INTERNATIONAL STANDARD

ISO/IEC 9318-4

Second edition
2002-12

Information technology – Intelligent peripheral interface –

Part 4: Device generic command set for magnetic tape drives (IPI-3 tape)

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INFORMATION TECHNOLOGY – INTELLIGENT PERIPHERAL INTERFACE –

Part 4: Device generic command set for magnetic tape drives (IPI-3 tape)

FOREWORD

1) ISO (International Organization for Standardization) and IEC (International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

2) In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

3) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

International Standard ISO/IEC 9318-4 was prepared by subcommittee 25: Interconnection of information technology equipment, of ISO/IEC joint technical committee 1: Information technology.

This second edition cancels and replaces the first edition published in 1990, and constitutes a technical revision. The following items have been added or changed since the first edition:

- revised scope;
- attribute usage was added (subclause 4.10, subsequent clauses were renumbered);
- addition of new parameters for position control command (subclause 7.2).

ISO/IEC 9318-4 complements other Intelligent Peripheral Interface standards.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

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INTRODUCTION

This standard provides a definition of the device-generic command set portion of a series of standards called the Intelligent Peripheral Interface (IPI), a high performance, general-purpose parallel peripheral interface. This standard responds to an industry market need (expressed both by users and manufacturers) to limit the increasing costs in hosts associated with changes in peripherals.

The first five clauses of this standard contain material that is useful across all classes of device that the device-generic command sets can support. Clauses 6 to 12 are oriented to particular device classes and in this document these clauses are intended for use with Magnetic Tape Drives.

Clause 1 describes the scope.

Clause 2 lists the normative references.

Clause 3 provides descriptions of conventions.

Clause 4 describes the Environment of Use and projected application areas.

Clause 5 describes the Message Packet structure used for commands and responses.

Clause 6 describes Control commands.

Clause 7 describes Position commands.

Clause 8 describes the most generic Transfer commands.

Clause 9 describes the Combination Transfer commands, which require a minimum of two sets of extents.

Clause 10 describes the other Transfer commands, which are more device specific than those in clause 8.

Clause 11 describes the Diagnostic commands.

Clause 12 summarizes the commands defined in the document.

Annex A gives an overview of interface levels and concepts.

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INFORMATION TECHNOLOGY – INTELLIGENT PERIPHERAL INTERFACE –

Part 4: Device generic command set for magnetic tape drives (IPI-3 tape)

1 Scope

This part of ISO/IEC 9318 describes the logical level (generic level) interface for tape drives and it provides a definition of the device-generic portion of a family of standards called the Intelligent Peripheral Interface (IPI).

The purpose of this standard is to facilitate the development and utilization of an intelligent interface which permits the interconnection of multiple peripheral types such as disk, tape and communications to a controller.

The intent of the IPI is to isolate the host (CPU), both hardware and software, from changes in peripherals by providing a "function-generic" command set to allow the connection of multiple types of peripherals (disks, printers, tapes, communications). To smooth the transition from the current methods to the generic approach, the IPI supports device-specific command sets to aid in bridging the gap between the two approaches.

To accomplish this set of goals, the design of the IPI includes device-specific and device-generic command sets. The device-specific command set provides:

– device-oriented control;
– physical data addressing;
– timing critical operations;
– lower device cost.

The device-generic command set provides a higher level of functionality and portability. It includes:

– host/device independence;
– logical data addressing;
– timing independence;
– command queuing capability.

A system is not restricted to the use of one level of command set or the other. It is possible that both levels of command sets will be utilized with a given system's architecture to balance such parameters as system performance, cost and peripheral availability. It is also possible for the host to provide for the migration from device-specific to device-generic levels while still retaining the same physical interface.

The IPI standards family includes the definition of a high performance, general-purpose parallel peripheral interface. However, the device-generic command set may also be transported over other non-IPI physical interfaces. ANSI X3.291:1997 contains "mappings" to the High-Performance Parallel Interface (HIPPI) and Fibre Channel (FC) as well as to the IPI Enhanced Physical Interface. The "mappings" are not contained in this document.

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2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies.

ISO/IEC 9661:1994, *Information technology – Data interchange on 12,7 mm magnetic tape cartridges – 18 tracks, 1491 data bytes per millimetre*

ISO/IEC 11559:1993, *Information technology – Data interchange on 12,7 mm wide 18-track magnetic tape cartridges – Extended format*

ISO/IEC 14251:1995, *Information technology – Data interchange on 12,7 mm wide 36-track magnetic tape cartridges*

ISO/IEC 14417:1999, *Information technology – Data recording format DD-1 for magnetic tape casette conforming to ISO/IEC 1016*

ISO/IEC 14840:1996, *Information technology – 12,65 mm wide magnetic tape cartridge for information interchange – Helical scan recording – Data D3-1 format*

ANSI X3.291:1997, *Intelligent Peripheral Interface – Device Generic Command Set for Magnetic and Optical Disk Drives*

3 Definitions and conventions

3.1 Definitions

For the purpose of this standard the definitions in ANSI X3.291:1997 and the following definitions apply:

3.1.1
beginning of file
recorded mark on the medium that marks the beginning of a file

3.1.2
beginning of media (BOM)
beginning of the default data partition

NOTE 1 This media position is usually marked by some physical (not recorded) marker on the medium. The marker is detectable by a facility and allows the tape to be automatically and properly positioned at the beginning of the default data partition when rewound. The implementation of the BOM marker is defined in the vendor specification.

NOTE 2 Certain Information Processing Systems standards contain physical requirements for the position of the BOM marker in the default data partition (Beginning-of-Tape (BOT) marker on reel-to-reel tape).

3.1.3
end-of-media warning (EMW)
usually a physical marker on the medium that indicates the end of the normal recording area of a partition

NOTE Certain Information Processing Systems standards contain physical requirements for the position of the EMW marker in the default data partition (End-of-Tape (EOT) marker on reel-to-reel tape).

3.1.4
end of file
a mark recorded on the medium to mark the end of a file detectable by a facility

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3.1.5
erase gap
physical sections of the medium that contain no recognizable data

NOTE An Erase Gap may be used to overcome media defects by extending an interblock gap such that the next recorded element occurs past the defect on the medium.

3.1.6
file mark
see tape mark

3.1.7
forward motion
tape motion logically proceeding from BOM toward Physical End of Media (PEOM)

3.1.8
ID burst
burst of special recorded data that may be used by the facility to identify the recording format or density of data written on the medium

NOTE This burst usually occurs as the first recorded element on a volume. The ID burst content is an attribute of a volume and not considered part of any partition.

3.1.9
interblock gap
physical section of the medium that contains no recognizable data and separates adjacent recorded elements (i.e. PhysicalBlocks and file marks)

NOTE Interblock gaps are automatically introduced by a facility between adjacent recorded elements without explicit action by a master.

3.1.10
partition
recording area that may be logically addressed

NOTE A partition may be slave defined (e.g. data area, CE area, IML area) or may be master defined (e.g. an addressable set of contiguous blocks within the data area).

A partition may be defined to exist within a tape volume by the slave, the master, or both. Since tape volumes are removable, such a partition will be removed with the volume. A slave or facility may define other partitions that are not associated with a volume and that may or may not be removable. Typically, such partitions may be used for Maintenance partitions as defined in ANSI X3.291:1997, but are not limited to such use.

3.1.11
PhysicalBlock
physical representation of data on the media (e.g. sectors or records on disk and blocks or records on tape)

NOTE 1 This definition applies uniquely to this document. It is given to prevent confusion between industry usage of terms.

NOTE 2 A facility may record any two adjacent blocks with different physical lengths, depending upon the capability of the facility and the selection of a master. Tape volumes typically are not preformatted, as disks are, so that references to DataBlocks or PhysicalBlocks within a partition that has not been previously written usually fail.

NOTE 3 A tape volume having preformatted PhysicalBlocks is very similar to a fixed-block disk volume and may be used in a similar fashion.

3.1.12
physical end of media (PEOM)
position on the medium beyond which normal tape operation is impossible (i.e., data cannot be written or the medium cannot be positioned)

3.1.13
reverse motion
tape motion contrary to forward motion (i.e., logical motion from PEOM toward BOM)

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3.1.14
tape mark
recorded element on the medium, not containing data, that is used to separate or otherwise identify groups of DataBlocks on the medium

NOTE The most common tape mark is known as a file mark.

3.1.15
volume
a removable entity of tape media

3.1.16
write protect
an attribute of a tape volume

NOTE A write protect usually requires some physical sensing by a facility, indicating whether the facility is allowed to write data on the medium. When a volume is write protected, the facility is prevented from writing on the medium.

3.2 Conventions

In this standard, certain terms that are proper names of commands are printed in uppercase to avoid possible confusion with other uses of the same words (e.g. ATTRIBUTES). Any lowercase uses of these words have the normal English meaning.

A number of conditions, status indications or similar terms are printed with the first letter of each word in uppercase and the rest lowercase (e.g. Partition, Erase Gap). Any lowercase uses of these words have the normal English meaning.

4 Logical interface characteristics of the tape

4.0 General

The descriptions in ANSI X3.291:1997 shall apply to this standard, plus the information provided in the following subclauses. Only the subclauses which have complementary information are included here.

4.1 PhysicalBlocks

Tape PhysicalBlocks may be fixed or variable. In the case of fixed PhysicalBlocks, the block size may be preset in manufacture or may be specified by the master using the OPERATING MODE command. A tape recording fixed blocks shall pad to the end of the block if the master does not supply enough information in a transfer command to fill the block. Once recorded, the size of fixed PhysicalBlocks shall become an attribute of the volume (or partition, if applicable).

A slave/facility that adds padding octets shall be capable of removing such padding when the PhysicalBlocks are subsequently read and thus may require some control information to be added to the PhysicalBlock contents.

Tapes that record variable PhysicalBlocks shall record blocks of any size within the bounds reported in ATTRIBUTES. The master may record multiple equal length blocks by setting the block size with the OPERATING MODE command and transferring data. However, it is then the responsibility of the master to pad any blocks that do not contain enough data to fill the block. Variable PhysicalBlock Size is not an attribute of the volume (or the partition, if applicable). If the master does not transfer enough information to fill a variable PhysicalBlock, the addressee shall record a short PhysicalBlock.

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Facilities may be implemented to record PhysicalBlocks of the exact size specified by the master or may record the PhysicalBlock size plus some control information (e.g., data plus a block numbering field).

The relationship between PhysicalBlock and DataBlock size is not fixed, the DataBlock being the master-defined unit of preference. Depending on addressee implementation, DataBlock size may be the same as PhysicalBlock size, an integer multiple of the PhysicalBlock size, or a non-integer multiple.

4.2 DataBlocks

DataBlock size is not an attribute of a volume or a partition. It specifies the master-to-slave transfer unit size (not to be confused with Burst Size) until changed by the ATTRIBUTES or OPERATING MODE command or overridden in a data transfer Command Extent parameter (when transferring in Octet mode).

4.3 Extents

The general definition of an extent applies to tape. However, a slave/facility may have no method for knowing in advance, when reading, that all blocks defined for an extent are present. When writing, the slave/facility may not be able to determine in advance of beginning data transfer whether all blocks can be transferred to the medium. Thus, Command Exceptions resulting from detection of an invalid data extent are infrequent.

The Incomplete Major Status is used in most instances instead of Command Exception with indications such as File Mark, End of Media Warning and the like, indicated in the Incomplete parameter.

4.4 Partitions

Historically, tape volumes have been considered as having only one data partition (the default data partition), starting at BOM at one end of the medium and continuing until EMW at the other end of the medium. The size of this default data partition varied with the density and recording format of the slave/facility.

With the advent of track-addressable tape devices and serpentine recording, it may be possible to define and manage partitions that subdivide the total recording area of a volume. Such partitions may be slave defined or master defined. Partitions may hold usage and error information, selected data from Disk volumes, independent application data files and other data.

Since tape volumes are removable, the partition concept is extended for tape to include semi-permanent storage areas (other than the medium) associated with a volume, that may be retained in the slave/facility. Such areas may contain IML data for the slave/facility, usage/error information for the slave/facility, and the like. Slaves/facilities shall support a default data partition on the storage medium. Other partitions and their location, Partition ID, size, and the like (if any) shall be defined by the vendor.

Each partition residing on the medium shall define a BOM, an EMW and PEOM. All operations related to a partition shall operate within this defined storage space. Tape slaves/facilities typically perform no data transfer operations while in the process of making a transition between partitions.

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4.5 Alternate data areas

Tape processing typically does not reserve separate space on the medium for storing blocks when a write error occurs. The lack of such alternate data areas is assumed in this standard. For performance reasons, various methods of error recovery in the general vicinity of the original error have been implemented as opposed to block reallocation common in disk processing.

One method for error recovery common in tape data processing erases the area of the medium in which the error was detected and rewrites the block farther down the medium, but within the same partition. The process may be repeated multiple times in an attempt to write an acceptable quality block.

4.6 Partition parameters

Tape position shall be maintained relative to the last position operation or BOM within a partition (i.e., the medium is static between operations). Owing to the use of this positioning method, a new relative position shall be established whenever a partition transition is made. This and other performance-related issues prevent tape devices from making the rapid partition transitions common in discs. The use of partition parameters is, therefore, redefined here to be consistent with tape operations.

Partition transitions define a semi-permanent state change similar to a physical volume change. Once the partition transition has been ordered by issuing a command with a partition parameter appended, all subsequent commands shall execute in the specified partition. This condition shall persist until the master explicitly changes the partition by issuing a command with a partition parameter appended. Chains to commands containing a Partition parameter shall not continue to operate in a partition other than the default partition. Such command chains shall not be precluded by the tape definition, but an automatic transition back to the default partition at the end of the chain shall not occur.

When a transition is made to a new partition all attributes and operating mode conditions associated with the volume shall persist in the new partition.

4.7 Block numbering

Block numbering is defined as a slave/facility adding to the recording medium (without master intervention) information about a PhysicalBlock relative to the block attributes. Typical block numbering fields contain (but are not limited to) information about the block location within the partition, block translation flags, error recovery information, and the like. The size and content of block numbering fields is vendor specific and shall be transparent to the master.

4.8 Data buffer operation

A tape slave/facility may contain buffer space capable of containing multiple blocks of data. This data buffer may contain data "read ahead" from the medium or data waiting to be written to the medium. When performing a write, a slave/facility capable of storing multiple blocks in the data buffer may

a) transfer an operation response indicating Successful status to the master once all the write data has been transferred from the master and successfully stored in the data buffer. If an unrecoverable write error is subsequently encountered while attempting to record the data on the medium, the addressee shall generate an Asynchronous Response packet to inform the master of the failure. The master may then use the REPORT POSITION command to determine the number and addresses of the data blocks remaining to be fixed to tape. Unwritten data may then be recovered by using the READ FROM BUFFER command;

or, alternatively:

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b) transfer an operation response indicating Successful status to the master only when all of the write data has been successfully written to the media. If an unrecoverable error occurs anywhere in this process, then the operation response (command completion) indicates the error to the master as usual. The Master may then be able to determine the media position from the CRN in the response packet, or it may have to issue a REPORT POSITION command. The master may then cause the addressee to clear the buffer contents and may reissue the data that was not written on the media to the same or different media. This alternative may be useful in journaling applications in which the performance degradation of true synchronous mode due to multiple repositions is unacceptable. Note, however, that implementations that use this alternative must carefully consider the impact of the depth of their command queues on the usable size of their data buffer. Note also that this alternative combined with the supression of Operation Responses on Successful is almost equivalent to alternative a) above.

If method b) above is supported then ATTRIBUTES (Parameter 6E Octet 1 Bit 0) shall be used to indicate that fact to the master. If both of the above methods are supported, then the master shall use either ATTRIBUTES or OPERATING MODE to select the method to be used.

Addressees that "read ahead" into a data buffer shall not report an unrecoverable read error to the master until the unrecoverable data is requested by the master.

Tape slaves/facilities that provide the asynchronous buffer mode described shall also support a synchronous mode of operation that may be controlled by the master (i.e., the addressee shall be capable of disabling the data buffer). Enabling and disabling the data buffer is accomplished using the ATTRIBUTES and OPERATING MODE commands. In addition, a master may instruct an addressee, operating in the asynchronous mode, to synchronize its buffer and media position by issuing a POSITION CONTROL command with the Synchronize bit asserted.

4.9 Positioning

4.9.0 General

Positioning of the medium is relative to recorded elements or the BOM in a partition.

4.9.1 Mount or rewind

When a volume is first mounted and made ready, or is rewound, the medium shall be positioned relative to the BOM such that the first recorded element of the default data partition can be read or written.

4.9.2 Partition transition

If a partition parameter is appended to a command that contains no implicit or explicit positioning information (e.g., a Command Extent parameter or POSITION CONTROL command), the slave/facility shall position to the BOM within the new partition. A Partition Parameter appended to a command that contains valid position information shall cause the addressee to position to the specified address in the new partition. If a specified position cannot be located, the new position is indeterminate and Incomplete major status shall be returned with Block Not Found indicated in the substatus parameter.

4.9.3 Normal data operation completion

After successful completion of a read, write, or space operation, the medium shall be logically positioned to process the next recorded element in the same direction as the previous operation.

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4.9.4 Abnormal data operation completion

After a read or write error and any automatic error recovery has been performed, the medium shall be positioned in such a way that the recorded element that caused the exception can be read in a direction opposite from the one which was used when the exception occurred.

4.9.5 Normal position operation completion

After successful completion of an explicit position to a recorded element, the medium shall be positioned to process the specified recorded element.

4.9.6 Abnormal position operation completion

If an error is detected while performing a position operation to a specific recorded element, the final position of the medium shall be as defined in the vendor specification.

4.9.7 Tape mark detected

If a tape mark is detected while performing a read or space block operation, the medium shall be positioned to process the next sequential recorded element after the tape mark in the same direction as the just completed read or space block operation.

4.9.8 BOM detected (reverse operations)

After detecting BOM while reading, spacing, or positioning to a specific recorded element, the medium shall be positioned to process, in the forward direction, the first recorded element after BOM.

Write reverse is a vendor-specific operation. If BOM is encountered while performing a WRITE in the reverse direction, the vendor specification shall be consulted to define the media position.

4.9.9 EMW detected

The position of the medium relative to EMW is command dependent and defined with the individual command descriptions.

4.9.10 PEOM detected

If PEOM is detected while moving the media in a forward direction, the position of the medium is defined in the vendor specification (e.g., the media may have left the tape path).

4.10 Attributes usage

The handling of Attributes in this standard mimics that of the Device Generic Command Set for Magnetic and Optical Disk Drives in that Attributes are managed by ATTRIBUTES and OPERATING MODE commands which can be issued at any time.

However, a number of recently-defined tape formats include the storage of information on the media which will define Attributes. This information can only be recorded during appropriate media positioning operations and is normally read at load time. Thus this information can override previously-defined and previously-read "volume" attributes when new media is loaded.

This position-sensitivity of attributes makes the ATTRIBUTES and OPERATING MODE commands much more difficult to use. To overcome this difficulty, the following strategy is suggested:

a) read and Set these volume-associated Attributes with the Read Volume Attributes and Set Volume Attributes parameters of the POSITION CONTROL command only;

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b) use the ATTRIBUTES and OPERATING MODE commands to define slave-related and Facility-related "permanent" Attributes when no media is loaded.

4.11 Command usage

Where possible, the tape commands have been defined to be identical to the disk commands, and in the clauses that follow a command may be named with a reference to the disk command. In the disk description, any minor exceptions for tape have been appended to the disk text and clearly noted as applying to tape. The disk text may also indicate certain items (usually an Opcode Modifier bit) not used for disk (i.e., the Reverse direction modifier in some transfer and position commands).

When a command that is common to disk and tape is used quite differently by the two media, a complete description of the command and its use is included in this standard.

Some unique commands are required for tape and their complete descriptions are found in the clauses that follow.

5 Message packet structure

The message packet structure for magnetic tape drives is functionally identical to the packet structure for the magnetic and optical disk drives and shall be as described in ANSI X3.291:1997.

6 Control commands

6.0 General

The commands in this clause use basic packets and shall be used as Control commands in Level 3 of the logical interface.

6.1 NOP

This command is identical to the NOP command described in ANSI X3.291:1997 and the same requirements shall be observed.

6.2 FACILITY OPERATION

This command is identical to the FACILITY OPERATION command described in ANSI X3.291:1997 and the same requirements shall be observed.

6.3 ATTRIBUTES

6.3.1 Command packet

PKT LTH	REF NO 0 1	OP CODE 2	COM MOD 3	OP MOD	SLAV ADDR 4	FAC ADDR 5	PARAMETERS 6 through n
xxxx	xxxx	02	bbbb (7654)	bbbb (3210)	xx	xx	

Bits 0, 1, 3 have encoded meaning of:
x'0'=Report
x'1'=Initialize x'2'=Restore
x'9'=Load x'A'=Save

Figure 1 – Command packet for ATTRIBUTES

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6.3.2 Response packet

PKT LTH	Echoed From Command 0 1 2 3 4 5	MAJOR STATUS CODES 6	MAJOR STATUS TYPE 7	MAJOR STATUS CODE	PARAMETERS 8 through n
xxxx	eeeeeeeeeeee	bbbb bbbb 7654 3210	0001	bbbb 3210	

Figure 2 — Response packet for ATTRIBUTES

6.3.3 Description

The ATTRIBUTES command allows modification of the slave or facility attributes that are used to tell the master what the addressee's operational characteristics are and to allow them to be examined or modified. The operational characteristics that may be modified in the addressee are implementation dependent.

The operating mode of ATTRIBUTES is determined by the opcode modifier, which allows the master to Initialize, Report, Restore, Load, or Save the addressee attributes. The modifiers are mutually exclusive.

The information that the slave supplies or modifies, or supplies and modifies, in accordance with the command, is specific to the addressee identified by the Slave Address and Facility Address of the command. Unless a master has prior knowledge, processing of Attributes should begin by analysis of the slave's capabilities and proceed through each attached operational facility.

Bits 0, 1, and 3 (x'1', x'2', and x'8') are encoded. The opcode modifiers shall be as follows:

a) **Report:** This requires the addressee to respond with a list of parameters that detail the attributes requested by the command.

b) **Initialize:** This allows the master to require the addressee to set all of its attributes to their initial values.

NOTE These attributes may not represent a valid configuration.

c) **Restore:** This allows the restoration of saved attributes. At power on, slaves and facilities shall perform an automatic Restore. If no attributes have been Saved by the master, the Restore values shall be a valid configuration of the Initialize attributes.

d) **Save:** This allows the addressee attributes, including those associated with this command, to be saved prior to power down or removal of the media from a removable media facility.

e) **Load:** This requires the addressee to modify attributes within the addressee (if they are valid).

When the Initialize or Restore modifiers are set, the addressee acts upon all attributes. Similarly, if no parameters are transmitted with the command packet when the Report or Save modifiers are set, the addressee acts upon all attributes.

If the master wishes to be selective about attributes to be effected, it shall provide a list of the parameter IDs (via the Request Parm parameter), with the Report, Load, or Save modifiers.

The master and slave either have parameters that are unique to each other (so indicated by either M or S in the @ column), or are common to both (indicated by "B" in the @ column). Common parameters are used by the slave to report attributes and by the master to modify attributes. A consistent sequence is necessary to properly manage parameters that are common.

If a master wishes to find out the Initial settings of the slave (rather than the Restored settings), it issues an ATTRIBUTES command with the Initialize modifier set. The slave shall set the Attributes parameters to their initial factory values. The master issues an

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ATTRIBUTES command with the Report modifier set, to look at the parameter or parameters of interest.

The master can change the Attributes parameters by issuing an ATTRIBUTES command with the Load or Save modifier set and thus instruct the slave to act upon the new values.

If the master does not wish the new values to be kept beyond Power Off, the Load modifier is set.

If the master wishes the new values to be kept beyond Power Off, and Restored by the slave after Power On, the Save modifier is set.

The master can use the Restore modifier to have the slave return to its previously Saved values.

Some of the attributes apply equally to either slave or facility (e.g., number of ports). In the case of an integrated slave and facility, both slave and facility apply. For this reason, it is impossible to clearly define attributes as belonging to either slave or facility unless the configuration of intended use is known. Therefore, all attributes are shown as being relative to the addressee, even though some may be specifically slave oriented and others may be specifically facility oriented.

Within the parameters there are sets of octets that may need to be repeated several times to provide all of the information. These repetitive octet sets are noted in the parameter tables.

On facilities that support more than one type of partition, the Partition Parameter shall precede every set of attribute parameters for that partition. In this manner, every partition is described by a group of succeeding attribute parameters (e.g., if a disk that has been formatted with one PhysicalBlock size has three partitions, the Size of Disk PhysicalBlocks parameter would be the same and repeated in every set of parameters succeeding each Partition parameter.

If the Report modifier is set, and a Partition Parameter with an ID of x'FF' is appended to the command, the slave shall respond with information on all of the partitions (with each set of information preceded by a Partition Parameter). On a Report, Load or Save, the absence of a Partition Parameter means the default data partition attributes are to be referenced.

If any fields are not needed in a parameter, the parameter length can be cut short (for example, on Parameters 53 and 54, a disk with a fixed clock rate and variable rotation speed has a different number of bytes per track on every cylinder, so parameters such as the Total Number of Blocks per Cylinder and Total Number of Blocks per Track need not be supplied).

There is a need for three types of memory to completely manage Attributes:

a) **Permanent:** This memory contains all of the attributes as defined by the manufacturer and the initial value of Attributes. The initial attributes may not be set to a valid configuration (e.g., two features that are mutually self-exclusive may be capable of being supported by the slave).

b) **Semi-permanent:** At the point of manufacture, these values are set to a valid combination of the initial Attributes. The contents may be replaced by the master performing a save. The slave uses the contents of this memory to restore Attributes at power on, or under command of the master when the restore modifier is set.

c) **Current:** After power on, the contents are the same as semi-permanent memory, that is, restored. Individual Attributes may be changed by the master performing either a load, or a save with parameters.

To retain Attributes, permanent memory shall be used; to retain Attributes changed by the master, semi-permanent memory shall be used.

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The following modifiers permit operations upon individual Attributes:

a) **Report:** The current memory contents are reported to the master. If no parameters are appended, the slave responds with all attributes (which can be a very large length). The Request Parms parameter may be used to specifically identify Attributes.

b) **Load:** This modifier requires that parameters be appended for attributes that may be modified. The slave shall replace the contents of the designated parameters in Current memory with the ones in the command parameter list (if valid).

c) **Save:** If this modifier has associated parameters, the command is executed in the same manner as a Load, then the contents of Current memory shall be written into Semi-Permanent memory.

The following modifiers are those that operate upon all changeable Attributes:

a) **Initialize:** No parameters are accepted. The contents of Permanent memory shall be written into Current memory.

b) **Restore:** No parameters are accepted. The contents of Semi-Permanent memory are written into the Current memory.

c) **Save:** If no parameters are appended, the contents of Current memory are written into Semi-Permanent memory.

6.3.4 Parameters

6.3.4.1 Parameters 3A, 3E, 50.

Table 1 – Attributes parameters 3A, 3E, 50

@	LTH	ID	OCTET	X/b	DEF	ATTRIBUTE PARAMETERS
B	n+1	3A	01- n			Data Address parameter
B	n+1	3E	01- n			Partition parameter
S	n+1	50	01-10			Vendor id (iso is 646/ascii)

These parameters shall be as described in ANSI X3.291:1997.

6.3.4.2 Parameters 51 to 58

6.3.4.2.1 Size of Tape DataBlocks parameter

This parameter contains an unsigned binary number specifying the size of the datablocks currently set in the addressee. The master may use this parameter to set the datablock size in the addressee.

6.3.4.2.2 Size of Tape PhysicalBlocks parameter

This field contains an unsigned binary number specifying the size of the physicalblocks currently set in the addressee. The master may use this parameter to set the physicalblock size in the addressee.

6.3.4.2.3 Variable DataBlock sizes supported parameter

The first field contains an unsigned binary number specifying the smallest value of a range of datablock sizes. The second field contains an unsigned binary number specifying the largest value of the range supported. The third field is an unsigned binary number that specifies the increment by which the block size may be increased from smallest to largest.

If more than one range is supported, these three fields are repeated as many times as required.

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Table 2 — Attributes parameters 51 to 58

@	LTH	ID	OCTET	X/b	DEF	ATTRIBUTE PARAMETERS
B	05	51	01-04			Size of tape DataBlocks
B	05	52	01-04			Size of tape PhysicalBlocks
		53				reserved
		54				reserved
S	n+1	55				VARIABLE DATABLOCK SIZES SUPPORTED
			01-04			Smallest block size supported
			05-08			Largest block size supported
			09-0C			Increment size
			n-B:8			Smallest block size | repeated as many
			n-7:4			Largest block size | times as needed
			n-3:n			Increment size
S	n+1	56				VARIABLE PHYSICALBLOCK SIZES SUPPORTED
			01-04			Smallest block size supported
			05-08			Largest block size supported
			09-0C			Increment size
			n-B:8			Smallest block size | repeated as many
			n-7:4			Largest block size | times as needed
			n-3:n			Increment size |
S	n+1	57				FIXED DATABLOCK SIZE(S) SUPPORTED
			01-04			Block size (first) repeated as many
			n-3:n			Block size (last) | times as needed
S	n+1	58				FIXED PHYSICALBLOCK SIZE(S) SUPPORTED
			01-04			Block size (first) repeated as many
			n-3:n			Block size (last) | times as needed

6.3.4.2.4 Variable PhysicalBlock sizes supported parameter

The first field contains an unsigned binary number specifying the smallest value of a range of PhysicalBlock sizes. The second field contains an unsigned binary number specifying the largest value of the range supported. The third field is an unsigned binary number that specifies the increment by which the block size may be increased from smallest to largest.

If more than one range is supported, these three fields are repeated as many times as required.

6.3.4.2.5 Fixed DataBlock size(s) supported parameter

The first field contains an unsigned binary number specifying the DataBlock size supported. If more than one size is supported, this field is repeated as many times as needed.

6.3.4.2.6 Fixed PhysicalBlock size(s) supported parameter

The first field contains an unsigned binary number specifying the PhysicalBlock size supported. If more than one size is supported, this field is repeated as many times as needed.

6.3.4.3 Parameters 59 and 5A

These parameters shall be as described in ANSI X3.291:1997.

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Table 3 – Attributes parameters 59, 5A

@	LTH	ID	OCTET	X/b	DEF	ATTRIBUTE PARAMETERS
S	02	59				Attribute table conditions
B	n+1	5A				Pad with fill characters

6.3.4.4 Parameters 5B to 5D

These parameters shall be as described in ANSI X3.291:1997.

Table 4 – Attributes parameters 5B to 5D

@	LTH	ID	OCTET	X/b	DEF	ATTRIBUTE PARAMETERS
B	n+1	5B				TAPE PARTITION DEFINITION
			01			Partition ID
			02			Facility address
			03-04			reserved
			05-08			Block count
			09-0C			DataBlock address
B	n+1	5C				Synonym definition
B	n+1	5D				Alias definition

6.3.4.5 Parameter 5E - Multi-port characteristics

This parameter shall be as described in ANSI X3.291:1997.

6.3.4.6 Parameter 61 - Transfer rate

This parameter shall be as described in ANSI X3.291:1997.

6.3.4.7 Parameters 64 to 65

6.3.4.7.0 General

Table 5 – Attributes parameters 5E to 65

@	LTH	ID	OCTET	X/b	DEF	ATTRIBUTE PARAMETERS
B	n+1	5E				Multi-port characteristics
S	09	61				Transfer rate (octets/second)
S	15	64				Physical interface attributes parameter
S	n+1	65				Addressee configuration parameter

6.3.4.7.1 Physical interface attributes parameter

This parameter shall be as described in ANSI X3.291:1997.

6.3.4.7.2 Addressee configuration parameter

This parameter shall be as described in ANSI X3.291:1997.

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6.3.4.8 Parameter 66 to Slave configuration (bit significant)

This parameter shall be as described in ANSI X3.291:1997.

6.3.4.9 Parameter 67 to Slave configuration (fields)

This parameter shall be as described in ANSI X3.291:1997.

Table 6 – Attributes parameters 66, 67

@	LTH	ID	OCTET	X/b	DEF	ATTRIBUTE PARAMETERS
S	n+1	66				Slave configuration (bit significant)
S	n+1	67				Slave configuration (fields)

6.3.4.10 Parameter 68 to Facilities attached to slave

Table 7 – Attributes parameter 68

@	LTH	ID	OCTET	X/b	DEF	ATTRIBUTE PARAMETERS
B	n+1	68				Facilities attached to slave parameter

This parameter shall be as described in ANSI X3.291:1997.

This parameter has been defined as "Both" for the purpose of commonality. However in the Tape situation a master would not normally specify this parameter.

6.3.4.11 Parameters 69 to 6A

6.3.4.11.1 Parameter 69

This parameter is reserved.

6.3.4.11.2 Command supported parameter

This parameter shall be as described in ANSI X3.291:1997.

Table 8 – Attributes parameters 69, 6A

@	LTH	ID	OCTET	X/b	DEF	ATTRIBUTE PARAMETERS
S	n+1	69				reserved
S	n+1	6A				Command supported

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6.3.4.12 Parameter 6B to Masks of octets supported

This parameter shall be as described in ANSI X3.291:1997.

Table 9 – Attributes parameters 6B to 6F

@	LTH	ID	OCTET	X/b	DEF	ATTRIBUTE PARAMETERS
S	n+1	6B				Masks of octets supported
M	n+1	6C				Request parm parameter
S	05	6D				Parm length parameter
B	n+1	6E				Slave reconfiguration (bit significant)
B	n+1	6F				Slave reconfiguration (fields)

6.3.4.13 Parameters 6C to 6D

6.3.4.13.1 Parameters 6C - Request parm parameter

This parameter shall be as described in ANSI X3.291:1997.

6.3.4.13.2 Parameters 6D - Parm Length parameter

This parameter shall be as described in ANSI X3.291:1997.

6.3.4.14 Parameter 6E to Slave reconfiguration (bit significant)

This parameter shall be as described in ANSI X3.291:1997.

6.3.4.15 Parameter 6F to Slave reconfiguration (fields)

This parameter shall be as described in ANSI X3.291:1997.

6.3.4.16 Parameters 70 and 71

6.3.4.16.0 General

Table 10 – Attributes parameters 70, 71

@	LTH	ID	OCTET	X/b	DEF	ATTRIBUTE PARAMETERS
B	05	70	01-04			Size of data buffer blocks
S	n+1	71				DATA BUFFER BLOCK SIZES SUPPORTED
			01-04			Smallest block size supported
			05-08			Largest block size supported
			09-0C			Increment size
			n-B:8			Smallest block size repeated as many
			n-7:4			Largest block size times as needed
			n-3:n			Increment size

6.3.4.16.1 Size of data buffer blocks parameter

This is an unsigned binary number used to specify the block size currently set in the Data Buffer.

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6.3.4.16.2 Data buffer block size supported parameter

The first field contains an unsigned binary number that specifies the smallest value of a range of Data Buffer Block sizes. The second field contains an unsigned binary number that specifies the largest value of the range supported. The third field is an unsigned binary number that specifies the increment by which the block size may be incremented from smallest to largest.

If more than one range is supported, these three fields are repeated as many times as required. If the Data Buffer Block size is fixed, the fixed value is reported for both maximum and minimum block size and the increment is reported as zero.

6.3.4.17 Parameter 72 to Tape characteristics (bit significant)

a) **Suppression of repositioning:** This bit indicates that any repositioning activity that may be required under normal operating conditions can be suppressed.

b) **PhysicalBlock:** This bit, when set, indicates that the addressee is capable of operating in a "Fixed Block" mode.

c) **Variable PhysicalBlock:** This bit indicates that the addressee can accept PhysicalBlock sizes of any size from the master, up to the maximum block size specified in the Variable PhysicalBlock Size parameter.

d) **Datablocks same as PhysicalBlocks:** This bit informs the master that the addressee will only accept DataBlocks that are the same size as the PhysicalBlocks.

e) **Multiple of PhysicalBlock:** When set, this bit means that the addressee will accept DataBlock sizes that are larger than the PhysicalBlock size in increments equal in size to whole PhysicalBlocks. To illustrate - if the PhysicalBlock size is set to 256 octets, then the DataBlock size may be 256 or 512 or 768 or 1024 etc. Any DataBlock sizes that are not multiples of the PhysicalBlock size shall be rejected.

f) **DataBlock non-multiple of PhysicalBlock:** This bit indicates that the size of the DataBlock may be of any size with no regard for the size of the PhysicalBlock. In cases where the DataBlock size results in a PhysicalBlock that is not completely utilized the Facility will fill the remainder of the incomplete PhysicalBlock with vendor- unique padding characters, unless the External fill character-bit is set.

g) **Fill character supported:** This bit indicates that the fill characters specified by the set Attributes command, parameter 5A Pad with fill characters, will be used by the Facility to fill all PhysicalBlocks that are not completely filled with data while in the Fixed PhysicalBlock mode.

h) **Automatic error recovery:** This bit indicates that the Facility is capable of performing Automatic (unassisted by the master) Error Recovery according to a vendor-unique Error Recovery algorithm.

i) **Data buffer:** The presence of this bit indicates that the addressee has a Data Buffer available. The data buffer size is reported in the Addressee Configuration parameter (ID 65).

j) **Streaming tape:** When set, this bit informs the master that the attached addressee is capable of operating in the streaming mode.

k) **Start-stop tape:** This bit indicates that the addressee is capable of operating in the start-stop mode.

NOTE Start-Stop and Streaming are not mutually exclusive. A drive may be capable of operating in either the start-stop or the streaming mode.

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Table 11 – Attributes parameter 72

@	LTH	ID	OCTET	X/b	DEF	ATTRIBUTE PARAMETERS
S	n+1	72				TAPE CHARACTERISTICS (BIT SIGNIFICANT)
			01			Tape slave attributes
				7		Suppression of repositioning
				6		Fixed physicalblock
				5		Variable physicalblock
				4		DataBlocks same as PhysicalBlocks
				3		DataBlock multiple of PhysicalBlock
				2		DataBlock non-multiple of PhysicalBlock
				1		External fill character
				0		Automatic error recovery
			02	7		Data buffer
				6		Streaming tape
				5		Start stop tape
				4		Block numbering supported
				3		Encryption supported
				2		Compression supported
				1		Translation supported
				0		Implicit positioning supported
			03	7		Track addressable
				6		Serpentine
				5		Auto speed control
				4		Multiple fixed gaps
				3		Read reverse
				2		Write reverse
				1		Edit capability
				0		Variable gap
			04	7		Cartridge Loader
				6		Volume attributes
				5		Volume attributes in asynchronous response
				4		Optimized positioning supported
				3-0		reserved

l) **Block numbering supported:** This bit indicates to the master that the addressee supports internal block numbering and is capable of using the block number field to perform explicit position operations (see POSITION CONTROL) and other internal control functions. The actual recorded block number field and the algorithm used to develop the block number are not specified in this standard.

m) **Encryption supported:** This bit is used to inform the master that some data encryption capability is available in the Addressee.

n) **Compression supported:** This bit informs the master that the Addressee has an internal compression algorithm that can be applied to the data.

o) **Translation supported:** This bit informs the master that the Addressee can translate data being written to or read from the media.

p) **Implicit positioning supported:** This bit, when set, indicates that the addressee is capable of using the address field in the command extent parameter to perform implicit and explicit space operations when required.

q) **Track addressable:** When this bit is set, the facility is capable of supporting track addressing.

r) **Serpentine:** When this bit is set, the facility utilizes a format for writing or reading data that requires more than one full excursion of the medium past the read-write head to obtain a full volume.

s) **Auto speed control:** When this bit is set, the addressee has the capability of using an internal algorithm to optimize tape speed to achieve the best transfer rate and reinstruct window on a streaming tape drive.

t) **Multiple fixed gaps:** This bit informs the master that the addressee has the capability to write fixed Interblock Gaps of varying size. The sizes supported by the addressee shall be as specified in the fields for Minimum and Maximum Gap sizes.

u) **Read reverse:** This bit indicates that the addressee is capable of performing a Read in the reverse direction.

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v) **Write reverse:** This bit indicates to the master that the addressee is capable of writing in the reverse direction.

w) **Edit capability:** This bit indicates to the master that the addressee has the ability to rewrite an existing PhysicalBlock or DataBlock, from a PhysicalBlock or DataBlock of the same size, without destroying the adjacent PhysicalBlocks or DataBlocks on the media. When Edit is not supported and the master attempts to write a PhysicalBlock or DataBlock over an existing PhysicalBlock or DataBlock, it is assumed that the block(s) immediately following the block being written will be destroyed. If the addressee has the property that it can overwrite without causing the destruction of any adjacent PhysicalBlocks or DataBlocks, it shall set this bit. This function requires that the master use the edit modifier with the WRITE command for each write edit to be performed. Leaving an addressee constantly in edit mode could cause the tape drive or tape subsystem to perform needless repositioning and control functions during all write operations.

x) **Variable gap:** This bit advises the master that the addressee is capable of providing variable gaps that vary from the Minimum Gap size up to the Maximum Gap Size set by the master.

y) **Cartridge loader:** This bit advises the master that the Cartridge Loader is installed.

z) **Volume attributes:** This bit advises the master that Volume attributes are supported.

aa) **Volume attributes in Asynchronous Response:** This bit advises the master that the inclusion in the Asynchronous Response of the Reported Volume Attributes parameter as defined for the Position Control command is supported.

bb) **Optimized Positioning Supported:** When this bit is set, the addressee has the capability of using an internal positioning scheme that can provide optimized positioning of the medium. The optimization is based on the use of positioning information previously recorded in a special area on the medium.

6.3.4.18 Parameter 73 to Tape characteristics (fields)

Table 12 – Attributes parameter 73

@	LTH	ID	OCTET	X/b	DEF	ATTRIBUTE PARAMETERS	
S	n+1	73				TAPE CHARACTERISTICS (FIELDS)	
			01			Maximum write retry count	
			02			Maximum read retry count	
			03			Number of translation tables supported	
			04			Number of alterable translation tables	
			05			Units of measure	
				7-6		Tape speed	
				5-4		Gap size	
				3-2		Density	
				1-0		Format	
			06			Minimum gap size	
			07			Maximum gap size	
			08			Gap size increment	
			09			Maximum erase multiplier supported	
			0A	7		Default	
				6		0 = start/stop 1 = streaming	
				5-0		reserved	
			0B-0C			Recording density	
			0D-0E			Tape speed	
			n-9			Units of measure	
			n-8			Minimum gap size	
			n-7			Maximum gap size	
			n-6			Gap size increment	
			n-5			Maximum erase	repeated as many
			n-4	7		Default	times as needed
				6		0 = start/stop 1 = stream.	
				5-0		reserved	
			n-3:2			Recording density	
			n-1:n			Tape speed	

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a) **Maximum write retry count:** This is a 1-octet field, containing an unsigned binary number, that specifies the largest write retry count supported by the Addressee. If this field is set to zero, the addressee does not perform automatic write retries.

b) **Maximum read retry count:** This is a 1-octet field, containing an unsigned binary number, that specifies the largest read retry count supported by the Addressee. If this field is set to zero, the addressee does not perform automatic read retries.

c) **Number of translation tables supported:** This is a 1-octet field that specifies the number of translation tables supported by the addressee.

d) **Number of alterable translation tables:** This is a 1-octet field that specifies the number of translation tables supported by the addressee that can be altered by the master.

NOTE Translation tables may be contained in alterable or unalterable storage within the addressee (RAM or ROM). Translation tables are numbered consecutively from x00 to xFE with unalterable tables located in the lowest numbered tables. An addressee that reports a "Number of Tables Supported" as x0F and an "alterable table count" of x03 should have ROM translation tables numbered x00 through x0B and alterable (RAM) translation tables numbered x0C, x0D, and X0E.

e) **Units of measure:** This is a 1-octet field containing four 2-bit fields encoded to indicate the units of measure used by the master to interpret the associated tape attribute field. Unassigned codes are reserved for vendor-unique units of measure.

bits 7-6 tape speed	bits 3-2 density
00 = inch/second	00 = bits/inch per track
01 = centimeters/second	01 = bits/millimeter per track
10 = vendor units	10 = vendor units
11 = vendor units	11 = vendor units

bits 5-4 gap size	bits 1-0 format
00 = tenths of an inch	00 = ISO
01 = millimeters	01 = vendor units
10 = centimeters	10 = vendor units
11 = vendor units	11 = vendor units

f) **Minimum gap size:** This is an unsigned binary number that specifies the minimum gap size that the addressee supports, expressed in units defined in the Units of Measure field.

g) **Maximum gap size:** This is an unsigned binary number that represents the largest interblock gap (in units specified in the Units of Measure field) the addressee can record on the media without the use of the ERASE command.

NOTE If the addressee does not support variable gaps or multiple fixed gaps, the maximum and the minimum gap size shall both be set to the addressee's fixed gap size.

h) **Gap size increment:** This is an unsigned binary number that specifies the incremental value by which the addressee can lengthen or shorten the gap. If the addressee does not support more than one gap size, the increment shall be set to zero.

i) **Maximum erase multiplier supported:** This bit informs the master of the largest number that the addressee will accept to be used in calculating a long erase gap.

NOTE The erase multiplier is a number that, when multiplied by the minimum interblock gap size, produces a nominal erase gap size.

j) **Default:** When set to 1, this bit indicates to the master that the described configuration is the addressee's default configuration.

k) **Mode:** This bit indicates that the addressee, when set to the reported configuration, operates in the Streaming or Start-Stop mode of operation.

--`,,,`-`-`,,`,,`,`,,`---

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l) **Recording density:** This is an unsigned binary number that is used to report the recording density supported by the addressee, expressed in units specified in the Units of Measure field. When the format code in the units of measure field indicates a recording format described in an International Standard, the Recording Density field implies the recording format (1600 CPI is Phase Encoded, 6250 is a GCR format, etc.).

m) **Tape speed:** This is an unsigned binary number that is used to specify tape speed in units contained in the units of measure field.

6.3.4.19 Parameters 74 and 75

6.3.4.19.1 Current tape configuration (bit significant)

This parameter is used by the master to determine or change the current configuration of the addressee (see Parameter 72 for field descriptions).

6.3.4.19.2 Current tape configuration (fields)

This parameter is used by the master to determine or change the current configuration of the addressee (see Parameter 73 for field descriptions).

Table 13 – Attributes parameters 74, 75

@	LTH	ID	OCTET	X/b	DEF	ATTRIBUTE PARAMETERS
B	n+1	74				CURRENT TAPE CONFIGURATION (BIT SIGNIFICANT)
			01			Tape slave attributes
				7		Suppression of repositioning enabled
				6		Fixed PhysicalBlock 1=fixed 0=variable
				5		Serpentine
				4		Automatic error recovery
				3		Data buffer
				2		Streaming tape mode
				1		Start stop tape mode
				0		Variable gap enabled
			02	7		Block numbering
				6		Encryption
				5		Compression
				4		Translation
				3		Auto speed control
				2		Multiple fixed gap
				1-0		reserved
B	n+1	75				CURRENT TAPE CONFIGURATION (FIELDS)
			01			Write retry count
			02			Read retry count
			03			Current translation table number
			04			Units of measure
				7-6		Tape speed
				5-4		Gap size
				3-2		Density
				1-0		Format
			05			Current gap size
			06			Current erase multiplier
			07-08			Recording density
			09-0A			Tape speed

6.3.4.20 Parameters 76 to 79

6.3.4.20.1 Block numbering parameter

This parameter is used to inform the master of the information carried in the addressee's Block Number field. This information is useful when the master uses special addressee functions, such as encryption or compression.

a) **Encrypted:** When set to 1, this bit informs the master that the addressee can mark encrypted blocks. If this function is supported, the master may encrypt data by block as opposed to encrypting an entire volume.

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b) **Compressed:** This bit informs the master that compressed blocks can be marked when written and detected when read. This allows the master to invoke compression on a block basis.

c) **Translated:** When set, this bit indicates that the addressee can mark and detect translated blocks.

6.3.4.20.2 Encryption parameter

This parameter contains vendor-unique encryption information, such as keys, passwords, and control data, required to set up and enable the addressee encryption mechanism.

Table 14 – Attributes parameters 76 to 79

@	LTH	ID	OCTET	X/b	DEF	ATTRIBUTE PARAMETERS
S	02	76				BLOCK NUMBERING PARAMETER
			01	7		Encrypted
				6		Compressed
				5		Translated
				4-0		reserved
M	n+1	77				ENCRYPTION PARAMETER
			01-n			Vendor Unique
S	n+1	78				TRANSLATION TABLE PARAMETER
			01			Translation table size
			02			Translation table number
			n - 1			Translation table size repeated as many
			n			Translation table number times as needed
B	n+1	79				TRANSLATION PARAMETER
			01			Translation table number
			02-n			Translation table (vendor unique)

6.3.4.20.3 Translation Table parameter

The Translation Table parameter is used by the addressee to report to the master the size of the translation tables specified by the Translation Table Number. If no Translation Table Number field is present in the parameter, the table size specified in the Translation Table Size field applies to all translation tables supported by the addressee. If more than one translation table size is supported by the addressee, the table size and table number fields may be repeated as many times as needed.

a) **Translation Table Size:** This field informs the master of the addressee's Translation Table size.

b) **Translation Table Number:** This field specifies the Translation Table for which the table size is provided.

6.3.4.20.4 Translation parameter

The translation parameter is used to transfer vendor-unique translation tables between the master and the addressee. The addressee shall report the Table Number and content of the Translation Table currently being used when requested by the master. The master may also use this parameter to load an alterable Translation Table contained in the addressee.

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6.4 REPORT ADDRESSEE STATUS

6.4.1 Command packet

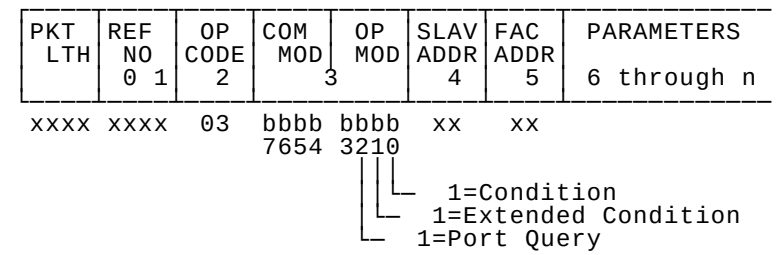

Figure 3 — Command packet for REPORT ADDRESSEE STATUS

6.4.2 Response packet

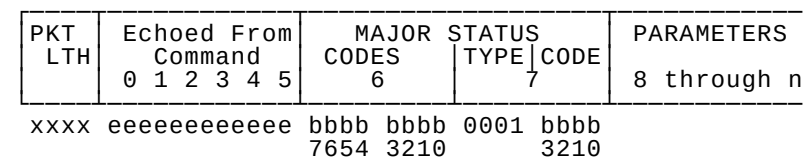

Figure 4 — Response packet for REPORT ADDRESSEE STATUS

6.4.3 Description

REPORT ADDRESSEE STATUS shall cause the slave to report the condition, status or port mask of the port or port(s) of the addressee. Execution of this command shall not clear any condition or status in the addressee.

One modifier bit is required for the execution of this command, and the bits are mutually exclusive.

If the Condition modifier is set, the slave shall report the condition (see ANSI X3.291:1997) of the addressee for the port or ports specified.

If the Status modifier is set, the slave shall report the status of the addressee. The response is a Vendor Unique parameter that includes information about the addressee. One of the uses of this command is to permit a master that has not been available or operational to establish the configuration of operating slaves. Status is device type and implementation dependent. It includes the current status of the addressee (e.g. which side an optical platter is loaded).

If the Port Query modifier is set, the slave shall report the addressee port mask(s) for the path over which the command was received. The master can use the Port Mask parameter(s) to find out which port, in a multi-ported slave, it is connected to.

NOTE The Path Control command provides the master with the capability of excluding other (presumed defective) masters from using a specific slave. The Port Mask defines the port that the master is connected to so that it can prevent excluding itself from port access.

6.4.4 Parameters 50 to 53

6.4.4.1 Port mask parameter

This parameter shall be as described in ANSI X3.291:1997.

6.4.4.2 Condition parameter

This parameter shall be as described in ANSI X3.291:1997.

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Table 15 – Report addressee status parameters 50 to 53

@	LTH	ID	OCTET	X/b	DEF	REPORT ADDRESSEE STATUS PARAMETERS
B	n+1	50	01-04			Port mask parameter
S	n+1	51	01-02			Condition
S	02	52				MEDIA STATUS
			01	7		Beginning of media
				6		End of media warning
				5		Media present
				4		Logical end of media warning
				3-2		reserved
				1		Default recording format
				0		Write protect
S	n+1	53	01-n			Status unqiue to the vendor

6.4.4.3 Media status

Media Status is a bit significant field used to inform the master of the tape drive general status in relation to the media.

a) **Beginning of media (BOM):** This bit, when set to 1, indicates that the tape is positioned at load point.

b) **End of media warning (EMW):** When set to 1, this bit informs the master that a previous command has left the media positioned at or beyond the EMW indicator (the reflective end of tape marker on reel-to-reel tape). When positioned before (on the logical BOM side) the EMW indicator, either because EMW has not yet been reached or because a subsequent operation leaves the media positioned before EMW, this bit shall be set to 0.

c) **Media present:** This bit informs the master that a volume is mounted and correctly loaded. This bit shall be set to 0 to inform the master of conditions such as broken tape or no volume mounted.

d) **Logical end of media (LEOM) warning:** This bit informs the master that the tape is positioned at the LEOM warning.

e) **Default recording format:** This bit, when set to 1, indicates that the tape drive is set to process data with the drive default recording density.

f) **Write protect:** When set, this bit indicates to the master that the tape volume is write protected (i.e., absence of a "write ring").

6.4.4.4 Vendor unique status

The field or fields, if any, in this parameter shall be specified in the vendor's documentation.

6.5 PORT ADDRESS

This command shall be as described in ANSI X3.291:1997.

6.6 PATH CONTROL

This command shall be as described in ANSI X3.291:1997.

6.7 ATTENTION CONTROL

This command shall be as described in ANSI X3.291:1997.

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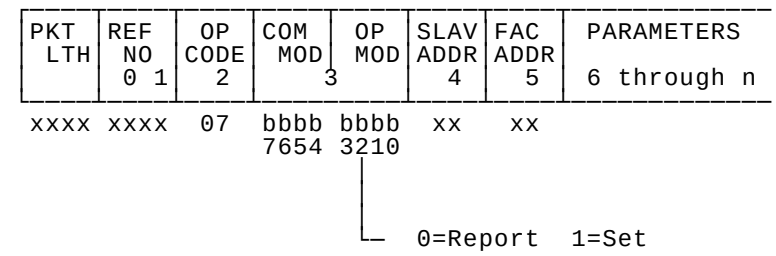
6.8 OPERATING MODE

6.8.1 Command packet



NOTE The polarity of the Set/Report bit is reversed between ANSI X3.291:1997 and this standard.

Figure 5 – Command packet for OPERATING MODE

6.8.2 Response packet

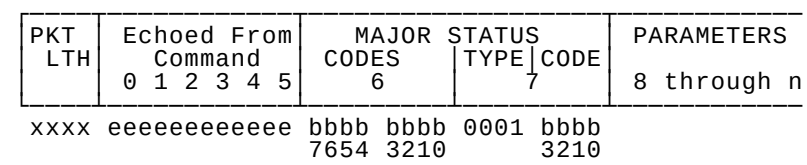


Figure 6 – Response packet for OPERATING MODE

6.8.3 Description

The OPERATING MODE command allows the master to change the operating modes of the slave or facility dynamically. The parameter field of the command packet defines what action the slave or facility is to take (for example, those associated with establishing device-unique operating characteristics, such as recording density on tape, removal of media, etc.).

The master may directly transfer commands to nonprimary data spaces, such as the CE Partition, IML Partition, etc. Data transfer commands shall be Chained or Sequenced to OPERATING MODE with the Partition parameter in order to access the data space desired.

Execution of transfer commands in slave-defined areas other than that for data may require different types of response information. The Response Conditions parameter is used to override the conditions established by Housekeeping Attributes.

The parameters associated with this command shall remain in effect until a subsequent Operating Mode command is issued with the SET modifier active, or until the volume is dismounted. The current Operating Mode shall not persist across partition boundaries.

6.8.4 Parameters 3E, 50, 53, 54

6.8.4.1 Partition (common) parameter

This parameter shall operate as described in ANSI X3.291:1997.

6.8.4.2 Response conditions parameter

This parameter shall operate as described in ANSI X3.291:1997.

6.8.4.3 Tape modes (bit significant) parameter

The first three octets of the Tape Modes parameter consist of pairs of bits used by the master to enable and disable optional features. Each pair consists of two bits that are mutually

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exclusive (for example, Enable Data Buffer and Disable Data Buffer). If neither of the two bits is set, no action shall be taken by the addressee.

The Disable Writing and Enable Writing bits provide a path for the master to remotely enable and disable writing on a volume. The Enable Writing bit shall not override a hardware write protect (for example, the "write ring" on reel-to-reel tape).

The fourth octet has two pairs of bits whose use is the same as that defined for the pairs of bits in the first three octets. A single bit is used to inform the addressee to employ its default recording density. If the recording density is to be anything other than the default recording density, it shall be set using the Recording Density field.

The fifth octet sets the mode of the Cartridge Loader (CL). The CL operates in one of three modes:

a) **Manual:** Cartridges are loaded and unloaded by the operator.

b) **System:** The host has control of cartridge loading and unloading.

c) **Automatic:** The CL automatically loads and unloads cartridges.

Table 16 – Operating mode parameters 3E, 50, 52

@	LTH	ID	OCTET	X/b	DEF	OPERATING MODE PARAMETERS
B	n+1	3E				Partition parameter
M	02	50				Response conditions
B	n+1	52				TAPE MODES (bit significant)
			01	7		On-line
				6		Off-line
				5		Enable suppress repositioning
				4		Disable suppress repositioning
				3		Fixed PhysicalBlock
				2		Variable PhysicalBlock
				1		Enable automatic error recovery
				0		Disable automatic error recovery
			02	7		Enable streaming mode
				6		Enable start/stop mode
				5		Enable variable gap
				4		Disable variable gap
				3		Enable data buffer
				2		Disable data buffer
				1		Enable writing
				0		Disable writing
			03	7		Enable stop at end of media warning
				6		Disable stop at end of media warning
				5		Enable block numbering
				4		Disable block numbering
				3		Enable encryption
				2		Disable encryption
				1		Enable compression
				0		Disable compression
			04	7		Enable translation
				6		Disable translation
				5		Enable auto speed control
				4		Disable auto speed control
				3		Default recording density
				2		Unrecognized format
				1-0		reserved
			05	7		Manual cartridge load
				6		System cartridge load
				5		Automatic cartridge load
				4-0		reserved

6.8.4.4 Parameter 53 - Tape modes (fields)

a) **Write retry count:** This is a 1-octet field containing an unsigned binary number that specifies the current setting of the write retry count. If this field is set to 0, the addressee is not enabled to perform automatic write retries.

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b) **Read retry count:** This is a 1-octet field containing an unsigned binary number that specifies the current setting of the read retry count. If this field is set to 0, the addressee is not enabled to perform automatic read retries.

c) **Translation table address:** This is a 1-octet field that specifies the translation table address currently being used by the addressee.

Table 17 – Operating mode parameter 53

@	LTH	ID	OCTET	X/b	DEF	OPERATING MODE PARAMETERS
B	n+1	53				TAPE MODES (FIELDS)
			01			Write retry count
			02			Read retry count
			03			Translation table address
			04			Units of measure
				7-6		Tape speed
				5-4		Gap size
				3-2		Density
				1-0		Format
			05			Gap size
			06			Erase multiplier
			07-08			Recording density
			09-0A			Tape speed
			0B-0E			DataBlock size
			0F-12			PhysicalBlock size
			13-16			Data buffer block size

d) **Units of measure:** This is a 1-octet field containing four 2-bit fields encoded to indicate the units of measure used by the master to interpret the associated tape Operating Mode field. Unassigned codes are reserved for vendor-unique units of measure.

bits 7-6 tape speed
- 00 = inch/second
- 01 = centimeters/second
- 10 = vendor units
- 11 = vendor units

bits 3-2 density
- 00 = bits/inch per track
- 01 = bits/millimeter per track
- 10 = vendor units
- 11 = vendor units

bits 5-4 gap size
- 00 = tenths of an inch
- 01 = millimeters
- 10 = centimeters
- 11 = vendor units

bits 1-0 format
- 00 = ISO
- 01 = vendor units
- 10 = vendor units
- 11 = vendor units

e) **Gap size:** This is an unsigned binary number that specifies the current gap size the addressee is configured to write, expressed in units defined in the Units of Measure field.

f) **Erase multiplier:** This bit informs the master of the current erase multiplier value to be used in calculating a long erase gap.

g) **Recording format:** This is an unsigned binary number used to report the addressee's current recording density expressed in units specified in the Units of Measure field. If ISO format is specified in the Units Specifier (bits 1-0), the encoding scheme used to record data on the media shall be specified by the density (i.e., 1600 is Phase Encoded, 6250 is Group Coded, etc.).

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h) **Tape speed:** This is an unsigned binary number used to specify the current setting of tape speed in units contained in the Units of Measure field.

i) **DataBlock size:** This is an unsigned binary number used to specify the DataBlock Size, in octets.

j) **PhysicalBlock size:** This is an unsigned binary number used to specify the PhysicalBlock Size, in octets. This may or may not be equal to the DataBlock Size.

k) **Data buffer block size:** This is an unsigned binary number used to specify the block size in the data buffer. This number may or may not be equal to the DataBlock Size or PhysicalBlock Size.

6.8.4.5 Operating mode parameter 54 - Data operation

This parameter is used to inform the addressee of special operations to be performed on the data being written or read.

Table 18 – Operating mode parameter 54

@	LTH	ID	OCTET	X/b	DEF	OPERATING MODE PARAMETERS
M	n+1	54				DATA OPERATION PARAMETER
			01		7	Compress
					6	Encrypt
					5	Translate
					4-0	reserved
			02			Translation Index

a) **Compress:** This bit indicates that the addressee is to compress or decompress the data. If, during a Read operation, the addressee detects that the block being read is not compressed, this bit shall be ignored.

b) **Encrypt:** This bit informs the addressee that the data is to be encrypted or decrypted. If, during a Read operation, the addressee detects that the block being read is not encrypted or if the master has not properly set up and enabled the encryption function, the addressee shall transfer the data as read and shall ignore the Encrypt bit.

c) **Translate:** This bit indicates to the addressee that it shall translate the data being written or read and shall use the translation table indicated by the Translation Index octet.

d) **Translation index:** This is a hexadecimal code that identifies the translation table within the addressee that is to be used. Valid codes are x'01' through x'FF'. The translation indexes supported by the addressee are reported in ATTRIBUTES.

6.9 ABORT

This command is identical to the ABORT command described in ANSI X3.291:1997 and the same requirements shall be observed.

6.10 ACCESS PERMITS

This command is identical to the ACCESS PERMITS command described in ANSI X3.291:1997 and the same requirements shall be observed. Note that in the Tape Situation, access permits are normally defined on a partition basis only, and thus no 31, 32 and 3A parameters are used.

6.11 RESUME

This command is identical to the RESUME command described in ANSI X3.291:1997 and the same requirements shall be observed.

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6.12 PORT RESPONSE

This command is identical to the PORT RESPONSE command described in ANSI X3.291:1997 and the same requirements shall be observed.

6.13 ANTICIPATED ACTION

This command is identical to the ANTICIPATED ACTION command described in ANSI X3.291:1997 and the same requirements shall be observed.

6.14 OPERATOR DISPLAY

This command is identical to the OPERATOR DISPLAY command described in ANSI X3.291:1997 and the same requirements shall be observed.

7 Position commands

7.0 General

The commands in this clause require the Command Extent parameter unless otherwise noted.

7.1 SPACE BLOCK/FILE MARK

7.1.1 Command packet

```
┌────┬────┬────┬────┬────┬────┬────┬──────────────
│PKT │REF │ OP │COM │ OP │SLAV│FAC │  COMMAND
│ LTH│ NO │CODE│ MOD│ MOD│ADDR│ADDR│ PARAMETERS
│    │ 0 1│  2 │    3    │  4 │  5 │ 6 through n
└────┴────┴────┴────┴────┴────┴────┴──────────────
 xxxx xxxx  40  bbbb bbbb  xx   xx
                7654 3210
                     ││││
                     ││└─  0=Block  1=File Mark
                     │└─  1=Stop at End of Track
                     └─  1=Logical End Of Media Warning (LEOM)
                     └─  Direction  0=Forward  1=Reverse
```

Figure 7 – Command packet for SPACE BLOCK/FILE MARK

7.1.2 Response packet

```
┌────┬──────────────┬──────────────────────┬──────────────
│PKT │ Echoed From│   MAJOR STATUS     │  RESPONSE
│ LTH│   Command  │ CODES   │TYPE│CODE│ PARAMETERS
│    │ 0 1 2 3 4 5│    6    │    7    │ 8 through n
└────┴──────────────┴──────────────────────┴──────────────
 xxxx eeeeeeeeeeee bbbb bbbb 0001 bbbb
                   7654 3210      3210
```

Figure 8 – Response packet for SPACE BLOCK/FILE MARK

7.1.3 Description

The SPACE BLOCK/FILE MARK command causes the tape facility to position (in the direction specified by the modifier octet) over the number of Blocks/File Marks specified in the Extent parameter, if present. Upon normal completion of this command, the tape shall be positioned to process the next recorded element immediately following the last Block/File Mark spaced over, in the same direction as the space that was just completed. If no Extent parameter accompanies this command, the addressee shall space over one Block/File Mark. Data is not transferred by this command and data errors, if any, are not reported.

If the Block modifier is set and an Extent parameter is present, the facility spaces over the number of Blocks specified in the Count in the direction specified.

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If a File Mark is detected before the count is exhausted, the tape shall be positioned to process the next sequential recorded element after the file mark in the specified direction. The command shall then be terminated with the appropriate status and a Residual Count in the Response Extent parameter.

If the addressee encounters PEOM before the count is exhausted, the command shall terminate with the appropriate status and a residual count in the Response Extent Parameter.

If the reverse modifier is set and BOM is detected before the count is exhausted, the tape shall be positioned at BOM. The command shall then be terminated with the appropriate status and a residual count in the Response Extent Parameter.

If the File modifier is set and an Extent parameter is present, the Facility shall position the tape in the direction specified, stopping after detecting the number of File Marks specified in the count, and shall then position the tape in preparation for processing the next sequential recorded element in the specified direction.

If PEOM is encountered before the File Mark count is exhausted, the command shall terminate with the appropriate status and a residual count in the Response Extent Parameter.

If the Reverse modifier is set and BOM is encountered before the File Mark count is exhausted, positioning shall be stopped at the beginning of the media and the command shall be terminated with the appropriate status and a residual count in the Response Extent Parameter.

A LEOM Warning is an optional recorded tape mark that may be used to separate two large data sets on tape or mark the end of the recorded portion of the media. If the LEOM modifier is set, the addressee shall position in the direction specified and shall stop; prepared to process the first recorded element after LEOM in the same direction. If PEOM is encountered before a LEOM is detected, the addressee shall terminate the command with the appropriate status. If the reverse modifier is set and BOM is encountered before a LEOM is detected, the addressee shall position to BOM and the command shall be terminated with the appropriate status.

NOTE LEOM is a vendor-unique function and no attempt is made in this standard to define the actual mark on the tape or the way in which the mark is detected or used. It should be noted, however, that the implementation of a LEOM could affect interchangeability of tapes between devices that support LEOM and devices that do not support LEOM. One possible implementation would be two successive tape marks recorded on the media. This implementation would allow a device to use the LEOM function without affecting the interchangeability of the volume.

For facilities with automatic track addressing, an end of track condition shall cause the slave to select the next track, in the appropriate direction, and to continue spacing as instructed by the command. Automatic track selection shall continue until either the command is completed or BOM or PEOM is detected. Automatic track selection may be inhibited by the Stop at End of Track modifier.

The data address field of the Command and Response Extent is not used by the SPACE BLOCK/FILE MARK.

NOTE The POSITION CONTROL command is the preferred command for positioning the media on addressees that are capable of positioning to a specified block address. The SPACE BLOCK/FILE MARK command is provided for addressees that do not support implicit positioning and cannot position the media to a specified block address.

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7.1.4 Parameters 31, 32, 35

7.1.4.0 General

Table 19 — Space block/file mark parameters 31, 32, 35

@	LTH	ID	OCTET	X/b	DEF	SPACE BLOCK/FILE MARK PARAMETERS
M	n+1	31				COMMAND EXTENT
			01-04			Count
			05-08			Data Address (Set to 0)
S	n+1	32				RESPONSE EXTENT
			01-04			Residual Count
			05-08			Data Address (Set to 0)
M	05	35	01-04			Access Key parameter

7.1.4.1 Command Extent (common) parameter

This parameter shall be as described in ANSI X3.291:1997. This parameter is used to specify the number of blocks or file marks to be spaced over.

7.1.4.2 Response Extent (common) parameter

This parameter shall be as described in ANSI X3.291:1997. If the command should fail, this parameter is used to report the number of file marks or blocks remaining to be spaced.

7.1.4.3 Access Key (common) Parameter

This parameter shall be as described in ANSI X3.291:1997.

7.2 POSITION CONTROL

7.2.1 Command packet

PKT LTH	REF NO 0 1	OP CODE 2	COM MOD 3	OP MOD	SLAV ADDR 4	FAC ADDR 5	COMMAND PARAMETERS 6 through n
xxxx	xxxx	41	bbbb	bbbb	xx	xx	
			7654	3210			

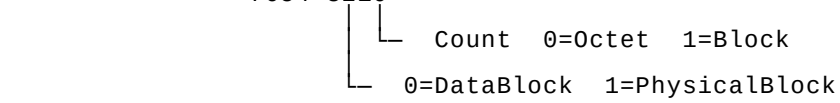

Figure 9 – Command packet for POSITION CONTROL

7.2.2 Response packet

PKT LTH	Echoed From Command 0 1 2 3 4 5	MAJOR STATUS CODES 6	TYPE	CODE 7	RESPONSE PARAMETERS 8 through n
xxxx	eeeeeeeeeeee	bbbb bbbb	0001	bbbb	
		7654 3210		3210	

Figure 10 — Response packet for POSITION CONTROL

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7.2.3 Description

The count modifier is not used for tapes.

The POSITION CONTROL command causes the tape to be positioned according to the Extent parameter Data Address, which may be either logical or physical (for example, on tape, it may be serpentine head position). The Tape Position parameter is mutually exclusive with the Command Extent parameters.

If the Tape Position parameter has the Load bit set and a Parameter 54 with a length of 1 is included with the command, then the Report Volume Attributes parameter is included in the Response packet.

If the Tape Position parameter has the Initialize Position bit set and a Parameter 55 is included with the command, then the bits in Parameter 55 shall determine the Volume Attributes of the media, regardless of the previous Attributes.

If the addressee is positioning to a block specified by the Command Extent Data Address and a block numbering sequence error is detected, the command shall be terminated with Incomplete status and Block Not Found substatus. If PEOM, BOM, or a Tape Mark is encountered before the block is found, the command shall be terminated with the appropriate status.

The Count field of the Command and Response Extent parameters is not used by the POSITION CONTROL command.

7.2.4 Parameters 31, 32, 35, 3A, 3E, 51, 52, 53, 54, 55

7.2.4.1 Command Extent (common) parameter

This parameter shall be as described in ANSI X3.291:1997. This parameter is used to define the Data Address at which a tape is to be positioned. The Count field is not used.

7.2.4.2 Response Extent (common) parameter

This parameter shall be as described in ANSI X3.291:1997. If the command fails, this parameter is used to return the Data Address of the last block accessed prior to failure. The Count field is not used.

7.2.4.3 Access Key (common) parameter

This parameter shall be as described in ANSI X3.291:1997.

7.2.4.4 Data Address (common) parameter

This parameter shall be as described in ANSI X3.291:1997.

7.2.4.5 Partition (common) parameter

This parameter shall be as described in ANSI X3.291:1997.

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Table 20 – Position control parameters 31 to 32, 35, 3A, 3E, 51 to 53

@	LTH	ID	OCTET	X/b	DEF	POSITION CONTROL PARAMETERS
M	n+1	31				COMMAND EXTENT PARAMETER
			01-04			Count (not used)
			05-08			Data Address
S	n+1	32				RESPONSE EXTENT PARAMETER
			01-04			Residual Count (not used)
			05-08			Data Address
M	05	35	01-04			Access Key parameter
B	n+1	3A				Data Address parameter
M	n+1	3E				Partition parameter
M	02	51	01			TAPE POSITION PARAMETER *
				7		Initialize position *
				6		Position to beginning *
				5		Unload *
				4		Load *
				3		Rewind *
				2		Synchronize *
				1		Retension *
				0		Position to end of media warning *
M	n+1	52				CARTRIDGE SOURCE ADDRESS
			01-n			Address
M	n+1	53				CARTRIDGE DESTINATION ADDRESS
			01-n			Address
						* mutually exclusive

7.2.4.6 Tape position parameter

a) **Initialize position:** When set, this bit causes the addressee to position the tape to its initial position and to perform whatever initial load action it would normally perform when a new volume is installed. An example might be to rewind to BOM, read the ID burst on the media, initialize speed and density consistent with the volume mounted and prepare to process the first record in the forward direction.

b) **Position to beginning:** When set, this bit causes the addressee to position the tape to the beginning of the data area on the tape and to prepare to process the first record in the forward direction.

c) **Unload:** When set, this bit causes the addressee to position the tape in preparation for removal from the device.

NOTE When the Cartridge Loader (CL) is present and in system mode, the host designates (via the Cartridge Destination parameter) the destination location for cartridge unloads. If no destination parameter is supplied, the CL will unload the cartridge to the next available location.

d) **Load:** When set, this bit causes the addressee to position a newly mounted volume in preparation for executing commands directed to the addressee and to perform whatever initialization procedures are necessary to make the volume accessible to the master (for example initialize speed and density, read volume ID, prepare to move tape and the like).

NOTE When the CL is present and in system mode, the CL will load the cartridge from the location specified by the Cartridge Source Address. If no Cartridge Source Address parameter is supplied, the CL will load the next available cartridge into the tape drive.

e) **Rewind:** When set, this bit causes the addressee to position to the beginning of the media (for example, the BOM marker on the tape) and to prepare to move in the forward direction.

f) **Synchronize:** When set, this bit instructs the addressee to record all data that may be in its buffer on the media. This bit is associated with cached devices in which data may have been received and a good response sent to the master, but the data actually had not been recorded on tape.

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g) **Retension:** When set, this bit causes the addressee to perform whatever internal procedures are necessary to redistribute tension on the tape and then return to the position on tape at which the command was received.

h) **Position to end of media warning:** When set, this bit instructs the addressee to position to the beginning of the first recorded element beyond the EMW marker.

7.2.4.7 Cartridge source address parameter

The cartridge source address parameter specifies the location a cartridge is to be retrieved from.

7.2.4.8 Cartridge destination address parameter

The cartridge destination parameters specifies the location a cartridge is to be placed.

Table 21 – Position control parameters 54, 55

@	LTH	ID	OCTET	X/b	DEF	POSITION CONTROL PARAMETERS
B	n+1	54				REPORT VOLUME ATTRIBUTES
			01			reserved
			02	7-4		reserved
			02	3		
				to		Volume Definition
			03	0		
			04	7-4		reserved
				3-0		Volume Media Length
			05	7-0		Compression Scheme used
			06	7-0		Encryption Scheme used
			07	7		Translation
				6-0		reserved
			08	7		Volume Write Protect
				6		Write Retry
				5		Write Unconditional
				4		Write Append
				3		Optional correction
				2		Alternate numbering
				1-0		reserved
			09	7-0		Volume Stripe Number
			0A	7-0		Number of Volumes in Stripe set
			0B-13			Stripe set Identifier (ISO646/ASCII)
			14-64			ANSI Volume Label
M	n+1	55				SET VOLUME ATTRIBUTES
			01-04			reserved
			05	7-0		Compression Scheme to be used
			06	7-0		Encryption Scheme to be used
			07	7		Translation
				6-0		reserved
			08	7		Volume Write Protect
				6		Write Retry
				5		Write Unconditional
				4		Write Append
				3		Optional correction
				2		Alternate numbering
				1-0		reserved
			09	7-0		Volume Stripe Number
			0A	7-0		Number of Volumes in Stripe set
			0B-13			Stripe set identifier (ISO646/ASCII)
			14-64			ANSI Volume Label

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7.2.4.9 Report volume attributes

a) **Volume definition:** This is a twelve bit field which indicates the standard which defines both the media and its packaging. Values are:

x`000'	ISO/IEC 9661:1994 (3480 cartridge)
x`001'	ISO/IEC 11559:1993 (extended format)
x`002'	reserved
x`003'	ISO/IEC 14251:1995 (3490E cartridge)
x`004'	ISO/IEC 14840:1996 (helical-scan half-inch cartridge)
x`005'	X3B5/852D (helical-scan 19 mm)
x`006' to x`3FF'	reserved
x`400'	reserved
x`401'	SMPTE D1, ISO/IEC 14417:1999 (DD-1)
x`402'	SMPTE D2, (DD2)
x`403'	SMPTE D3
x`404' to x`5FF'	reserved
x`600'	VHS
x`601' to x`60F'	reserved
x`610'	Beta
x`611' to x`7FF'	reserved
x`800'	8 mm helical scan
x`801' to x`80F'	reserved
x`810'	X3.202-199x (4 mm DAT)
x`811'	X3.203-199x (4 mm DDS)
x`812' to x`8FF'	reserved
x`900'	CREO
x`901' to x`BFF'	reserved
x`C00' to x`FFF'	vendor unique

b) **Volume media length:** This is a four bit field which indicates the length of media contained in the package. Values are:

0000 to 0100	Shortest to Standard
0111	Longest
1000	unknown
1001 to 1111	vendor unique

c) **Compression scheme used:** This is a one byte field which indicates that the data was recorded on the media using a particular compression algorithm. The compression scheme identification is referenced to the volume definition above. Values are:

x`00'	No Compression
x`01'	Compression Scheme #1
x`10' to x`3F'	Compression Scheme#63
x`40' to x`7F'	reserved
x`80' to x`FF'	vendor unique

d) **Encryption scheme used**: This is a one byte field which indicates that the data was recorded on the media using a particular encryption algorithm. The encryption scheme identification is referenced to the volume definition above. Values are:

x`00'	No Encryption
x`01'	Encryption Scheme #1
x`10' to x`3F'	Encryption Scheme#63
x`40' to x`7F'	reserved
x`80' to x`FF'	vendor unique

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e) **Translation:** This bit indicates that the data was recorded on the media using a translation table.

f) **Volume Write Protect:** This bit indicates that a mechanical device included with the media is indicating that the media is write-protected.

g) **Write Retry:** This bit indicates that data was recorded on the media by a device which was able to rerecord data at another position in the event of a detected failure in the first recording.

h) **Write Unconditional:** This bit indicates that data was recorded on the media by a device which performed no readback checks.

j) **Write Append:** This bit indicates that data already recorded on the media cannot be overwritten or erased, but new data can be appended.

k) **Optional Correction:** This bit indicates that data was recorded on the media using a correction scheme which is identified by the format standard for the media as optional.

m) **Alternate Numbering:** This bit indicates that data was recorded on the media using a block numbering scheme which is identified by the format standard for the media as optional.

n) **Volume Stripe Number:** This is a one byte field which contains an unsigned binary number. When this field is non-zero, it indicates that this Volume is a member of a Stripe set, and the number indicates the number of the Volume within that Stripe set. When this field is zero, the Volume is not part of a Stripe set.

o) **Number of Volumes in Stripe set:** This is a one byte field which contains an unsigned binary number. When this field is non-zero, it indicates the total number of Volumes in the Stripe set of which this Volume is a member. When this field is zero, the Volume is not part of a Stripe set.

p) **Stripe set Identifier:** This is a nine byte field which contains a string which identifies the Stripe set of which the Volume forms a part.

q) **ANSI Volume Level:** This field contains the First Start of Volume Label (VOL1), which was recorded on the media.

7.2.4.10 Set Volume Attributes

a) **Compression:** This is a one byte field which selects the algorithm with which data is to be recorded on the media. Details of the algorithm may be found by referencing the Volume definition above. Values are:

x`00' No Compression
x`01' Compression Scheme #1
x`10' Compression Scheme #2
to
x`3F' Compression Scheme#63

b) **Encryption:** This bit indicates that the data is to be recorded on the media using a compression algorithm.

c) **Translation:** This bit indicates that the data is to be recorded on the media using a translation table.

d) **Write Retry:** This bit indicates that if data recorded on the media is detected as incorrect by a readback check, it is to be rerecorded at another position on the media.

e) **Write Unconditional:** This bit indicates that data is to be recorded on the media without any readback checks being performed.

f) **Write Append:** This bit indicates that data already recorded on the media cannot be overwritten or erased, but new data can be appended.

g) **Optional Correction:** This bit indicates that data is to be recorded on the media using a correction scheme which is identified by the format standard for the media as optional.

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h) **Alternate Numbering:** This bit indicates that data is to be recorded on the media using a block numbering scheme which is identified by the format standard for the media as optional.

i) **Volume Stripe Number:** This is a one byte field which contains an unsigned binary number. When this field is non-zero, it indicates that this Volume will be a member of a Stripe set, and the number indicates the number of the Volume within that Stripe set. When this field is zero, the Volume will not be part of a Stripe Set.

j) **Number of Volumes in Stripe set:** This is a one byte field which contains an unsigned binary number. When this field is non-zero, it indicates the total number of Volume which there will be in the Stripe set of which this Volume is a member. When this field is zero, the Volume will not be part of a Stripe set.

k) **Stripe set Identifier:** This is a nine byte field which contains an string which will form an identifier of the Stripe set of which the Volume will form a part.

l) **ANSI Volume Level:** This field contains the First Start of Volume Label (VOL1), which is to be recorded on the media.

7.3 REPORT POSITION

7.3.1 Command packet

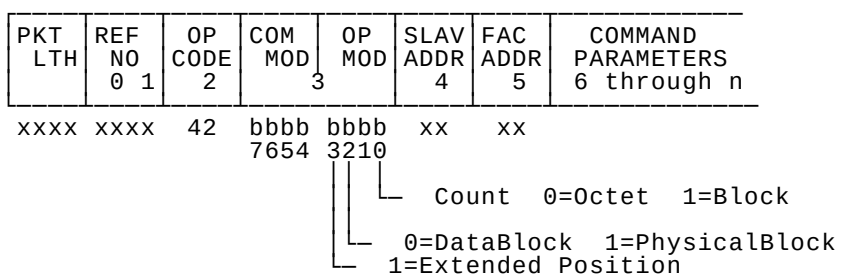

Figure 11 – Command packet for REPORT POSITION

7.3.2 Response packet

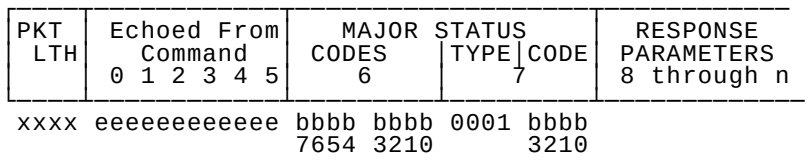

Figure 12 – Response packet for REPORT POSITION

7.3.3 Description

The Count field is not used for tape. The REPORT POSITION command instructs the addressee to report its current position. The position is returned in the Data Address field of the Response Extent parameter. On an addressee that is fully buffered, this command can also be used to determine how much data is remaining in the buffer and how much has been fixed on the media by use of the Extended Position parameter. The Extended Position parameter shall only be appended to the response when the Extended Position modifier is set to 1.

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7.3.4 Parameters 32, 35, 3A, 3E, 51-52

7.3.4.1 Response Extent (common) parameter

This parameter is used to return the Data Address of the current position of the media (i.e., the address of the next sequential record to be processed in the forward direction). The residual count is not used.

NOTE The Response Extent may not be sufficient for the master to manage fully buffered devices.

7.3.4.2 Access Key (common) parameter

This parameter shall be as described in ANSI X3.291:1997.

7.3.4.3 Data Address (common) parameter

This parameter shall be as described in ANSI X3.291:1997.

7.3.4.4 Partition (common) parameter

This parameter shall be as described in ANSI X3.291:1997.

Table 22 – Report position parameters 32, 35, 3A, 3E, 51, 52

@	LTH	ID	OCTET	X/b	DEF	REPORT POSITION PARAMETERS
S	n+1	32				RESPONSE EXTENT PARAMETER
			01-04			Residual count
			05-08			Data Address
M	05	35	01-04			Access Key parameter
S	n+1	3A				Data Address parameter
S	n+1	3E				Partition parameter
S	09	51				EXTENDED POSITION
			01-04			Logical position
			05-08			Physical position
S	02	52				MEDIA POSITION
			01	7		Beginning of media
				6		End of media warning
				5		Media present
				4		Logical End of Media (LEOM)
				3-2		reserved
				1		Default recording format
				0		Write protect

7.3.4.5 Extended position

This parameter is used to report the logical and physical position of the media. This information is useful to a master that is attempting to recover data from an addressee that has experienced an unrecoverable error and still has data in its buffer that has not yet been fixed to the media.

a) **Logical position:** This field contains the address of the next recorded element to be transferred. The address reported shall always be the address of the next recorded element to be processed in the forward direction.

b) **Physical position:** This field contains the address of the next recorded element to be transferred between the media and the buffer. The address reported shall always be the address of the next recorded element to be processed in the forward direction.

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All recorded elements that are in the buffer which have not been fixed to the media are reported by the addressee (i.e., the buffer may hold tape marks as well as data).

7.3.4.6 Media Position

This is a bit-significant octet used to report the general position of the media to the master.

a) **Beginning of media:** This bit, when set to 1, indicates that the tape is positioned at load point.

b) **End of Media Warning:** When set to 1, this bit informs the master that a previous command has left the media positioned at or beyond the EMW indicator (the reflective EOT marker on reel to reel tape). When positioned before the EMW indicator (on the logical BOM side), either because the EMW has not yet been reached, or because a subsequent operation leaves the media positioned before EMW, this bit shall be set to 0.

c) **Media present:** This bit informs the master that a volume is mounted and correctly loaded. This bit shall be set to 0 to inform the master of such conditions as broken tape or no volume mounted.

d) **Logical End of Media:** This bit informs the master that the tape is positioned at the LEOM warning.

e) **Default recording format:** This bit, when set to 1, indicates that the tape drive is set to process data with the drive default recording density.

f) **Write protect:** When set, this bit indicates to the master that the tape volume is write protected (i.e., the absence of a "write ring").

7.4 RECORD POSITION

7.4.1 Command packet

PKT LTH	REF NO 0 1	OP CODE 2	COM MOD 3	OP MOD	SLAV ADDR 4	FAC ADDR 5	COMMAND PARAMETERS 6 through n
xxxx	xxxx	43	bbbb 7654	bbbb 3210	xx	xx	

1=Record and report position

Figure 13 – Command packet for RECORD POSITION

7.4.2 Response packet

PKT LTH	Echoed From Command 0 1 2 3 4 5	MAJOR STATUS CODES 6	TYPE	CODE 7	RESPONSE PARAMETERS 8 through n
xxxx	eeeeeeeeeeee	bbbb 7654	bbbb 3210	0001	bbbb 3210

Figure 14 – Response packet for RECORD POSITION

7.4.3 Description

The RECORD POSITION command instructs the facility to record at its current position the tape mark defined by the tape mark parameter.

The Record and report position modifier, when set, indicates to the addressee that it is to record its current Data Address on the medium and report it to the master. The objective of storing the positioning information is to optimize future positioning operations. At the successful completion of any other operations of this command, the current Data Address of the medium will be recorded in a special area on the medium. This Data Address will be reported to the master in the Data Address parameter of the command completion response.

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When the master uses this Data Address for subsequent positioning operations, the addressee will be able to optimize the positioning based on the information previously recorded in the special area of the medium.

7.4.4 Parameters 31, 32, 35, 51

7.4.4.1 Command Extent (common) parameter

This parameter shall be as described in ANSI X3.291:1997. The Command Extent parameter, if present, specifies the number of times the specified tape mark is to be recorded. If the Data Address is any value other than zero, it shall agree with the current position of the addressee (e.g., if on multi-track tape, a serpentine track number in the Data Address shall agree with the track upon which the addressee is to Record Position). If the Command Extent parameter is not present and the Record and report position modifier is not set, one tape mark shall be recorded.

Table 23 – Record position parameters 31, 32, 35, 3A, 51

@	LTH	ID	OCTET	X/b	DEF	RECORD POSITION PARAMETERS
M	n+1	31				COMMAND EXTENT
			01-04			Count
			05-08			Data Address
S	n+1	32				RESPONSE EXTENT
			01-04			Residual count
			05-08			Data Address
M	05	35	01-04			Access Key parameter
S	n+1	3A				Data Address parameter
M	02	51	01			TAPE MARK PARAMETER
				7		File Mark *
				6		Beginning Of File *
				5		End Of File *
				4		Logical End Of Media (LEOM) *
				3-0		reserved
						* Mutually exclusive

7.4.4.2 Response Extent (common) parameter

This parameter shall be as described in ANSI X3.291:1997. If the command fails, this parameter shall be used to report to the master the number of tape marks remaining to be recorded. The Data Address field shall not be used.

7.4.4.3 Access Key (common) parameter

This parameter shall be as described in ANSI X3.291:1997.

7.4.4.4 Data Address (common) parameter

This parameter shall be as described in ANSI X3.291:1997. If this command completes successfully and the Record and report position modifier is set, the current position of the media shall be returned in the Data Address field.

7.4.4.5 Tape Mark parameter

This is a bit significant octet used to specify the mark to be recorded on the media. When this parameter is present, the specified Tape Mark shall be recorded. If the Tape Mark parameter is not present, a File Mark shall be recorded.

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The bits of the Tape Mark parameter are mutually exclusive and shall only be set one at a time.

a) **File Mark:** When set, this bit specifies that a File Mark is to be recorded.

b) **Beginning of File:** This bit instructs the addressee to record a Beginning of File mark.

c) **End of File:** This bit instructs the addressee to record an End of File mark.

d) **Logical End of Media:** When set, this bit instructs the addressee to record a Logical End of Media Warning mark.

7.5 Reserved

For use only in ANSI X3.291:1997.

8 Transfer commands

8.0 General

Transfer commands allow for multiple block transfers across physical boundaries. Upon recognizing a transfer command, the slave or facility shall position to the Data Address specified in the Command Extent parameter, locate the block and perform the required action. The command terminates when the amount of data specified by the Count has been transferred, or an error occurs that requires earlier termination. The status provided in the response packet shall identify what actions occurred during the execution of the command.

When a transfer command that reads data from the medium is executed in the reverse direction, the first octet read from the medium shall be the first octet transferred to the master (i.e., logically the last octet written is the first octet read).

8.1 READ

8.1.1 Command packet

PKT LTH	REF NO 0 1	OP CODE 2	COM MOD 3	OP MOD	SLAV ADDR 4	FAC ADDR 5	COMMAND PARAMETERS 6 through n
xxxx	xxxx	10	bbbb 7654	bbbb 3210	xx	xx	

Count 0=Octet 1=Block
Data Recovery 0=On 1=Off
0=DataBlock 1=PhysicalBlock
Direction 0=Forward 1=Reverse

Figure 15 – Command packet for READ

8.1.2 Response packet

PKT LTH	Echoed From Command 0 1 2 3 4 5	MAJOR STATUS CODES 6	TYPE 7	CODE 7	RESPONSE PARAMETERS 8 through n
xxxx	eeeeeeeeeeee	bbbb bbbb 7654 3210	0001	bbbb 3210	

Figure 16 – Response packet for READ

8.1.3 Description

The READ command transfers data from the addressee to the master starting at the location given in the Data Address of the Command Extent parameter or at the current location if implicit positioning is not supported. When the addressee supports implicit positioning and positioning is required before the data can be accessed, the slave shall initiate the positioning

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operation. If the addressee does not support implicit positioning, the master shall position the media explicitly, and the Data Address of the Command Extent parameter shall be ignored by the slave. [See the SPACE BLOCK/FILE MARK command (7.1) and the POSITION CONTROL command (7.2) for details of the positioning operation.]

When the access is complete, the addressee shall read, and transfer to the master, the number of sequentially addressed blocks or octets specified by the Count. If the Command Extent parameter is not appended to the READ command, one block shall be sent to the master starting at the current position. (The count modifier shall be ignored.)

When the Data Recovery modifier is set to On (data recovery enabled), the slave or facility shall initiate data error recovery to attempt to recover data read with errors. If the error is unrecoverable, data shall be transferred up to the error and the command shall terminate. If the recovery attempts are successful, the transfer shall continue until all of the requested data has been transferred.

When the modifier specifies blocks to be transferred, a partial block in error may be transferred to the master. However, the Residual Count in the Response Extent parameter shall indicate that the block in error was not transferred. When the addressee has received a read command specifying an octet transfer, data shall be transferred up to the octet in error and the Residual Count shall indicate the remaining octets to be transferred.

When the Data Recovery modifier is set to Off (data recovery disabled), the slave or facility shall terminate the command if a data error is detected. The data in error shall be transferred. Recovery from non-data transfer errors are not suppressed by the Data Recovery Off modifier.

If a File Mark or End Of Media is encountered during a transfer, the command shall be terminated and the appropriate status and substatus codes shall be sent to the master. If, while reading in the reverse direction, a File Mark or the Beginning Of Media is detected, the command shall be terminated, and Incomplete Status with the appropriate substatus code shall be returned to the master in the command response.

If the READ command modifier specified an octet transfer and the end of the block to be read was encountered before the Count in the Command Extent parameter was exhausted, the command shall be terminated with Incomplete status and Length Error indicated in Substatus.

The slave shall present only valid data to the master if the Data Recovery modifier is set. Recovery from data errors detected during reading shall be attempted by the slave prior to transfer of the data in error to the master. If the data error is not corrected by the slave, processing of the command shall be terminated with a Machine Exception indicated in Major Status. The cause of the termination shall be indicated in substatus and extended substatus (if applicable).

8.1.4 Parameters 31 to 32, 3A, 35, 3E, 51, 52

8.1.4.1 Command Extent (common) parameter

This parameter shall be as described in ANSI X3.291:1997. The Count specifies the number of blocks (or octets) to be transferred and cannot be zero. A zero value shall cause the command to be terminated with a Command Exception. The Data Address specifies the starting location. If the Data Address is not valid for the addressee, processing shall be terminated with Command Exception.

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8.1.4.2 Response Extent (common) parameter

This parameter shall be as described in ANSI X3.291:1997. This parameter shall be used to return the Residual Count of blocks (or octets) remaining in the transfer after it terminated. The Data Address varies in accordance with those modifiers that have been set.

8.1.4.3 Access Key (common) parameter

This parameter shall be as described in ANSI X3.291:1997.

8.1.4.4 Data Address (common) parameter

This parameter shall be as described in ANSI X3.291:1997.

8.1.4.5 Transfer (common) parameter

This parameter shall be as described in ANSI X3.291:1997.

8.1.4.6 Partition (common) parameter

This parameter shall be as described in ANSI X3.291:1997.

8.1.4.7 Information Transfer Size Override parameter

This parameter shall be as described in ANSI X3.291:1997.

8.1.4.8 Master termination permitted parameter

This parameter shall be as described in ANSI X3.291:1997.

Table 24 – Read parameters 31, 32, 35, 3A, 3C, 3E, 51, 52

@	LTH	ID	OCTET	X/b	DEF	READ PARAMETERS
M	n+1	31				COMMAND EXTENT PARAMETER
			01-04			Count
			05-08			Data Address
S	n+1	32				RESPONSE EXTENT PARAMETER
			01-04			Residual count
			05-08			Data Address
M	05	35	01-04			Access Key parameter
B	n+1	3A				Data Address parameter
M	04	3C				Transfer parameter
M	n+1	3E				Partition parameter
M	n+1	51	01-04			Information transfer size override parameter
M	01	52				Master termination permitted parameter

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8.2 READ RAW DATA

8.2.1 Command packet

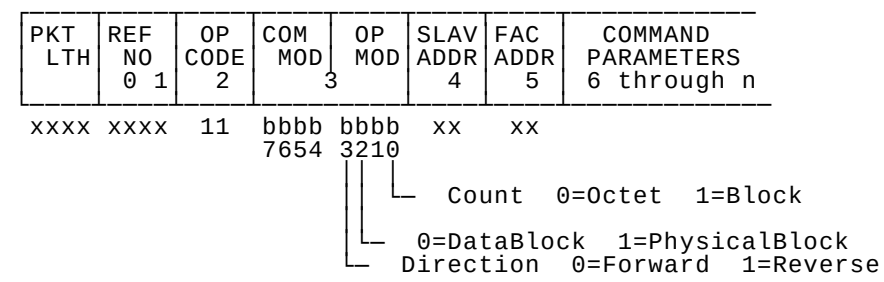

Figure 17 – Command packet for READ RAW DATA

8.2.2 Response packet

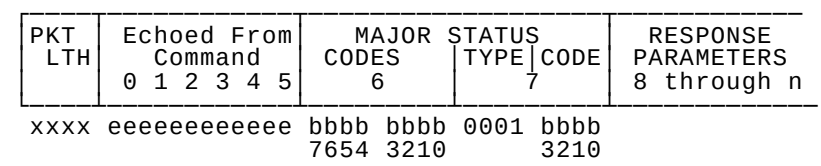

Figure 18 — Response packet for READ RAW DATA

8.2.3 Description

The READ RAW DATA command reads data from the addressee and transfers it to the master, regardless of data errors encountered in the read. An error shall be reported only if the data cannot be transferred because of a condition such as the inability to access the block, or if an unrecoverable slave or facility error (not associated with data transfer) is encountered.

The operation starts at the location given in the Data Address of the Command Extent parameter or at the current location, if implicit positioning is not supported. When the addressee supports implicit positioning and positioning is required before the data can be accessed, the slave shall initiate the positioning operation. If the addressee does not support implicit positioning, the master shall position the media explicitly, and the Data Address of the Command Extent parameter shall be ignored by the slave. [See the SPACE BLOCK/FILE MARK command (7.1) and the POSITION CONTROL command (7.2) for details of the positioning operation.]

When the access is complete, the addressee shall execute the command on the number of sequentially addressed blocks or octets specified by the Count. If the Command Extent parameter is not appended to the command, one block shall be processed starting at the current position. (The count modifier shall be ignored.)

8.2.4 Parameters 31, 32, 35, 3A, 3C, 3E

8.2.4.1 Command Extent (common) parameter

This parameter shall be as described in 8.1.4.1.

8.2.4.2 Response Extent (common) parameter

This parameter shall be as described in 8.1.4.2.

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Table 25 – Read raw data parameters 31, 32, 35, 3A, 3C, 3E

@	LTH	ID	OCTET	X/b	DEF	READ RAW DATA PARAMETERS
M	n+1	31				COMMAND EXTENT PARAMETER
			01-04			Count
			05-08			Data Address
S	n+1	32				RESPONSE EXTENT PARAMETER
			01-04			Residual count
			05-08			Data Address
M	05	35	01-04			Access Key parameter
B	n+1	3A				Data Address parameter
M	04	3C				Transfer parameter
M	n+1	3E				Partition parameter

8.2.4.3 Access Key (common) parameter

This parameter shall be as described in ANSI X3.291:1997.

8.2.4.4 Data Address (common) parameter

This parameter shall be as described in ANSI X3.291:1997.

8.2.4.5 Transfer (common) parameter

This parameter shall be as described in ANSI X3.291:1997.

8.2.4.6 Partition (common) parameter

This parameter shall be as described in ANSI X3.291:1997.

8.3 Reserved

For use only in ANSI X3.291:1997.

8.4 SEARCH

This command shall be as described in ANSI X3.291:1997 90.

8.5 WRITE

8.5.1 Command packet

```
 ____________________________________________________
|PKT  |REF  |  OP  |COM  |  OP  |SLAV|FAC  |   COMMAND
|  LTH|  NO  |CODE|  MOD|  MOD|ADDR|ADDR|  PARAMETERS
|     |  0 1|   2  |     3     |   4  |   5  |  6 through n
|____|____|____|____|____|____|____|_____________
 xxxx xxxx  20  bbbb bbbb  xx   xx
                7654 3210
                     ||||
                     |||└─  Count  0=Octet  1=Block
                     ||└─  1=Write Edit
                     |└─  0=DataBlock  1=PhysicalBlock
                     └─  Direction  0=Forward  1=Reverse
```

Figure 19 — Command packet for WRITE

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8.5.2 Response packet

PKT LTH	Echoed From Command 0 1 2 3 4 5	MAJOR STATUS CODES 6	TYPE 7	CODE	RESPONSE PARAMETERS 8 through n
xxxx	eeeeeeeeeeee	bbbb bbbb 7654 3210	0001	bbbb 3210	

Figure 20 — Response packet for WRITE

8.5.3 Description

The WRITE command transfers data from the master to the addressee starting at the position specified in the Data Address of the Command Extent parameter or at the current position, if implicit positioning is not supported by the slave. When the addressee supports implicit positioning and positioning is required before the data can be accessed, the slave shall initiate the positioning operation. If the addressee does not support implicit positioning, the master shall position the media explicitly, and the Data Address of the Command Extent parameter shall be ignored by the slave. [See the SPACE BLOCK/FILE MARK command (7.1) and the POSITION CONTROL command (7.2) for details of the positioning operation.] The mode and direction of the command shall be specified by the modifier octet.

If EMW is detected during the execution of a WRITE in the forward direction, the command shall be terminated after the current block is written and the appropriate status shall be presented to the master. As long as the media is positioned at or beyond EMW, all forward write operations shall be terminated after the first block is written and the appropriate status shall be returned to the master. If PEOM is encountered during the execution of a forward write, the command shall be terminated and the appropriate status shall be presented to the master. Data being written when PEOM was encountered may not be recoverable. If the BOM is detected while writing in the reverse direction, the command shall be terminated and the appropriate status code shall be returned to the master in the command response.

If the Write Edit modifier is set, the addressee is to perform an update to the record at the address specified in the Command Extent Parameter. If the addressee does not support the Edit function (as specified in Attributes), the command shall be rejected and Command Exception status with Invalid Command substatus returned to the master.

8.5.4 Parameters 31, 32, 35, 3A, 3C, 3E, 51, 52

Table 26 — Write parameters 31, 32, 35, 3A, 3C, 3E, 51, 52

@	LTH	ID	OCTET	X/b	DEF	WRITE PARAMETERS
M	n+1	31				COMMAND EXTENT PARAMETER
			01-04			Count
			05-08			Data Address
S	n+1	32				RESPONSE EXTENT PARAMETER
			01-04			Residual count
			05-08			Data Address
M	05	35	01-04			Access Key parameter
B	n+1	3A				Data Address parameter
M	04	3C				Transfer parameter
M	n+1	3E				Partition parameter
M	n+1	51	01-04			Information transfer size override parameter
M	01	52				Master termination permitted parameter

8.5.4.1 Command Extent (common) parameter

This parameter shall be as described in 8.1.4.1.

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8.5.4.2 Response Extent (common) parameter

This parameter shall be as described in 8.1.4.2.

8.5.4.3 Access Key (common) Parameter

This parameter shall be as described in ANSI X3.291:1997.

8.5.4.4 Data Address (common) parameter

This parameter shall be as described in ANSI X3.291:1997.

8.5.4.5 Transfer (common) parameter

This parameter shall be as described in ANSI X3.291:1997. This parameter shall be used to specify the actions to be taken by the slave when writing to the media. If this parameter is not present, the addressee shall verify the data immediately after it is written (i.e. "Verify" is the default mode for tape).

8.5.4.6 Partition (common) parameter

This parameter shall be as described in ANSI X3.291:1997.

8.5.4.7 Information transfer size override parameter

This parameter shall be as described in ANSI X3.291:1997.

8.5.4.8 Master termination permitted parameter

This parameter shall be as described in ANSI X3.291:1997.

8.6 WRITE PATTERN

This command is identical to the WRITE PATTERN command described in ANSI X3.291:1997 and the same requirements shall be observed.

8.7 Reserved

For use only in ANSI X3.291:1997.

9 Combination commands

9.1 COPY

This command shall be as described in ANSI X3.291:1997.

9.2 COMPARE SLAVE DATA

This command shall be as described in ANSI X3.291:1997.

9.3 COMPARE DATA

This command shall be as described in ANSI X3.291:1997.

9.4 Reserved

For use only in ANSI X3.291:1997.

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9.5 Reserved

For use only in ANSI X3.291:1997.

9.6 SHADOW READ

This command shall be as described in ANSI X3.291:1997 990.

9.7 SHADOW WRITE

This command shall be as described in ANSI X3.291:1997.

9.8 SHADOW RESTORE

This command shall be as described in ANSI X3.291:1997.

10 Other transfer commands

10.0 General

The data transfer commands in this clause are used for specific functions other than typical read and write activity. In many situations, these commands may be used to complement diagnostics. These commands by their very nature are either device specific or vendor specific.

NOTE It is recommended to refer carefully to vendor specifications as to the implementation of these commands.

10.1 READ VERIFY

10.1.1 Command packet

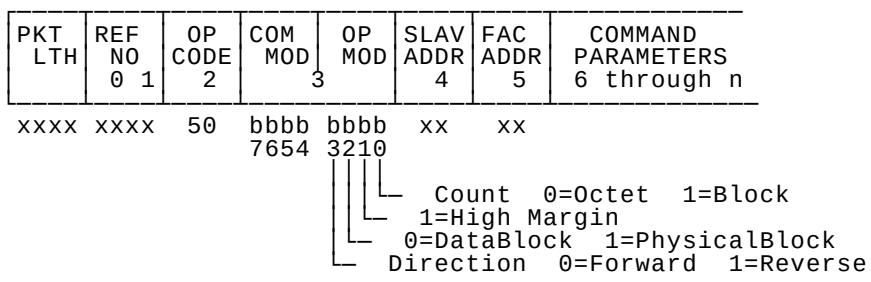

Figure 21 – Command packet for READ VERIFY

10.1.2 Response packet

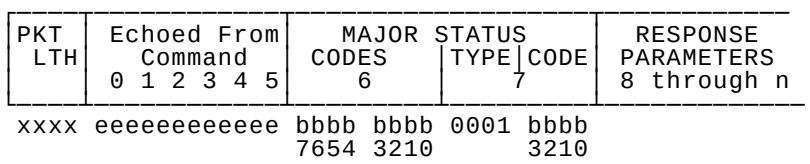

Figure 22 – Response packet for READ VERIFY

10.1.3 Description

The READ VERIFY command reads data from the addressee and verifies that the data is correct as determined by the slave or facility's error detection/correction scheme. Data is not transferred to the master.

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When used with tape, this command shall be used to verify data integrity on the media. Every PhysicalBlock within the extent is read and the crc/ecc is checked. If an error is detected, the operation is terminated and the data address in the response extent parameter identifies the block containing the error. The residual count may be used to determine the block in error.

The operation starts at the location given in the data address of the command extent parameter or at the current location if implicit positioning is not supported. When the addressee supports implicit positioning and positioning is required before the data can be accessed, the slave shall initiate the positioning operation. If the addressee does not support implicit positioning, the master shall position the media explicitly and the data address of the command extent parameter shall be ignored by the slave. [See the SPACE BLOCK/FILE MARK command (7.1) and the POSITION CONTROL command (7.2) for details of the positioning operation.]

When the access is complete the addressee shall execute the command on the number of sequentially addressed blocks or octets specified by the Count. If the command extent parameter is not appended to the command, one block shall be processed starting at the current position. (The count modifier shall be ignored.)

If the Volume modifier in the parameters is set, the slave shall verify the entire volume.

The High Margin modifier, when set, indicates to the addressee that an error-detecting threshold lower than the normal read threshold shall be used while executing the READ VERIFY operation.

No error correction or automatic error recovery procedures shall be performed while executing a READ VERIFY command.

10.1.4 Parameters 31, 32, 35, 3A, 3C, 3E

Table 27 – Read verify parameters 31, 32, 35, 3A, 3C, 3E

@	LTH	ID	OCTET	X/b	DEF	READ VERIFY PARAMETERS
M	n+1	31				COMMAND EXTENT PARAMETER
			01-04			Count
			05-08			Data Address
S	n+1	32				RESPONSE EXTENT PARAMETER
			01-04			Residual Count
			05-08			Data Address
M	05	35	01-04			Access Key parameter
B	n+1	3A				Data Address parameter
M	04	3C				Transfer parameter
M	n+1	3E				Partition parameter

10.1.4.1 Command Extent (common) parameter

This parameter shall be as described in 8.1.4.1.

10.1.4.2 Response Extent (common) parameter

This parameter shall be as described in 8.1.4.2.

10.1.4.3 Access Key (common) parameter

This parameter shall be as described in ANSI X3.291:1997.

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10.1.4.4 Data Address (common) parameter

This parameter shall be as described in ANSI X3.291:1997.

10.1.4.5 Transfer (common) parameter

This parameter shall be as described in ANSI X3.291:1997.

10.1.4.6 Partition (common) parameter

This parameter shall be as described in ANSI X3.291:1997.

10.2 Reserved

For use only in ANSI X3.291:1997.

10.3 READ FROM BUFFER

10.3.1 Command packet

```
┌────┬────┬────┬────┬────┬────┬────┬──────────────
│PKT │REF │ OP │COM │ OP │SLAV│FAC │  COMMAND
│ LTH│ NO │CODE│ MOD│ MOD│ADDR│ADDR│ PARAMETERS
│    │ 0 1│  2 │    3    │  4 │  5 │ 6 through n
└────┴────┴────┴────┴────┴────┴────┴──────────────
 xxxx xxxx  52  bbbb bbbb  xx   xx
                7654 3210
                     │ │ │└─  Count  0=Octet  1=Block
                     │ │└─  0=Diagnostic  1=Recovery
                     │└─  0=DataBlock  1=PhysicalBlock
                     └─  0=FIFO  1=LIFO
```

Figure 23 – Command packet for READ FROM BUFFER

10.3.2 Response packet

```
┌────┬──────────────┬──────────────────────┬──────────────
│PKT │ Echoed From│   MAJOR STATUS      │  RESPONSE
│ LTH│   Command  │ CODES   │TYPE│CODE│ PARAMETERS
│    │ 0 1 2 3 4 5│    6    │    7    │ 8 through n
└────┴──────────────┴──────────────────────┴──────────────
 xxxx eeeeeeeeeeee bbbb bbbb 0001 bbbb
                   7654 3210      3210
```

Figure 24 – Response packet for READ FROM BUFFER

10.3.3 Description

The READ FROM BUFFER command transfers the contents of the addressee buffer to the master beginning at the octet offset or the block address contained in the Data Address of the Command Extent parameter. The Command Extent Count specifies the number of octets or blocks that are to be transferred to the master.

When the Diagnostic/Recovery modifier is set to Diagnostic, the READ FROM BUFFER may be used in conjunction with WRITE TO BUFFER to test the addressee's data buffer. The addressee shall transfer the specified number of blocks or octets from its internal buffer to the master. The Fifo/Lifo modifier shall be ignored and all data shall be transferred to the master in a "logical forward" direction. When the Octet/Block modifier is set to Octet, the addressee shall begin transferring data at an octet from zero equal to the value contained in the Command Extent Data Address field. If the modifier is set to Block, the addressee shall transfer data at the specified block address. In both cases, the addressee shall transfer the number of octets or blocks specified in the Command Extent Count field.

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When the Diagnostic/Recovery modifier is set to Recovery, the READ FROM BUFFER command shall be executed in a manner similar to a normal read, except that the read is limited to data contained in the addressee data buffer. When present, the Data Address field of the Command Extent specifies the block address at which the addressee is to begin the transfer. The Command Extent Count field specifies the number of octets or blocks the addressee is to transfer.

If in the Recovery mode the Octet/Block modifier is set to Octet, the addressee shall transfer, starting at the Data Address, one block of data or the number of octets specified in the Count, whichever is less. If the addressee transfers an entire block of data without exhausting the Command Extent Count, the command shall terminate with Incomplete Status and a residual count in the Response Extent parameter.

If the Octet/Block modifier is set to Block while in the Recovery mode, the addressee shall transfer, starting at the Data Address, the number of blocks specified in the Count. If transferring in block mode the addressee reads a block whose length is not equal to the addressee's currently defined block length, the command shall be terminated with Incomplete status and a residual count in the Response Extent parameter.

When executing a READ FROM BUFFER command in Recovery mode, the FIFO/LIFO modifier shall be used to specify the starting read position in the absence of the Data Address field of the Command Extent. If the Command Extent does not contain a Data Address and the FIFO/LIFO modifier is set to FIFO, the addressee shall start the transfer at the address of the next block to be transferred between the data buffer and the media as reported in the REPORT POSITION Extended Position parameter. The addressee shall continue to the transfer in FIFO order until the Command Extent Count is exhausted (or to the end of the block if in Octet mode and the Count exceeds the block size). If the FIFO/LIFO bit is set to LIFO, the addressee shall begin the transfer at the block address of the next block to be transferred between the master and the addressee as reported in the REPORT POSITION Extended Position parameter. The transfer shall proceed, transferring blocks in LIFO order until the count is exhausted (or to the end of the block if in Octet mode and the Count exceeds the block size). In either FIFO or LIFO mode, all octets within a block are transferred to the master such a way that the octet having the lowest offset from the origin of the block is transferred first. As blocks are transferred to the master, the addressee buffer pointers shall be adjusted such a way that a succeeding READ FROM BUFFER command in FIFO or LIFO mode will transfer the next sequential block.

If the Data Address field is present in the Command Extent parameter and the READ FROM BUFFER command is being executed in the Recovery mode, the addressee begins reading at the specified block address. The FIFO/LIFO modifier shall be used by the addressee to determine whether to increment or decrement the block address pointer (i.e., read "forward" or "reverse" through the data buffer).

Whether or not an addressee stores special control characters in the data buffer is implementation dependent. If the addressee encounters a tape mark during the execution of a READ FROM BUFFER command, the command shall be terminated with the appropriate status and a residual count in the Response Extent parameter.

If the combination of the Data Address and the Count in the Command Extent exceeds the addressee buffer size, the command shall be rejected by the addressee with Command Exception status.

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10.3.4 Parameters 31, 32, 35, 3A, 3E, 50

10.3.4.0 General

Table 28 – Read from buffer parameters 31, 32, 35, 3A, 3E, 50

@	LTH	ID	OCTET	X/b	DEF	READ FROM BUFFER PARAMETERS
M	n+1	31				COMMAND EXTENT PARAMETER
			01-04			Count
			05-08			Data Address
S	n+1	32				RESPONSE EXTENT PARAMETER
			01-04			Residual count
			05-08			Data Address
M	05	35	01-04			Access Key parameter
B	n+1	3A				Data Address parameter
M	n+1	3E				Partition parameter
M	03	50	01			Buffer address parameter

10.3.4.1 Command Extent (common) parameter

This parameter shall be as described in 8.1.4.1.

10.3.4.2 Response Extent (common) parameter

This parameter shall be as described in 8.1.4.2.

10.3.4.3 Access Key (common) parameter

This parameter shall be as described in ANSI X3.291:1997.

10.3.4.4 Data Address (common) parameter

This parameter shall be as described in ANSI X3.291:1997.

10.3.4.5 Partition (common) parameter

This parameter shall be as described in ANSI X3.291:1997.

10.3.4.6 Buffer address parameter

This parameter shall be as described in ANSI X3.291:1997.

10.4 READ FACILITY DATA TO BUFFER

This command is identical to the READ FACILITY DATA TO BUFFER command in ANSI X3.291:1997 and the same requirements shall apply, with the exception that the Direction modifier is applicable to tape.

10.5 READ PHYSICAL DATA AND ECC

This command is identical to the READ PHYSICAL DATA AND ECC command in ANSI X3.291:1997 and the same requirements shall apply, with the exception that the Direction modifier is applicable to tape.

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10.6 READ PHYSICAL HEADER

This command is identical to the READ PHYSICAL HEADER command in ANSI X3.291:1997 and the same requirements shall apply, with the exception that the Direction modifier is applicable to tape.

10.7 READ IPL

10.7.1 Command packet

PKT LTH	REF NO 0 1	OP CODE 2	COM MOD 3	OP MOD	SLAV ADDR 4	FAC ADDR 5	COMMAND PARAMETERS 6 through n
xxxx	xxxx	56	bbbb	bbbb	xx	xx	
			7654	3210			

Figure 25 – Command packet for READ IPL

10.7.2 Response packet

PKT LTH	Echoed From Command 0 1 2 3 4 5	MAJOR STATUS CODES 6	TYPE 7	CODE 7	RESPONSE PARAMETERS 8 through n
xxxx	eeeeeeeeeeee	bbbb bbbb	0001	bbbb	
		7654 3210		3210	

Figure 26 – Response packet for READ IPL

10.7.3 Description

Read IPL (Initial Program Load) causes the first block of IPL data to be transferred to the master. Typically, receipt of the Read IPL command shall cause the slave to initialize its position and to access Block 0 in the forward direction on the addressed facility. When the access is complete, the addressee shall transfer one block of data to the master. This command may not be chained from any other command and always executes from the default data partition.

10.8 READ PHYSICAL HEADER AND ECC

This command is identical to the READ PHYSICAL HEADER AND ECC command in ANSI X3.291:1997 and the same requirements shall apply, with the exception that the Direction modifier is applicable to tape.

10.9 WRITE TO BUFFER

This command is identical to the WRITE TO BUFFER command in ANSI X3.291:1997 and the same requirements shall apply, with the exception that the Direction modifier is applicable to tape.

10.10 WRITE BUFFER TO FACILITY

This command is identical to the WRITE BUFFER TO FACILITY command in ANSI X3.291:1997 and the same requirements shall apply, with the exception that the Direction modifier is applicable to tape.

10.11 WRITE PHYSICAL DATA AND ECC

This command is identical to the WRITE PHYSICAL DATA AND ECC command ANSI X3.291:1997 and the same requirements shall apply, with the exception that the Direction modifier is applicable to tape.

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10.12 WRITE PHYSICAL HEADER

This command is identical to the WRITE PHYSICAL HEADER command in ANSI X3.291:1997 and the same requirements shall apply, with the exception that the Direction modifier is applicable to tape.

10.13 LOAD SLAVE IML

This command is identical to the LOAD SLAVE IML command in ANSI X3.291:1997 and the same requirements shall apply, with the exception that the Direction modifier is applicable to tape.

10.14 ERASE

10.14.1 Command packet

PKT LTH	REF NO 0 1	OP CODE 2	COM MOD 3	OP MOD	SLAV ADDR 4	FAC ADDR 5	COMMAND PARAMETERS 6 through n
xxxx	xxxx	67	bbbb 7654	bbbb 3210	xx	xx	

- 3210 bit 0: Count 0=Octet 1=Block
- 3210 bit 1: 0=Security Erase 1=Gap Erase
- 3210 bit 2: Gap 0=Short 1=Long
- 3210 bit 3: Direction 0=Forward 1=Reverse

Figure 27 – Command packet for ERASE

10.14.2 Response packet

PKT LTH	Echoed From Command 0 1 2 3 4 5	MAJOR STATUS CODES 6	TYPE	CODE 7	RESPONSE PARAMETERS 8 through n
xxxx	eeeeeeeeeeee	bbbb 7654 bbbb 3210	0001	bbbb 3210	

Figure 28 – Response packet for ERASE

10.14.3 Description

The ERASE command instructs the addressee to erase a gap beginning at the current tape position and extending beyond EMW (security erase) or to erase a gap of specified length beginning at the current location, depending on the command modifier.

When a Gap Erase is indicated by the erase modifier, the Gap modifier specifies the method to be used in calculating the gap length. When the Gap modifier is set to 0, the gap length shall be equal to the length of tape required to record the number of octets or blocks specified in the Command Extent Parameter Count. If the Gap modifier is set to 1, the gap length shall be equal to the length produced by multiplying the Erase Multiplier by the minimum gap length. When performing a long erase, the Command Extent Parameter Count field specifies the number of long gaps to be erased. The Data Address field of the Command and Response Extent parameters shall not be used. When executing a Gap Erase, the gap actually recorded on the media shall be the gap specified by the ERASE command and an Inter-Block gap of the currently defined size.

NOTE Explicit positioning is required for execution of this command. Therefore, Operation Modifier Bit 2 has been redefined to specify security erase/gap erase instead of DataBlock/PhysicalBlock.

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10.14.4 Parameters 31, 32, 35, 3A, 3E

Table 29 – Erase parameters 31, 32, 35, 3A, 3E

@	LTH	ID	OCTET	X/b	DEF	ERASE PARAMETERS
M	n+1	31				COMMAND EXTENT PARAMETER
			01-04			Count
			05-08			Data Address
S	n+1	32				RESPONSE EXTENT PARAMETER
			01-04			Residual amount
			05-08			Data Address
M	05	35	01-04			Access Key parameter
B	n+1	3A				Data Address parameter
M	n+1	3E				Partition parameter

10.14.4.1 Command Extent (common) parameter

This parameter shall be as described in ANSI X3.291:1997 and as modified by the description of this command.

10.14.4.2 Response Extent (common) parameter

This parameter shall be as described in ANSI X3.291:1997.

10.14.4.3 Access Key (common) parameter

This parameter shall be as described in ANSI X3.291:1997.

10.14.4.4 Data Address (common) parameter

This parameter shall be as described in ANSI X3.291:1997.

10.14.4.5 Partition (common) parameter

This parameter shall be as described in ANSI X3.291:1997.

10.15 WRITE PHYSICAL HEADER AND ECC

This command is identical to the WRITE PHYSICAL HEADER AND ECC command in ANSI X3.291:1997 and the same requirements shall apply, with the exception that the Direction modifier is applicable to tape.

11 Diagnostic commands

11.0 General

The commands in this clause are the maintenance and diagnostic commands of the Logical Interface. These commands by their very nature are either device specific or vendor specific.

NOTE It is recommended to refer to vendor specifications as to the implementation of these commands.

11.1 PERFORM SLAVE DIAGNOSTICS

This command is identical to the PERFORM SLAVE DIAGNOSTICS command in ANSI X3.291:1997 and the same requirements shall apply.

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11.2 PERFORM FACILITY DIAGNOSTICS

This command is identical to the PERFORM FACILITY DIAGNOSTICS command in ANSI X3.291:1997 and the same requirements shall apply.

11.3 Reserved

For use only in ANSI X3.291:1997.

11.4 Reserved

For use only in ANSI X3.291:1997.

11.5 READ ERROR LOG

11.5.1 Command packet

PKT LTH	REF NO 0 1	OP CODE 2	COM MOD 3	OP MOD	SLAV ADDR 4	FAC ADDR 5	COMMAND PARAMETERS 6 through n
xxxx	xxxx	84	bbbb 7654	bbbb 3210	xx	xx	

Count 0=Octet 1=Block

0=Clear Error Log

Figure 29 – Command packet for READ ERROR LOG

11.5.2 Response packet

PKT LTH	Echoed From Command 0 1 2 3 4 5	MAJOR STATUS CODES 6	TYPE	CODE 7	RESPONSE PARAMETERS 8 through n
xxxx	eeeeeeeeeee	bbbb 7654	bbbb 3210	0001	bbbb 3210

Figure 30 – Response packet for READ ERROR LOG

11.5.3 Description

This command is identical to the READ ERROR LOG command in ANSI X3.291:1997 and the same requirements shall apply.

NOTE In an earlier ISO version instead of referencing ISO/IEC 9318-3:1990, *Information technology – Intelligent peripheral interface – Part 3: Device generic command set for magnetic and optical disk drives,* (withdrawn publication) an outdated version of the Read Error Log command was mistakenly included. The outdated version differed substantially from ISO/IEC 9318-3:1990 in the areas of the operation modifier bits and the parameter list.

11.6 WRITE ERROR LOG

This command is identical to the WRITE ERROR LOG command in ANSI X3.291:1997 and the same requirements shall apply.

11.7 DIAGNOSTIC CONTROL

This command is identical to the DIAGNOSTIC CONTROL command in ANSI X3.291:1997 and the same requirements shall apply.

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12 Command summary

12.1 Control commands

OP	COMMAND	OPCODE MODIFIERS
00	NOP	None
01	FACILITY OPERATION	None
02	ATTRIBUTES	x'0' – Report x'1' – Initialize x'2' – Restore x'9' – Load x'A' – Save
03	REPORT ADDRESSEE STATUS	0 – Condition 1 – Extended Condition 2 – Port Query
04	PORT ADDRESS	0 – Reserve/Release 1 – Priority Reserve 2 – Notify Alternate Port of Priority Reserve
05	PATH CONTROL	0 – Purge Commands Outstanding at Disabled Port 1 – Path Select
06	ATTENTION CONTROL	x'0' – Enable x'2' – Disable x'4' – Clear x'6' – Set
07	OPERATING MODE	2 – Set /Report
08	ABORT	0 – Orderly Termination 1 – Terminate Command In Progress 2 – Terminate All Commands Not In Progress
09	ACCESS PERMITS	x'0' – Report x'1' – Initialize x'2' – Restore x'9' – Load x'A' – Save x'2' – DataBlock/PhysicalBlock
0A	RESUME	None
0B	PORT RESPONSE	None
0C	ANTICIPATED ACTION	None
0D	OPERATOR DISPLAY	x'2' – Report/Set

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12.2 Position commands

OP	COMMAND	OPCODE MODIFIERS
40	SPACE BLOCK/FILE MARK	0 – Block/File Mark 1 – Stop at End of Track 2 – Logical End of Media Warning 3 – Forward/Reverse
41	POSITION CONTROL	0 – Octet/Block Count 2 – DataBlock/PhysicalBlock
42	REPORT POSITION	0 – Octet/Block Count 2 – DataBlock/PhysicalBlock 3 – Extended Position
43	RECORD POSITION	None

12.3 Transfer commands

OP	COMMAND	OPCODE MODIFIERS
10	READ	0 – Octet/Block Count 1 – Data Recovery On/Off 2 – DataBlock/PhysicalBlock 3 – Forward/Reverse
11	READ RAW DATA	0 – Octet/Block Count 2 – DataBlock/PhysicalBlock 3 – Forward/Reverse
18	SEARCH	0 – Octet/Block Count 1 – Data Recovery On/Off 2 – DataBlock/PhysicalBlock 3 – Forward/Reverse
20	WRITE	0 – Octet/Block Count 1 – Write Edit 2 – DataBlock/PhysicalBlock 3 – Forward/Reverse
21	WRITE PATTERN	0 – Octet/Block Count 2 – DataBlock/PhysicalBlock 3 – Forward/Reverse

12.4 Combination commands

OP	COMMAND	OPCODE MODIFIERS
30	COPY	None
31	COMPARE SLAVE DATA	None
32	COMPARE DATA	None
35	SHADOW READ	None
36	SHADOW WRITE	None
37	SHADOW RESTORE	None

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12.5 Other transfer commands

OP	COMMAND	OPCODE MODIFIERS
50	READ VERIFY	0 – Octet/Block Count 1 – High Margin 2 – DataBlock/PhysicalBlock 3 – Forward/Reverse
52	READ FROM BUFFER	0 – Octet/Block Count 1 – Diagnostic/Recovery 2 – DataBlock/PhysicalBlock 3 – FIFO/LIFO
53	READ FAC. DATA TO BUFFER	0 – Octet/Block Count 1 – Data Recovery On/Off 2 – DataBlock/PhysicalBlock 3 – Forward/Reverse
54	READ PHYS. DATA AND ECC	0 – Octet/Block Count 1 – ECC/Syndrome 3 – Forward/Reverse
55	READ PHYSICAL HEADER	0 – Octet/Block Count 1 – Data Recovery On/Off 3 – Forward/Reverse
56	READ IPL	None
58	READ PHYS. HEADER & ECC	1 – ECC/Syndrome 3 – Forward/Reverse
62	WRITE TO BUFFER	None
63	WRITE BUFFER TO FAC.	0 – Octet/Block Count 2 – DataBlock/PhysicalBlock 3 – Forward/Reverse
64	WRITE PHYS. DATA AND ECC	0 – Octet/Block Count 3 – Forward/Reverse
65	WRITE PHYSICAL HEADER	0 – Octet/Block Count 3 – Forward/Reverse
66	LOAD SLAVE IML	x'0' – Load x'1' – Load x'2' – Report x'4' – Store
67	ERASE	0 – Octet/Block Count 1 – Security Erase/Gap Erase 2 – Short/Long Erase 3 – Forward/Reverse
68	WRITE PHYS. HEADER & ECC	0 – Octet/Block Count

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12.6 Diagnostic commands

OP	COMMAND	OPCODE MODIFIERS
80	PERFORM SLAVE DIAG	0 – Octet/Block Count
81	PERFORM FACILITY DIAG	0 – Octet/Block Count
84	READ ERROR LOG	0 – Octet/Block Count 1 – Clear Error Log
85	WRITE ERROR LOG	0 – Octet/Block Count 3 – Append/Create
90	DIAGNOSTIC CONTROL	0 – Octet/Block Count

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Annex A
(normative)

Overview: interface levels, concepts and application environments

A.1 Interface levels

The IPI has adopted a layered approach to functionality, described as levels. The description of Level 3 is as follows:

Level 3 is oriented to the generic components of devices (disk, tape, printer, and the like), and typically not the device-unique components (for example, cylinders, heads). Level 3 uses a packet structure that provides independence of the command repertoire from the Physical Interface. Some of the Level 3 characteristics are:

– operations may be Individual or Queued;
– the data area is defined by the facility addressability to the media and is specified by the attributes of the slave;
– the Transfer of data may or may not be timing critical, and typically is buffered;
– data is addressed by DataBlock address, but PhysicalBlock addresses may be used;
– DataBlock lengths typically are fixed over an addressable data area and can vary between different addressable areas on the media as well as varying between medias. Tape DataBlocks may vary between any two blocks;
– data is normally requested as "perfect" (data errors, if any, are corrected), or may be requested as "raw" (data errors, if any, are not corrected);
– positioning is requested implicitly, but may be explicit;
– media defect handling is transparent to the master, but may be managed by the master;
– error correction is transparent to the master, but may be managed by the master;
– error retry is transparent to the master, but may be managed by the master.

A.2 Concepts

A.2.0 General

These concepts are described relative to their usage in a device-generic environment. These relationships may be defined differently in other levels of IPI implementation.

A.2.1 Relationship of master, slave and facility

A master is an entity that has need for some form of information transfer or storage. The master makes use of slaves and facilities to perform the needed operation. The slave or facility (addressee) to which the master addresses a service request is expected to have sufficient intelligence and capability to perform the requested service.

A slave is subservient to one master per port. The slave provides services to the attached master or masters and is responsible for the control and operation of the facilities (if any) attached to it. The slave may also perform additional functions as it finds necessary.

A facility may be a unit of storage (for example, disk drives and tape drives) or a unit of functionality (for example, a communications interface). Facilities are not limited to these devices or even to being devices. Facilities are defined as having capabilities. A facility may be subservient to one or more slaves.

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A.2.2 Relationship of facilities and partitions

As an option, a slave may allow the subdivision of a facility into partitions. In a facility that is capable of being subdivided, there are two possible types of subdivision that could be supported. The first is the ability of the slave to subdivide the facility into a default data partition and up to 7 maintenance partitions.

For disks, the second is the ability of the master to subdivide the default data partition into up to 239 data partitions and up to 8 maintenance partitions.

For tapes, the second is the ability of the slave to define 112 additional partitions and the master to subdivide the default data partition into 127 data partitions and up to 8 maintenance partitions.

Maintenance partitions are typically used for maintenance purposes, but their use is not restricted thereto, and may be otherwise used for storage of specific data for the slave, the facility, or for both.

Maintenance partitions are not accessed by the master during normal operation, but access by the master is possible via the OPERATING MODE command.

The total area of a facility that is defined by the slave as the default data partition may be used for storage of the master's data. The partitioning and control of the partitions created in the default data area is the responsibility of the master.

A.2.3 Command structure

The device-generic command structure is based on message packets that are of variable length. The basic Command and Response packets are expanded by appending parameters that identify the specific actions to be taken. This provides a powerful tool for providing flexibility for future growth, since the addition of new functions over time should not require major changes to the command repertoire, but add functionality to the existing commands.

The device-specific (known also as Level 2) command repertoire previously described in ISO/IEC 9318-2:1992[1], uses a different command structure from the device-generic level. The major objective achieved by being different is the ability to execute timing critical operations. Because both levels use the same Physical interface, it is possible for device-specific slaves to co-exist on the same daisy-chained cable as device-generic slaves. If both device-specific and device-generic slaves are daisy-chained on the same Physical interface, the master must be able to handle both command structures.

Device-generic commands need to be consistent with the characteristics of the general device type (for example, the master must know if the general device type is a disk or tape). The commands provide for logical data addressing, buffers, error detection, error retry, error correction, and the like, at the slave. There are no timing-critical dependencies between commands.

A.3 Application environments

A.3.0 General

The degree of intelligence provided by the slave varies and is defined by Attributes provided by the manufacturer. The master can either select or respond to the level of intelligence provided by the slave.

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1 ISO/IEC 9318-2:1992, *Information technology – Intelligent Peripheral Interface – Part 2: Device command set for magnetic disk drives (withdrawn publication)*

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It is possible for the manufacturer of a computer system to implement products that are master oriented and that support software constraints for current operating systems. By adding different degrees of functionality, the manufacturer could migrate over time to a distributed-intelligence, slave-oriented environment.

A.3.1 Control of facilities by the master

The master performs Facility Selection and issues Individual commands. This is a master-oriented environment that typifies the operation of most of today's host system I/O interfaces. The master prioritizes tasks and dispenses them to the various peripherals attached to it in a fashion that optimizes the system performance from the master's perspective.

Since the master controls all activity on the interface, it shall poll both the slave and facility interrupts in order to maximize the efficiency of data transfers. The master-oriented environment is typified by the following features of the interface:

– command execution sequenced by the master;
– individual commands;
– selection to the facility;
– master polling of both slaves and facilities;
– Bus Control established by the master;
– command queuing done by the master.

A.3.2 Shared control of facilities

In this environment, a slave has functional control of the facilities, but the master has explicit control over some aspects of facility management. Some tasks, such as command queuing, may be left to the discretion of the slave, but the master may choose to sequence the flow of data between specific facilities based on its own algorithms.

This environment is typified by the following features of the interface:

– command execution between facilities sequenced by the master;
– queued commands;
– selection to the facility;
– master polling of both slaves and facilities;
– Bus Control established by the master;
– command queuing done by the slave.

A.3.3 Control of facilities by the slave

In this environment, the slave has functional control of the facilities and the master has limited control (if any) over facility management. The slave has the intelligence necessary to control operations on behalf of the master.

This is a slave-oriented environment because of the degree of control the slave exercises over system performance and optimization. This environment is typified by the following features of the interface:

– command execution between facilities sequenced by the slave;
– queued commands;
– selection to the slave;
– polling of the slave by the master;
– Bus Control established by the master or (optionally) by the slave;
– command queuing done by the slave.

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