 byte block size.

If the **BLK512** bit is set, the Device is capable of using a 512 byte block size.

The **Maximum Speed Supported** field indicates the maximum data rate the Device supports. This value is returned in 1000 bytes per second units which corresponds to the maximum sustained data transfer rate the Device is capable of without consideration of data compression.

The **Continuous Transfer Limit** field indicates the number of blocks for the current block size that can be transferred without delay due to a buffer limitation. Transfers restricted to this size when **DISCONNECT** is set to zero will result in efficient use of the bus.

The **Current Speed Selected** field indicates the actual data rate that the Device is currently using this value is return as 1000 bytes per second that the data is transferred between the Host and the Device.

The **Buffer Size** is an estimate in 512 byte increments of the read and write buffer size.

5.6.9. READ Command

The READ command requests that the Device transfer one or more block(s) of data to the Host beginning with the current block.

Table 5-47 Read Command *6. 6. 6. 6. 6. 6. 6.*

Bit Byte	7	6	5	4	3	2	1	0
0	Operation code (08h)							
1	Reserved						Reserved (SILI)	1 (Fixed)
2	(MSB)							
3	Transfer Length							
4								(LSB)
5	Reserved							

The **Transfer Length** specifies the number of fixed-length blocks to be transferred, using the current block length reported in the mode parameters block descriptor.

A successful READ command shall transfer the requested **Transfer Length** times the current block length in bytes. Upon completion, the logical position shall be after the last block transferred (**end-of-partition** side).

If an incorrect length block is read, "Check Condition" status shall be returned and the ILI and Valid bits shall be set to one in the sense data. Upon termination, the logical position shall be after the incorrect length block (**end-of-partition** side). The Information field shall be set to the difference (residue) of the requested **Transfer Length** minus the actual number of blocks read (not including the incorrect length block).

A **Transfer Length** of zero indicates that no data shall be transferred. This condition shall not be considered an error and the logical position shall not be changed but the Device shall start a read ahead mode of operation.

If the Device encounters a filemark during a READ command, "Check Condition" status shall be returned and the filemark and Valid bits shall be set to one in the sense data. The Sense Key shall be set to NO SENSE or RECOVERED ERROR, as appropriate. Upon termination, the logical position shall be after the filemark (**end-of-partition** side). The Information field shall be set to the difference (residue) of the requested **Transfer Length** minus the actual number of blocks read (not including the filemark).

Upon termination, the logical position shall be after the last block transferred or the block with an unrecoverable read error (**end-of-partition** side). The Information field shall be set to the difference (residue) of the requested **Transfer Length** minus the actual number of blocks read.

If the Device encounters **end-of-data** during a READ command, "Check Condition" status shall be returned, the Sense Key shall be set to BLANK CHECK, and the Valid bit shall be set to one in the sense data. If **end-of-data** is encountered at or after **early-warning**, the EOM bit shall also be set to one. Upon termination, the logical position shall be after the last recorded logical block (**end-of-partition** side). The Information field shall be set to the difference (residue) of the requested **Transfer Length** minus the actual number of blocks read.

If the Device encounters **end-of-partition** during a READ command, "Check Condition" status shall be returned, the Sense Key shall be set to MEDIUM ERROR, and the EOM and Valid bits shall be set to one in the sense data. The medium position following this condition is not defined. The Information field shall be set to the difference (residue) of the requested **Transfer Length** minus the actual number of blocks read.

Table 5-48 Recommended Sense Key, ASC and ASCQ for READ Errors

Sense Key	ASC	ASCQ	Description of Error
00	00	01	FILEMARK DETECTED
00	00	02	END OF PARTITION/MEDIUM DETECTED
00	00	05	END-OF-DATA DETECTED
02	04	00	NOT READY, CAUSE NOT REPORTABLE
02	3A	00	MEDIUM NOT PRESENT
03	11	00	UNRECOVERED READ ERROR
05	20	00	INVALID COMMAND OPERATION CODE
05	24	00	INVALID FIELD IN CDB
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON RESET OR DEVICE RESET OCCURRED
06	2A	01	MODE PARAMETERS CHANGED

5.6.10. READ POSITION Command

The READ POSITION command reports the current logical position of the Device. No medium movement shall occur as a result of the command.

Table 5-49 Read Position Command *6. 6. 6. 6. 6. 6. 6.*

Bit Byte	7	6	5	4	3	2	1	0
0	Operation code (34h)							
1	Reserved							
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	Reserved							
8	Reserved							
9	Reserved							

The READ POSITION data shown in Table 5-50 shall be returned as data after the command.

Table 5-50 Read Position Data Format *6. 6. 6. 6. 6. 6. 6.*

Bit Byte	7	6	5	4	3	2	1	0
0	BOP	EOP	Reserved					
1	Partition Number							
2	Reserved							
3	Reserved							
4	(MSB) Block Address							
5								
6								
7								(LSB)
8-19	Reserved							

A **B**eginning **O**f **P**artition (**BOP**) bit of one indicates that the Device is at the **beginning-of-partition** in the current partition. A **BOP** bit of zero indicates that the current logical position is not at the **beginning-of-partition**.

An **E**nd **O**f **P**artition (**EOP**) bit of one indicates that the Device is positioned between **early-warning** and **end-of-partition** in the current partition. An **EOP** bit of zero indicates that the current logical position is not between **early-warning** and **end-of-partition**.

***Implementor's Note**: The **BOP** and **EOP** indications are not necessarily a result of a physical tape marker (e.g., reflective marker or hole).*

The **Partition Number** field reports the partition number for the current logical position. If the Device only supports one partition for the medium, this field shall be set to zero.

The **Block Address** field indicates the logical block address associated with the current position. This value shall indicate the block address of the data block to be transferred between the Host and the Device if a READ or WRITE command is issued. See the *Blocks* section on page 6 for information on blocks.

Table 5-51 Recommended Sense Key, ASC and ASCQ for READ POSITION Errors

Sense Key	ASC	ASCQ	Description of Error
02	04	00	NOT READY, CAUSE NOT REPORTABLE
02	3A	00	MEDIUM NOT PRESENT
04	15	00	RANDOM POSITIONING ERROR
05	20	00	INVALID COMMAND OPERATION CODE
05	24	00	INVALID FIELD IN CDB
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON RESET OR DEVICE RESET OCCURRED
06	2A	01	MODE PARAMETERS CHANGED

5.6.11. REQUEST SENSE Command

The REQUEST SENSE command requests that the Device transfer sense data to the Host.

Table 5-52 Request Sense Command *6. 6. 6. 6. 6. 6.*

Bit Byte	7	6	5	4	3	2	1	0
0	Operation code (03h)							
1	Reserved							
2	Reserved							
3	Reserved							
4	Allocation Length							
5	Reserved							

The sense data:

1. shall be available if an error condition (“Check Condition”) had previously been reported to the Host;
2. shall be available if other information (e.g. medium position) is available in any field.

If the Device has no other 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 Device until retrieved by a REQUEST SENSE command or until the receipt of any other I/O Command. The Device shall return “Check Condition” status for a REQUEST SENSE command only to report exception conditions specific to the command itself. Example: a Device malfunction preventing return of the sense data.

If a recovered error occurs during the execution of the REQUEST SENSE command, the Device shall return the sense data with “Good” status. If a Device returns “Check Condition” status for a REQUEST SENSE command, the sense data may be invalid.

Devices shall be capable of returning at least 20 bytes of data in response to a REQUEST SENSE command. If the allocation length is 20 or greater, and a Device returns less than 20 bytes of data, the Host should assume that the bytes not transferred would have been zeros had the Device returned those bytes. The host can determine how much sense data has been returned by examining the allocation length parameter in the CDB and the additional sense length in the sense data. Devices shall not adjust the additional sense length to reflect truncation if the allocation length is less than the sense data available.

The sense data format for error codes 70h (current errors) and 71h (deferred errors) are defined in Table 5-53 Request Sense Standard Data. Error code values of 72h to 7Eh are reserved. Error code 7Fh is for a vendor-specific sense data format. Devices shall implement error code 70h; implementation of error code 71h is optional. Error code values of 00h to 6Fh are not defined by this Specification and their use is not recommended.

Table 5-53 Request Sense Standard Data

Bit Byte	7	6	5	4	3	2	1	0
0	Valid	Error Code (70h or 71h)						
1	Reserved (Segment Number)							
2	Filemark	EOM	ILI	Reserved	Sense Key			
3	(MSB)							
4	Information							
5								
6								(LSB)
7	Additional Sense Length (n - 7)							
8-11	Command Specific Information (Optional)							
12	Additional Sense Code							
13	Additional Sense Code Qualifier							
14	Field Replaceable Unit Code (Optional)							
15	SKSV (Optional)	Sense Key Specific (Optional)						
16-17	Sense Key Specific (Optional)							
18	Additional Sense Bytes							
n								

[**Editor's Note:** Due to hardware restrictions all sense data should be padded to a multiple of 4 bytes.]

A **Valid** bit of zero indicates that the **Information** field is not as defined in this Specification. A **Valid** bit of one indicates the **Information** field contains valid information as defined in this Specification. Devices shall implement the **Valid** bit.

The Segment Number field is Reserved.

A **Filemark** bit of one indicates that the current command has read a filemark.

A **end-of-medium** (**EOM**) bit of one indicates that an **end-of-medium** condition (**end-of-partition**, **beginning-of-partition**, out-of-paper, etc.) exists. For Streaming Tape Devices, this bit indicates that the unit is at or past the **early-warning** if the direction was forward or that the command could not be completed because **beginning-of-partition** was encountered if the direction was reverse.

An **I**ncorrect **L**ength **I**ndicator (**ILI**) bit of one indicates that the requested allocation length or selected blocks size did not match the logical block length of the data on the medium.

The **Sense Key**, **Additional Sense Code** and **Additional Sense Code Qualifier** provide a hierarchy of information. The intention of the hierarchy is to provide a top-down approach for the Host to determine information relating to the error and exception conditions. The **Sense Key** provides generic categories in which error and exception conditions can be reported. The Host would typically use the Sense Key for high-level error recovery procedures. **Additional Sense Code** provides further detail describing the **Sense Key**. **Additional Sense Code Qualifier** adds further detail to the **Additional Sense Code**. The **Additional Sense Code** and **Additional Sense Code Qualifier** can be used by the Host where sophisticated error recovery procedures require detailed information describing the error and exception conditions.

The **Sense Key** field indicates generic information describing an error or exception condition. The sense keys are defined in Table 5-56 Sense Key Descriptions on page 48.

The content of the **Information** field is command-specific and is defined within the appropriate section for the command of interest. Devices shall implement the **Information** field. Unless specified otherwise, when the **Valid** bit is one, this field contains the difference between the number

of blocks requested by the command or commands and the actual number of blocks and filemarks transferred to or from the medium, the residue.

The **Additional Sense Length** field indicates the number of additional sense bytes to follow. If the allocation length of the CDB is too small to transfer all of the additional sense bytes, the **Additional Sense Length** is not adjusted to reflect the truncation.

The **Command-Specific Information** field contains information that depends on the command that was executed. Further meaning for this field is defined within the command description.

The **Additional Sense Code** (**ASC**) field indicates further information related to the error or exception condition reported in the **Sense Key** field. Devices shall support the **Additional Sense Code** field. Support of the additional sense codes not explicitly required by this specification is optional. A list of additional sense codes is defined in Table 5-57. If the Device does not have further information related to the error or exception condition, the **Additional Sense Code** is set to NO ADDITIONAL SENSE INFORMATION.

The **Additional Sense Code Qualifier** (**ASCQ**) indicates detailed information related to the **Additional Sense Code**. If the error or exception condition is reportable by the Device, the value returned shall be as specified in the command descriptions. If the Device does not have detailed information related to the error or exception condition, the **ASCQ** is set to zero.

Non-zero values in the **Field Replaceable Unit Code** field are used to define a Device-specific mechanism or unit that has failed. A value of zero in this field shall indicate that no specific mechanism or unit has been identified to have failed or that the data is not available. The **F**ield **Replaceable Unit Code** field is optional. The format of this information is not specified by this Specification.

The **Additional Sense Bytes** field may contain command specific data, peripheral Device specific data, or vendor-specific data that further defines the nature of the “Check Condition” status.

5.6.11.1. Sense-key Specific

The **S**ense-**K**ey **S**pecific field is defined by this Specification when the value of the **S**ense-**K**ey **S**pecific **V**alid (**SKSV**) bit is one. The **S**ense-**K**ey **S**pecific **V**alid bit and **S**ense-**K**ey **S**pecific field are optional. The definition of this field is determined by the value of the **Sense Key** field. This field is reserved for sense keys not described below. An **SKSV** value of zero indicates that this field is not as defined by this Specification.

If the **Sense Key** field is set to ILLEGAL REQUEST and the **SKSV** bit is set to one, the sense-key specific field indicates which illegal parameters in the CDB or the data parameters are in error.

Table 5-54 Field Pointer Bytes *6. 6. 6. 6. 6. 6. 6.*

Bit Byte	7	6	5	4	3	2	1	0
15	SKSV	C/D	Reserved	Reserved	BPV	Bit Pointer		
16	(MSB)	Field Pointer						
17								(LSB)

A **C**ommand **D**ata (**C/D**) bit of one indicates that the illegal parameter is in the CDB. A **C/D** bit of zero indicates that the illegal parameter is in the data parameters sent by the Host.

A **B**it **P**ointer **V**alid (**BPV**) bit of zero indicates that the value in the **Bit Pointer** field is not valid. A **BPV** bit of one indicates that the **Bit Pointer** field specifies which bit of the byte designated by the **Field Pointer** field is in error. When a multiple-bit field is in error, the **Bit Pointer** field shall point to the most-significant (left-most) bit of the field.

The **Field Pointer** field indicates which byte of the CDB 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 is in error, the pointer shall point to the most significant (left-most) byte of the field.

If the Sense Key is RECOVERED ERROR, HARDWARE ERROR or MEDIUM ERROR and if the **SKSV** bit is one, the sense-key specific field shall be as shown in Table 5-55 Field Pointer Bytes.

Table 5-55 Field Pointer Bytes ***6. 6. 6. 6. 6. 6. 6.***

Bit Byte	7	6	5	4	3	2	1	0
15	SKSV	C/D	Reserved	Reserved	BPV	Bit Pointer		
16	(MSB)	Actual Retry Count						
17								(LSB)

The **Actual Retry Count** field returns implementation-specific information on the actual number of retries of the recovery algorithm used in attempting to recover an error or exception condition.

5.6.11.2. Deferred Errors

Error code 70h indicates that the “Check Condition” status returned is the result of an error or exception condition on the I/O process that returned the “Check Condition” status. This includes errors generated during execution of the command by the actual execution process. It also includes errors not related to any command that are first observed during execution of a command. Examples of this latter type of error include a servo-mechanism, off-track errors, and power-up test errors.

Error code 71h (deferred error) indicates that the “Check Condition” status returned is the result of an error or exception condition that occurred during execution of a previous command for which “Good” status has already been returned. Such commands are associated with use of the Immediate bit, with some forms of caching, and with multiple command buffering. Devices that implement these features are required to implement deferred error reporting.

The deferred error may be indicated by returning “Check Condition” status to the Host as described below. The subsequent execution of a REQUEST SENSE command shall return the deferred error sense information. If an I/O Command terminates with “Check Condition” status and the subsequent sense data returns a deferred error, that I/O command shall **not** have been executed. After the Device detects a deferred error condition, it shall return a deferred error according to the rules described below:

1. If a deferred error can be recovered with no external system intervention, a deferred error indication shall not be set unless required by the error handling parameters of the MODE SELECT command. The occurrence of the error may be logged if statistical or error logging is supported.
2. If a deferred error can be associated with a particular function or a particular subset of data, and the error is either unrecovered or required to be reported by the mode parameters, a deferred error indication shall be returned to the Host.

Deferred errors may indicate that an operation was unsuccessful long after the command performing the data transfer returned “Good” status. If data that cannot be replicated or recovered from other sources is being stored using buffered write operations, synchronization commands should be performed before the critical data is destroyed in the Host. This is necessary to be sure that recovery actions can be taken if deferred errors do occur in the storing of the data.

5.6.11.3. Sense-key and Sense Code Definitions

Table 5-56 Sense Key Descriptions 6.

Sense key	Description
0h	NO SENSE. Indicates that there is no specific Sense Key information to be reported. This would be the case for a successful command.
1h	RECOVERED ERROR. Indicates that the last command completed successfully with some recovery action performed by the Device. Details may be determinable by examining the additional sense bytes and the Information field. When multiple recovered errors occur during one command, the choice of which error to report (first, last, most severe, etc.) is Device specific.
2h	NOT READY. Indicates that the Device cannot be accessed. Operator intervention may be required to correct this condition.
3h	MEDIUM ERROR. Indicates that the command terminated with a non-recovered error condition that was probably caused by a flaw in the medium or an error in the recorded data. This Sense Key may also be returned if the Device is unable to distinguish between a flaw in the medium and a specific hardware failure (Sense Key 4h).
4h	HARDWARE ERROR. Indicates that the Device detected a non-recoverable hardware failure (for example, controller failure, Device failure, parity error, etc.) while performing the command or during a self test.
5h	ILLEGAL REQUEST. Indicates that there was an illegal parameter in the CDB or in the additional parameters supplied as data for some commands. If the Device detects an invalid parameter in the CDB, then it shall terminate the command without altering the medium. If the Device detects an invalid parameter in the additional parameters supplied as data, then the Device may have already altered the medium.
6h	UNIT ATTENTION. Indicates that the removable medium may have been changed or the Device has been reset.
7h	DATA PROTECT. Indicates that a command that reads or writes the medium was attempted on a block that is protected from this operation. The read or write operation is not performed.
8h	BLANK CHECK. Indicates that while reading either blank medium or format defined **end-of-data** was encountered or, for a write-once device while writing, non-blank medium was encountered.
9h - Ah	Reserved
Bh	ABORTED COMMAND. Indicates that the Device has aborted the command. The Host may be able to recover by trying the command again. This error is reported for conditions such as an overrun etc.
Dh	VOLUME OVERFLOW. Indicates a write operation was unable to complete a transfer.
Eh - Fh	Reserved

5.6.11.4. Using the REQUEST SENSE Command

Whenever an Error is reported, the Host should issue a REQUEST SENSE command to receive the sense data describing what caused the Error condition. If the Host issues some other command, the sense data is lost.

Table 5-57 ASC and ASCQ Assignments

ASC	ASCQ	Description
00	00	NO ADDITIONAL SENSE INFORMATION
00	01	FILEMARK DETECTED
00	02	END-OF-PARTITION/MEDIUM DETECTED
00	04	BEGINNING-OF-PARTITION/MEDIUM DETECTED
00	05	END-OF-DATA DETECTED
03	00	PERIPHERAL DEVICE WRITE FAULT
03	01	NO WRITE CURRENT
03	02	EXCESSIVE WRITE ERRORS
04	00	NOT READY, CAUSE NOT REPORTABLE
04	01	IN PROCESS OF BECOMING READY
04	02	NOT READY, INITIALIZING COMMAND REQUIRED
04	03	NOT READY, MANUAL INTERVENTION REQUIRED
04	04	NOT READY, FORMAT IN PROGRESS
08	00	COMMUNICATION FAILURE
08	01	COMMUNICATION TIME-OUT
09	00	TRACK FOLLOWING ERROR
0A	00	ERROR LOG OVERFLOW
0C	00	WRITE ERROR sense key says whether recovered
11	00	UNRECOVERED READ ERROR
11	01	READ RETRIES EXHAUSTED
11	02	ERROR TOO LONG TO CORRECT
11	03	MULTIPLE READ ERRORS
11	08	INCOMPLETE BLOCK READ (POSTAMBLE NOT FOUND)
11	09	NO GAP FOUND
11	0A	MISCORRECTED ERROR
14	00	RECORDED ENTITY NOT FOUND
14	01	RECORD NOT FOUND
14	02	FILEMARK NOT FOUND
14	03	END-OF-DATA NOT FOUND
14	04	BLOCK SEQUENCE ERROR
15	00	RANDOM POSITIONING ERROR
15	01	MECHANICAL POSITIONING ERROR
15	02	POSITIONING ERROR DETECTED BY READ OF MEDIUM
17	00	RECOVERED DATA WITH NO ERROR CORRECTION APPLIED
17	01	RECOVERED DATA WITH RETRIES
17	02	RECOVERED DATA WITH POSITIVE HEAD OFFSET
17	03	RECOVERED DATA WITH NEGATIVE HEAD OFFSET
18	00	RECOVERED DATA WITH ERROR CORRECTION APPLIED
19	00	DEFECT LIST ERROR
1A	00	PARAMETER LIST LENGTH ERROR
20	00	INVALID COMMAND OPERATION CODE
21	00	LOGICAL BLOCK ADDRESS OUT OF RANGE
24	00	INVALID FIELD IN CDB check field pointer in sense data
25	00	LOGICAL UNIT NOT SUPPORTED
26	00	INVALID FIELD IN PARAMETER LIST check field pointer is sense data
26	01	PARAMETER NOT SUPPORTED check field pointer is sense data
26	02	PARAMETER VALUE INVALID check field pointer in sense data
26	03	THRESHOLD PARAMETERS NOT SUPPORTED

27	00	WRITE PROTECTED
28	00	NOT READY TO READY TRANSITION medium may have changed
2A	00	PARAMETERS CHANGED
2A	01	MODE PARAMETERS CHANGED
2D	00	OVERWRITE ERROR ON UPDATE IN PLACE
29	00	POWER ON RESET OR DEVICE RESET OCCURRED
30	00	INCOMPATIBLE MEDIUM INSTALLED
30	01	CANNOT READ MEDIUM - UNKNOWN FORMAT
30	02	CANNOT READ MEDIUM - INCOMPATIBLE FORMAT
30	03	CLEANING CARTRIDGE INSTALLED
31	00	MEDIUM FORMAT CORRUPTED
33	00	TAPE LENGTH ERROR
37	00	ROUNDED PARAMETER
39	00	SAVING PARAMETERS NOT SUPPORTED
3A	00	MEDIUM NOT PRESENT
3B	00	SEQUENTIAL POSITIONING ERROR
3B	01	TAPE POSITION ERROR AT BEGINNING-OF-MEDIUM
3B	02	TAPE POSITION ERROR AT END-OF-MEDIUM
3B	08	REPOSITION ERROR
3E	00	NOT SELF-CONFIGURED YET
3F	00	OPERATING CONDITIONS HAVE CHANGED
3F	01	MICROCODE HAS BEEN CHANGED
3F	03	INQUIRY DATA HAS CHANGED
40	NN	DIAGNOSTIC FAILURE ON COMPONENT NN (80H-FFH)
44	00	INTERNAL FAILURE
46	00	UNSUCCESSFUL DEVICE RESET
4C	00	FAILED SELF-CONFIGURATION
4E	00	OVERLAPPED COMMANDS ATTEMPTED
50	00	WRITE APPEND ERROR
50	01	WRITE APPEND POSITION ERROR
50	02	POSITION ERROR RELATED TO TIMING
51	00	ERASE FAILURE (FORMAT FAILURE)
52	00	CARTRIDGE FAULT
53	00	MEDIA LOAD/EJECT FAILED
53	01	UNLOAD TAPE FAILURE
53	02	MEDIUM REMOVAL PREVENTED
5A	00	OPERATOR REQUEST OR STATE CHANGE INPUT (UNSPECIFIED)
5A	01	OPERATOR MEDIUM REMOVAL REQUEST
5A	02	OPERATOR SELECTED WRITE PROTECT
5A	03	OPERATOR SELECTED WRITE PERMIT
5B	00	LOG EXCEPTION
5B	01	THRESHOLD CONDITION MET
5B	02	LOG COUNTER AT MAXIMUM
5B	03	LOG LIST CODES EXHAUSTED
70	NN	DECOMPRESSION EXCEPTION SHORT ALGORITHM ID OF NN
71	00	DECOMPRESSION EXCEPTION LONG ALGORITHM ID
80-FF	80-FF	Vendor Unique

ALL CODES NOT SHOWN ARE RESERVED.

Table 5-58 Recommended Sense Key, ASC and ASCQ for REQUEST SENSE Errors

Sense Key	ASC	ASCQ	Description of Error
05	20	00	INVALID COMMAND OPERATION CODE
05	24	00	INVALID FIELD IN CDB
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON, RESET OR DEVICE RESET OCCURRED

5.6.12. REWIND Command

The REWIND command causes the Device to position to the **beginning-of-partition** in the current partition. Prior to performing the rewind operation, the Device shall ensure that all buffered data and filemarks have been transferred to the medium.

Table 5-59 Rewind Command *6. 6. 6. 6. 6. 6. 6.*

Bit Byte	7	6	5	4	3	2	1	0
0	Operation code (01h)							
1	Reserved							Immed
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							

An **Immed** (immediate) bit of zero indicates the Device shall not return status until the operation has completed. An **Immed** bit of one indicates that the target shall return status as soon as all buffered commands have completed execution and the CDB has been validated. If CHECK CONDITION status is returned when the **Immed** bit is set to one, the operation shall not be performed.

Table 5-60 Recommended Sense Key, ASC and ASCQ for REWIND Errors *6. 6. 6.*

Sense Key	ASC	ASCQ	Description of Error
02	04	00	NOT READY, CAUSE NOT REPORTABLE
02	3A	00	MEDIUM NOT PRESENT
04	15	00	RANDOM POSITIONING ERROR
05	20	00	INVALID COMMAND OPERATION CODE
05	24	00	INVALID FIELD IN CDB
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON RESET OR DEVICE RESET OCCURRED
06	2A	01	MODE PARAMETERS CHANGED

5.6.13. SPACE Command

The SPACE command is used to position to a relative filemark or to end of data depending on the Count and Code. Both forward and reverse filemark positioning are provided. If the Device does not support the reverse direction, then a SPACE command in the reverse direction shall be terminated with a "Check Condition" and the Sense Key shall be set to ILLEGAL REQUEST.

Table 5-61 Space Command ***6. 6. 6. 6. 6. 6. 6.***

Bit Byte	7	6	5	4	3	2	1	0
0	Operation code (11h)							
1	Reserved					Code		
2	(MSB)							
3	Count							
4								(LSB)
5	Reserved							

Table 5-62 Space Code

Code	Description
000b	Reserved
001b	Filemarks
010b	Reserved
011b	End of Data
100b-111b	Reserved

When spacing over filemarks, the **Count** field specifies the number of filemarks to be spaced over in the current partition. A positive value N in the **Count** field shall cause forward positioning (toward **end-of-partition**) over N filemarks ending on the **end-of-partition** side of the last filemark. A zero value in the **Count** field shall cause no change of logical position. A negative value -N (two's complement notation) in the **Count** field shall cause reverse positioning (toward **beginning-of-partition**) over N filemarks ending on the **beginning-of-partition** side of the last filemark.

Implementor's Note: *Reverse movement is intended for small changes in position. Some Devices may not support space reverse.*

If **end-of-data** is encountered while spacing over filemarks, "Check Condition" status shall be returned, the Sense Key shall be set to BLANK CHECK, and the Valid bit shall be set to one in the sense data. Additionally, the **EOM** bit shall be set to one if **end-of-data** is encountered at or after **early-warning**. The Information field shall be set to the difference (residue) of the requested count minus the actual number of filemarks spaced over.

If the **end-of-partition** is encountered while spacing forward over filemarks, "Check Condition" status shall be returned, the Sense Key shall be set to MEDIUM ERROR, the EOM bit shall be set to one, and the Valid bit shall be set to one. The Information field shall be set to the difference (residue) of the requested count minus the actual number of filemarks spaced over.

If **beginning-of-partition** is encountered while spacing over filemarks in the reverse direction, "Check Condition" status and the Sense Key to NO SENSE shall be set. The EOM and Valid bits shall be set to one, and the Information field set to the total number of filemarks not spaced over (the requested number of filemarks minus the actual number of filemarks spaced over).

When spacing to **end-of-data**, the count field is ignored. Upon successful completion, the medium shall be positioned such that a subsequent write operation would append to the last logically recorded information.

If **end-of-partition** is encountered while spacing to **end-of-data**, “Check Condition” status shall be returned, the Sense Key shall be set to MEDIUM ERROR, the EOM bit shall be set to one, and the Valid bit shall be set to zero.

Table 5-63 Recommended Sense Key, ASC and ASCQ for SPACE Errors

Sense Key	ASC	ASCQ	Description of Error
00	00	01	FILEMARK DETECTED
00	00	05	END-OF-DATA DETECTED
02	04	00	NOT READY, CAUSE NOT REPORTABLE
02	3A	00	MEDIUM NOT PRESENT
04	15	00	RANDOM POSITIONING ERROR
05	20	00	INVALID COMMAND OPERATION CODE
05	24	00	INVALID FIELD IN CDB
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON RESET OR DEVICE RESET OCCURRED
06	2A	01	MODE PARAMETERS CHANGED

5.6.14. TEST UNIT READY Command

The TEST UNIT READY command provides a means to check if the Device is ready. This is not a request for a self-test. If the Device would accept an appropriate medium-access command without returning “Check Condition” status, this command shall return a “Good” status. If the Device cannot become operational or is in a state such that Host action is required to make the unit ready, the Device shall return “Check Condition” status with a Sense Key of NOT READY.

Table 5-64 Test Unit Ready Command *6. 6. 6. 6. 6. 6.*

Bit Byte	7	6	5	4	3	2	1	0
0	Operation code (00h)							
1	Reserved							
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							

5.6.14.1. Using the TEST UNIT READY Command

The TEST UNIT READY command is useful in that it allows the Host to poll a Device until it is ready without the need to allocate space for returned data. It is especially useful to check cartridge status. Devices are expected to respond promptly to indicate the current status of the Device.

If a prior command is running upon receipt of this command such as an erase or rewind, the device shall report check condition with sense key 2 (NOT READY) and ASC/ASQ=04h/01h.

Table 5-65 Recommended Sense Key, ASC and ASCQ for TEST UNIT READY Errors *6. 6. 6.*

Sense Key	ASC	ASCQ	Description of Error
00	00	00	NO ADDITIONAL SENSE INFORMATION
05	20	00	INVALID COMMAND OPERATION CODE
05	24	00	INVALID FIELD IN CDB
02	04	00	NOT READY - CAUSE NOT REPORTABLE
02	04	01	NOT READY - IN PROGRESS OF BECOMING READY
02	04	02	NOT READY - INITIALIZING COMMAND REQUIRED
02	04	03	NOT READY - MANUAL INTERVENTION REQUIRED
02	04	04	NOT READY - FORMAT IN PROGRESS
02	3A	00	MEDIUM NOT PRESENT
03	-	-	Deferred medium error
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON RESET OR DEVICE RESET OCCURRED
06	2A	01	MODE PARAMETERS CHANGED

5.6.15. WRITE Command

The WRITE command requests that the Device write the data that is transferred from the Host starting at the current position.

Table 5-66 Write Command *6. 6. 6. 6. 6. 6. 6.*

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation code (0Ah)							
1	Reserved							1 (Fixed)
1	Reserved							
2	(MSB) Transfer Length							
3								
4								(LSB)
5	Reserved							

The **Transfer Length** specifies the number of fixed-length blocks to be transferred using the current block length reported in the mode parameter block descriptor.

If the **Transfer Length** is zero, no data shall be transferred and the current position shall not be changed. This condition shall not be considered an error.

If the Device encounters **early-warning** during a WRITE command, the command shall terminate with "Check Condition" status and the EOM and Valid bits shall be set to one in the sense data. If all data that is to be written is successfully transferred to the medium, the Sense Key shall be set to NO SENSE or RECOVERED ERROR, as appropriate. If any data that is to be written cannot be transferred to the medium when **early-warning** is encountered, the Sense Key shall be set to VOLUME OVERFLOW.

In the case of an unrecovered write error, the Valid bit shall be set to one and the Information field shall be set to the difference (residue) of the sum of the pending requested transfer lengths minus the actual number of blocks and filemarks written. The value in the Information field may exceed the **Transfer Length** for the last command. For formats able to restart a write operation, upon termination, the logical position shall be after the unrecovered block.

Implementor's Note: *The Device should ensure that some additional data can be written to the medium (e.g., labels or filemarks) after writing all data stored in the buffers and the first* ***early-warning*** *indication has been returned to the Host.*

Table 5-67 Recommended Sense Key, ASC and ASCQ for WRITE Errors *6. 6. 6.*

Sense Key	ASC	ASCQ	Description of Error
02	04	00	NOT READY, CAUSE NOT REPORTABLE
02	3A	00	MEDIUM NOT PRESENT
03	0C	00	MEDIUM ERROR: WRITE ERROR
05	20	00	INVALID COMMAND OPERATION CODE
05	24	00	INVALID FIELD IN CDB
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON RESET OR DEVICE RESET OCCURRED
06	2A	01	MODE PARAMETERS CHANGED
07	27	00	WRITE PROTECTED
0D	00	02	VOLUME OVERFLOW: END-OF-PARTITION/MEDIUM DETECTED

5.6.16. WRITE FILEMARK Command

The WRITE FILEMARK command requests that the Device write a filemark to the current position.

Table 5-68 Write Filemark Command *6. 6. 6. 6. 6. 6.*

Bit Byte	7	6	5	4	3	2	1	0
0	Operation code (10h)							
1	Reserved						0 (WSmk)	0 (Immed)
2	0							
3	0							
4	0							Transfer Length
5	Reserved							

The Device shall return status as soon as the command descriptor block has been validated.

A **Transfer Length** of one enables the writing of the filemark. A **Transfer Length** of zero can be also be used to synchronize (flush) any buffered data.

If the Device encounters **early-warning** during WRITE FILEMARK operation, any buffered data or filemarks shall be written to the medium, and a "Check Condition" will exist. If all buffered data, and filemarks are successfully transferred to the medium, the Sense Key will be set to NO SENSE or RECOVERED ERROR, as appropriate.

Implementor's Note: *The Device should ensure that some additional data can be written to the medium (e.g., labels or filemarks) after writing all data stored in the buffers and the first* ***early-warning*** *indication has been returned to the Host.*

In the case of an unrecovered write error, the Valid bit shall be set to one and the Information field shall be set to the difference (residue) of the sum of the pending requested transfer lengths minus the actual number of blocks and filemarks written. The value in the Information field may exceed the **Transfer Length** for the last command.

Table 5-69 Recommended Sense Key, ASC and ASCQ for WRITE FILEMARK Errors *6. 6. 6.*

Sense Key	ASC	ASCQ	Description of Error
02	04	00	NOT READY, CAUSE NOT REPORTABLE
02	3A	00	MEDIUM NOT PRESENT
03	0C	00	MEDIUM ERROR: WRITE ERROR
05	20	00	INVALID COMMAND OPERATION CODE
05	24	00	INVALID FIELD IN CDB
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON RESET OR DEVICE RESET OCCURRED
06	2A	01	MODE PARAMETERS CHANGED
07	27	00	WRITE PROTECTED
0D	00	02	VOLUME OVERFLOW: END-OF-PARTITION/MEDIUM DETECTED

5.7. Glossary for Device

Beginning-of-partition. The position at the beginning of the permissible recording region of a partition. If only one partition is defined, this position is typically equivalent to the beginning-of-medium.

beginning-of-medium. The extreme position along the medium in the direction away from the supply reel which can be accessed by the Device.

command descriptor block (CDB). command packet sent to the Device for execution.

early-warning. A physical mark or Device computed position near but logically before the **end-of-partition** (independent of physical direction).

end-of-data. End of data in a partition is denoted in format-specific manner.

end-of-medium. The extreme position along the medium in the direction away from the take-up reel that can be accessed by the Device.

end-of-partition. The position at the end of the permissible recording region of a partition.

partition. The entire usable region of recording and reading paths in a volume or in a portion of a volume, defined in a Device-specific manner. If there is more than one partition, they shall be numbered starting with zero (i.e., **beginning-of-partition-zero**).

volume. A recording medium together with its physical carrier.

5.8. Vendor Identification List

Vendor Identification List	
ID	Organization
AIWA	Aiwa
CIPHER	Cipher Data Products
COMBYTE	Combyte
CONNER	Conner Peripherals
EXABYTE	Exabyte Corp.
HP	Hewlett Packard
IBM	International Business Machines
IOMEGA	Iomega
NEC	NEC
PERTEC	Pertec Peripheral Corporation
REXON	Rexon
SEAGATE	Seagate
SONY	Sony
TANDBERG	Tandberg Data A/S
TEAC	TEAC Japan