dpANS

Project
INCITS 566

Information technology -
SCSI Primary Commands - 6 (SPC-6)

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ANSI ®
INCITS 566-202x

American National Standards for Information Systems -

SCSI Primary Commands - 6 (SPC-6)

Secretariat
InterNational Committee for Information Technology Standards

Approved mm dd yy

American National Standards Institute, Inc.

Abstract

This standard defines the device model for all SCSI devices. This standard defines the SCSI commands that are basic to every device model and the SCSI commands that may apply to any device model.

American National Standard

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FOREWORD (This foreword is not part of American National Standard INCITS 566.)

The SCSI command set is designed to provide efficient peer-to-peer operation of SCSI devices (e.g., disks, tapes, media changers) by an operating system. The SCSI command set assumes an underlying command-response protocol.

The SCSI command set provides multiple operating systems concurrent control over one or more SCSI devices. However, proper coordination of activities between the multiple operating systems is critical to avoid data corruption. Commands that assist with coordination between multiple operating systems are described in this standard. However, details of the coordination are beyond the scope of the SCSI command set.

This standard defines the device model for all SCSI devices. This standard defines the SCSI commands that are basic to every device model and the SCSI commands that may apply to any device model.

With any technical document there may arise questions of interpretation as new products are implemented. INCITS has established procedures to issue technical opinions concerning the standards developed by INCITS. These procedures may result in SCSI Technical Information Bulletins being published by INCITS.

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This standard was processed and approved for submittal to ANSI by the InterNational Committee for Information Technology Standards (INCITS). Committee approval of the standard does not necessarily imply that all committee members voted for approval. At the time it approved this standard, INCITS had the following members:

TBD

Technical Committee T10 on SCSI Storage Interfaces, which developed and reviewed this standard, had the following members:

William Martin, Chair
Curtis Ballard, Vice Chair
Curtis Stevens, Secretary

Organization Represented   *Name of Representative*

TBD

SCSI standards family

Figure 1 shows the relationship of this standard to the other standards and related projects in the SCSI family of standards as of the publication of this standard.
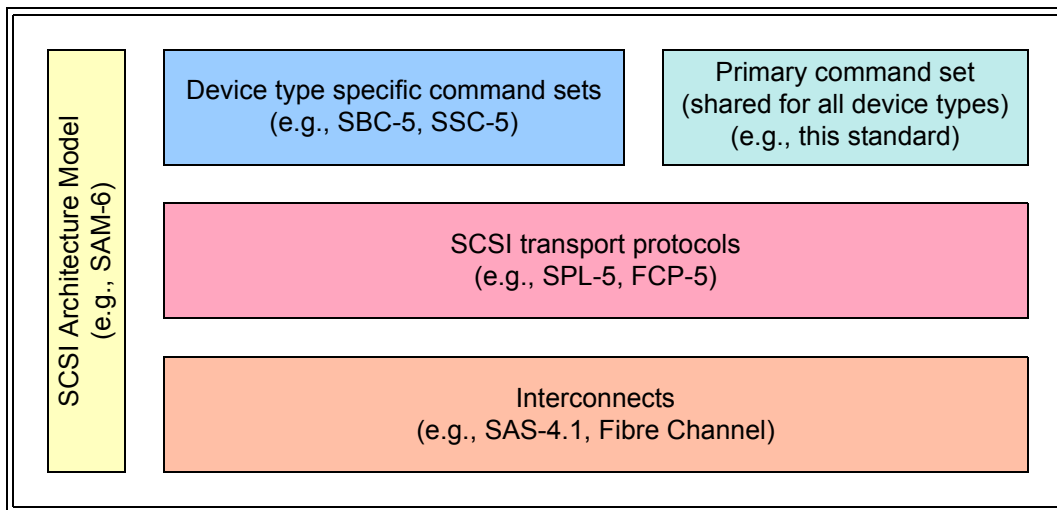
Figure 1 – SCSI document structure

The SCSI document structure in figure 1 is intended to show the general applicability of the documents to one another. Figure 1 is not intended to imply a relationship such as a hierarchy, protocol stack, or system architecture.

SCSI Architecture Model: Defines the SCSI systems model, the functional partitioning of the SCSI standard set and requirements applicable to all SCSI implementations and implementation standards.

Device Type Specific Command Sets: Implementation standards that define specific device types including a device model for each device type. These standards specify the required commands and behaviors that are specific to a given device type and prescribe the requirements to be followed by a SCSI initiator device when sending commands to a SCSI target device having the specific device type. The commands and behaviors for a specific device type may include by reference commands and behaviors that are shared by all SCSI devices.

Shared Command Set: An implementation standard that defines a model for all SCSI device types. This standard specifies the required commands and behaviors that are common to all SCSI devices, regardless of device type, and prescribes the requirements to be followed by a SCSI initiator device when sending commands to any SCSI target device.

SCSI Transport Protocols: Implementation standards that define the requirements for exchanging information so that different SCSI devices are capable of communicating.

Interconnects: Implementation standards that define the communications mechanism employed by the SCSI transport protocols. These standards may describe the electrical and signaling requirements essential for SCSI devices to interoperate over a given interconnect. Interconnect standards may allow the interconnection of devices other than SCSI devices in ways that are outside the scope of this standard.

The term SCSI is used to refer to the family of standards described in this introduction.

AMERICAN NATIONAL STANDARD   **BSR INCITS 566-202x**

**American National Standard
for Information Technology -**

SCSI Primary Commands - 6 (SPC-6)

1 Scope

The SCSI family of standards provides for many different types of SCSI devices (e.g., disks, tapes, media changers). This standard defines a device model that is applicable to all SCSI devices. Other command standards expand on the general SCSI device model in ways appropriate to specific types of SCSI devices.

The set of SCSI standards specifies the interfaces, functions, and operations necessary to ensure interoperability between conforming SCSI implementations. This standard is a functional description. Conforming implementations may employ any design technique that does not violate interoperability.

This standard defines the SCSI commands that are mandatory and optional for all SCSI devices. Support for any feature defined in this standard is optional unless otherwise stated. This standard also defines the SCSI commands that may apply to any device model.

The following commands, parameter data, and features defined in previous versions of this standard are made obsolete by this standard:

    a) the MODE SENSE(6) command; and
    b) the MODE SELECT(6) command.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 14776-412, *Information Technology - Small Computer Systems Interface (SCSI) - Part 412: SCSI Architecture Model - 2 (SAM-2)*

ISO/IEC 14776-415, *Information Technology - SCSI Architecture Model - 5 (SAM-5)*

INCITS 546-2021, *Information Technology - SCSI Architecture Model - 6 (SAM-6)*

ISO/IEC 14776-452, *Information Technology - Small Computer Systems Interface (SCSI) - Part 452: SCSI Primary Commands - 2 (SPC-2)*

ISO/IEC 14776-453, *Information technology - Small Computer System Interface (SCSI) - Part 453: SCSI Primary Commands - 3 (SPC-3)*

ISO/IEC 14776-454, *Information technology - Small Computer System Interface (SCSI) - Part 454: SCSI Primary Commands - 4 (SPC-4)*

INCITS 502-2019, *Information Technology - SCSI Primary Commands - 5 (SPC-5)*

ISO/IEC 14776-481, *Information Technology - Security Features for SCSI Commands (SFSC))*

INCITS 563-2023, *Information Technology - Fibre Channel Protocol for SCSI - 5 (FCP-5)*

INCITS 365-2002, *Information Technology - SCSI RDMA Protocol (SRP)*

INCITS 554-2023, *Information Technology - SAS Protocol Layer - 5 (SPL-5)*

INCITS 489-2014, *Information Technology - SCSI Over PCI Express® (SOP)*

INCITS 557-2023, *Information Technology - SCSI / ATA Translation - 5 (SAT-5)*

ISO/IEC 14776-322, *Information Technology - Small Computer Systems Interface (SCSI) - Part 322: SCSI Block Commands - 2 (SBC-2)*

ISO/IEC 14776-323, *Information Technology - Small Computer Systems Interface (SCSI) - Part 323: SCSI Block Commands - 3 (SBC-3)*

SCSI/INCITS 571, *Information Technology - SCSI Block Commands - 5 (SBC-5)*

SCSI/INCITS 579, *Information Technology - Zoned Block Commands - 3 (ZBC-3)*

INCITS 503-2022, *Information Technology - SCSI Stream Commands - 5 (SSC-5)*

INCITS 468-2010, *Information Technology - Multi-Media Commands - 6 (MMC-6)*

INCITS 468-2010/AM 1-2012, *Information Technology - Multi-Media Commands - 6 (MMC-6) - Amendment 1*

INCITS 484-2012, *Information Technology - SCSI Media Changer Commands - 3*

INCITS 375-2004, *Information Technology - Serial Bus Protocol - 3 (SBP-3)*

ISO/IEC 14776-381, *Information Technology - Small Computer System Interface (SCSI) - Part 381: Optical Memory Card Device Commands (OMC)*

INCITS 470-2011, *Information Technology - Fibre Channel - Framing and Signaling - 3 (FC-FS-3)*

INCITS 488-2016, *Information Technology - Fibre Channel - Framing and Signaling - 4 (FC-FS-4)*

INCITS 562-20xx, *Information Technology - Fibre Channel - Framing and Signaling - 6 (FC-FS-6)*

INCITS 477-2011, *Information Technology - Fibre Channel - Link Services - 2 (FC-LS-2)*

INCITS 487-2018, *Information Technology - Fibre Channel - Link Services - 3 (FC-LS-3)*

INCITS 496-2012, *Information Technology - Fibre Channel - Security Protocols - 2 (FC-SP-2)*

ISO 5807:1985 (S2013), *Documentation Symbols and Conventions for Data, Program and System Flowcharts, Program Network Charts and System Resource Charts*

ANSI/IEEE 1394a-2000, *High Performance Serial Bus (supplement to ANSI/IEEE 1394-1995)*

IEEE Identifier Guidelines, "Guidelines for Use of Extended Unique Identifier (EUI), Organizationally Unique Identifier (OUI), and Company_ID (CID)" [1]

INCITS 4-1986 (R2017), *Information Systems - Coded Character Sets - 7-Bit American National Standard Code for Information Interchange (7-Bit ASCII)*

ISO/IEC 13213, *Information technology - Microprocessor systems - Control and Status Registers (CSR) Architecture For Microcomputer Buses*

ISO/IEC 8859-1:1998, *Information technology - 8-bit single-byte coded graphic character sets - Part 1: Latin alphabet No. 1*

ISO/IEC 8859-2:1999, *Information technology - 8-bit single-byte coded graphic character sets - Part 2: Latin alphabet No. 2*

ISO/IEC 8859-3:1999, *Information technology - 8-bit single-byte coded graphic character sets - Part 3: Latin alphabet No. 3*

ISO/IEC 8859-4:1998, *Information technology - 8-bit single-byte coded graphic character sets - Part 4: Latin alphabet No. 4*

ISO/IEC 8859-5:1999, *Information technology - 8-bit single-byte coded graphic character sets - Part 5: Latin/Cyrillic alphabet*

ISO/IEC 8859-6:1999, *Information technology - 8-bit single-byte coded graphic character sets - Part 6: Latin/Arabic alphabet*

ISO/IEC 8859-7:2003, *Information processing - 8-bit single-byte coded graphic character sets - Part 7: Latin/Greek alphabet*

ISO/IEC 8859-8:1999, *Information technology - 8-bit single-byte coded graphic character sets - Part 8: Latin/Hebrew alphabet*

ISO/IEC 8859-9:1999, *Information technology - 8-bit single-byte coded graphic character sets - Part 9: Latin alphabet No. 5*

ISO/IEC 8859-10:1998, *Information technology - 8-bit single-byte coded graphic character sets - Part 10: Latin alphabet No. 6*

ISO/IEC 10646:2017, *Information technology - Universal Coded Character Set (UCS)*

ISO/IEC 9834-8, *Procedures for the operation of object identifier registration authorities - Part 8: Generation of universally unique identifiers (UUIDs) and their use in object identifiers*

Video Performance Guarantee Profile 1 Revision 1.0 (VPG1), May 24, 2011 [2]

RFC 791, *Internet Protocol - DARPA Internet Program - Protocol Specification* [3]

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1) See standards.ieee.org/content/dam/ieee-standards/standards/web/documents/tutorials/eui.pdf.
2) For more information about documents published by the CFA, see http://www.compactflash.org/.
3) For more information on the RFCs and standards published by the Internet Engineering Task Force (IETF), see http://www.ietf.org/.

RFC 1321, *The MD5 Message-Digest Algorithm* [3]

RFC 2279, *UTF-8, a transformation format of ISO 10646* [3]

RFC 2616, *Hypertext Transfer Protocol - HTTP/1.1* [3]

RFC 4122, *A Universally Unique IDentifier (UUID) URN Namespace* [3]

RFC 4291, *IP Version 6 Addressing Architecture* [3]

RFC 7143, *iSCSI Protocol (Consolidated)* [3]

Universal Serial Bus 3.2 Specification Revision 1.0 (USB-3), September 22, 2017 [4]

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[4]   For more information on publications by the USB Implementers Forum, see http://www.usb.org/.

3 Definitions, symbols, abbreviations, and conventions

3.1 Definitions

3.1.1 active power condition
power condition in which a device server is capable of completing the processing of all its supported commands

Note 1 to entry: See 5.13.5.

3.1.2 additional sense code
combination of the ADDITIONAL SENSE CODE field and the ADDITIONAL SENSE CODE QUALIFIER field in sense data (see 4.4)

3.1.3 alias list
list of alias values (see 3.1.4) and their associated designations maintained by the device server and managed by the CHANGE ALIASES command (see 6.3) and REPORT ALIASES command (see 6.27)

3.1.4 alias value
numeric value associated to a designation in the alias list (see 3.1.3)

Note 1 to entry: Used in command or parameter data to reference a SCSI target device or SCSI target port.

Note 2 to entry: See 6.3.2.

3.1.5 application client
object that is the source of SCSI commands

Note 1 to entry: See SAM-6.

3.1.6 ASCII format list log parameter
log parameter that contains ASCII data in a list log parameter format

Note 1 to entry: See 7.3.2.2.2.4.

3.1.7 auto contingent allegiance (ACA)
task set condition established following the return of CHECK CONDITION status if the NACA bit is set to one in the CONTROL byte

Note 1 to entry: See SAM-6.

3.1.8 background function
background scan operation (see SBC-5) or device specific background function (see 5.4)

3.1.9 beginning of partition (BOP)
position at the beginning of the permissible recording region of a partition

Note 1 to entry: The BOP position may not coincide with a beginning-of-medium position.

Note 2 to entry: See SSC-5.

3.1.10 binary format list log parameter
log parameter that contains binary data in a list log parameter format

Note 1 to entry: See 7.3.2.2.2.5.

3.1.11 binding
relationship between a subsidiary logical unit, an administrative logical unit, and an application client

Note 1 to entry: See 5.8.1.

3.1.12 bind operation
process by which an administrative logical unit's device server creates a binding and adds a LUN for a subsidiary logical unit to the logical unit inventory

Note 1 to entry: A successful bind operation allows an application client access to a subsidiary logical unit.

Note 2 to entry: A bind operation is an explicit bind operation or an implicit bind operation.

Note 3 to entry: See 5.8.9.

3.1.13 block device
SCSI device that returns a peripheral device type (see table 150) of direct access block device (i.e., 00h), CD/DVD device (i.e., 05h), optical memory device (i.e., 07h), simplified direct access block device (i.e., 0Eh), or host managed zoned block device (i.e., 14h)

3.1.14 bounded data counter log parameter
log parameter that contains one saturating counter (see 3.1.100) value

Note 1 to entry: Effects on other log parameters in the same log page are determined by the FORMAT AND LINKING field in the parameter control byte.

Note 2 to entry: See 7.3.2.2.2.2.

3.1.15 bound subsidiary logical unit
subsidiary logical unit that has at least one LUN

3.1.16 byte (B)
sequence of eight contiguous bits considered as a unit

3.1.17 cache memory
temporary and often volatile data storage area outside the area accessible by application clients

Note 1 to entry: Cache memory may contain a subset of the data stored in the nonvolatile data storage area.

3.1.18 code set enumeration
coded value used in one field to indicate the format of data in other fields or descriptors

Note 1 to entry: See 4.3.3.

3.1.19 command
request describing a unit of work to be performed by a device server

Note 1 to entry: See SAM-6.

3.1.20 command descriptor block (CDB)
structure used to communicate commands from an application client to a device server

Note 1 to entry: A CDB may have a fixed length of up to 16 bytes or a variable length of between 12 and 260 bytes.

Note 2 to entry: See clause 4.2.

3.1.21 command standard
SCSI standard that defines the model, commands, and parameter data for a device type (e.g., SBC-5, SSC-5, SMC-3, MMC-6, or SES-2)

3.1.22 copy manager
object (see SAM-6) that processes third-party copy commands (see 5.19.3) and manages copy operations (see 5.19.4.3)

3.1.23 copy operation
foreground or background operation that results from the processing of a third-party copy command
Note 1 to entry: See 5.19.4.3.

3.1.24 copy source or copy destination (CSCD)
source or destination of a copy operation (see 6.6.6) performed by an EXTENDED COPY command (see 6.6)

3.1.25 data counter log parameter
bounded data counter log parameter (see 7.3.2.2.2.2) or unbounded data counter log parameter (see 7.3.2.2.2.3)

3.1.26 Data-In Buffer
buffer specified by the application client to receive data from the device server during the processing of a command
Note 1 to entry: See SAM-6.

3.1.27 Data-Out Buffer
buffer specified by the application client to supply data that is sent from the application client to the device server during the processing of a command
Note 1 to entry: See SAM-6.

3.1.28 deferred error
CHECK CONDITION status and sense data that is returned as the result of an error or exception condition that occurred during processing of a previous command for which GOOD status or CONDITION MET status has already been returned
Note 1 to entry: See 4.4.7.

3.1.29 device server
object within a logical unit that processes SCSI commands according to the rules of command management
Note 1 to entry: See SAM-6.

3.1.30 device service request
request, submitted by an application client, conveying a SCSI command to a device server
Note 1 to entry: See SAM-6.

3.1.31 device service response
response returned to an application client by a device server on completion of a SCSI command
Note 1 to entry: See SAM-6.

3.1.32 device type
device model implemented by the logical unit and indicated to the application client by the contents of the PERIPHERAL DEVICE TYPE field in the standard INQUIRY data
Note 1 to entry: See clause 6.7.2.

3.1.33 enabled command
command that is being processed by the device server and is progressing towards completion
Note 1 to entry: See SAM-6.

3.1.34 end of data (EOD)
format specific recorded indication that no valid logical objects are recorded between this position and the EOP
Note 1 to entry: See SSC-5.

3.1.35 end of partition (EOP)
position at the end of the permissible recording region of a partition
Note 1 to entry: See SSC-5.

3.1.36 error history I_T nexus
I_T nexus for which the device server has reserved access to the error history snapshot (see 3.1.37)

3.1.37 error history snapshot
contents of the error history at a specific point in time
Note 1 to entry: See 5.6.2.

3.1.38 explicit bind operation
bind operation that is requested by an application client

3.1.39 Extended CDB (XCDB)
CDB that contains another CDB and additional information to support extra processing (e.g., security
features)
Note 1 to entry: See 4.2.4.

3.1.40 faulted I_T nexus
I_T nexus on which a CHECK CONDITION status was returned that resulted in the establishment of an ACA
Note 1 to entry: The faulted I_T nexus condition is cleared when the ACA condition is cleared.
Note 2 to entry: See SAM-6.

3.1.41 field
group of one or more contiguous bits, a part of a larger structure such as a CDB (see 3.1.20) or sense data
(see 3.1.114)

3.1.42 hard reset
condition resulting from the events defined by SAM-6 in which the SCSI device performs the hard reset opera-
tions described in SAM-6, this standard, and the applicable command standards

3.1.43 host
primary computing device that contains one or more SCSI initiator devices
Note 1 to entry: A host is typically a personal computer, workstation, server, minicomputer, mainframe
computer, or auxiliary computing device.
Note 2 to entry: A host includes one or more SCSI initiator devices.

3.1.44 I_T nexus
nexus between a SCSI initiator port and a SCSI target port
Note 1 to entry: See SAM-6.

3.1.45 I_T nexus loss
condition resulting from the events defined by SAM-6
Note 1 to entry: In response to this condition, the SCSI device performs the I_T nexus loss operations
described in SAM-6, this standard, and other applicable standards.

3.1.46 I_T nexus transaction
information transferred between SCSI ports in a single data structure with defined boundaries (e.g., an infor-
mation unit)

3.1.47 I_T_L nexus
nexus between a SCSI initiator port, a SCSI target port, and a logical unit
Note 1 to entry: See SAM-6.

3.1.48 idle power condition
one of the idle power conditions
Note 1 to entry: See 5.13.6.

3.1.49 IEEE-Administered Organizational Identifier (AOI)
24-bit organizational identifier that is administered by the IEEE
Note 1 to entry: AOIs are defined as administered organizational identifiers in the IEEE Identifier Guidelines (see clause 2).
Note 2 to entry: The IEEE defines some AOI values that are larger than 24 bits. Only 24-bit AOI values are used by this standard.
Note 3 to entry: AOI values are available from the IEEE-SA Registration Authority (see https://standards.ieee.org/products-services/regauth/index.html).

3.1.50 IEEE Extended Local Identifiers (ELI)
set of identifiers that the IEEE defines to have a local scope
Note 1 to entry: ELIs are defined in the IEEE Identifier Guidelines (see clause 2).
Note 2 to entry: The AOI values that are used to generate ELIs are provided at the discretion of the IEEE-SA Registration Authority.
Note 3 to entry: If the methods used for generating ELIs are the same as the methods used for generating EUIs, excepting only the AOI provided by the IEEE-SA Registration Authority, then those ELIs are globally unique with respect to each other and globally unique with respect to other EUIs, except in the cases where those ELIs are used in MAC addresses.
Note 4 to entry: This standard references ELI-48s and ELI-64s.

3.1.51 IEEE Extended Unique Identifiers (EUI)
set of identifiers that the IEEE defines to have a globally unique scope
Note 1 to entry: EUIs are defined in the IEEE Identifier Guidelines (see clause 2).
Note 2 to entry: The AOI values that are used to generate EUIs are provided at the discretion of the IEEE-SA Registration Authority.
Note 3 to entry: This standard references EUI-48s and EUI-64s.

3.1.52 IEEE-SA Registration Authority
provider of worldwide unique values for AOIs, ELI-48s, EUI-48s, ELI-64s, and EUI-64s
Note 1 to entry: The IEEE-SA Registration Authority also defines the formats for AOIs, ELI-48s, EUI-48s, ELI-64s, and EUI-64s.
Note 2 to entry: See https://standards.ieee.org/products-services/regauth/index.html.

3.1.53 implicit bind operation
bind operation that is requested by a device server

3.1.54 information unit (IU)
delimited and sequenced set of information in a format appropriate for transport by the service delivery subsystem (e.g., a CDB for a specific SCSI command)

3.1.55 initiator port identifier
value by which a SCSI initiator port (see 3.1.105) is referenced within a SCSI domain (see SAM-6)

3.1.56 initiator port name
name (see 3.1.73) of a SCSI initiator port

3.1.57 internet assigned numbers authority (IANA)
service that assigns and manages registries of code values (i.e., code points) for the IETF (see http://www.ietf.org) and other users of the public internet (see http://www.iana.org)

Note 1 to entry: IANA maintains registries of code values used by Internet Key Exchange version 2 (IKEv2) at http://www.iana.org/assignments/ikev2-parameters.

3.1.58 Internet protocol number
coded value assigned to identify protocols that layer on the Internet protocol (see RFC 791)

Note 1 to entry: The Internet protocol number assigned to the transmission control protocol (TCP, see RFC 793) is six.

Note 2 to entry: IANA maintains a list of Internet protocol number assignments at http://www.iana.org/assignments/protocol-numbers.

3.1.59 least significant bit (LSB)
bit or bit position with the smallest numerical weighting in a group of bits that, when taken as a whole, represent a numerical value

EXAMPLE – In the number 0001b, the bit that is set to one.

3.1.60 left-aligned
type of field containing ASCII data in which unused bytes are placed at the end of the field (i.e., highest offset) and are filled with ASCII space (i.e., 20h) characters

Note 1 to entry: See 4.3.1.

3.1.61 logical unit
externally addressable entity within a SCSI target device that implements a SCSI device model and contains a device server

Note 1 to entry: See SAM-6.

3.1.62 logical unit identifying information
value associated with a logical unit

Note 1 to entry: Logical unit identifying information is managed by the SET IDENTIFYING INFORMATION command (see 6.41) and the REPORT IDENTIFYING INFORMATION command (see 6.29).

Note 2 to entry: See 5.7.

3.1.63 logical unit inventory
list of the logical unit numbers reported by a REPORT LUNS command (see 6.30)

3.1.64 logical unit number (LUN)
encoded identifier for a logical unit

Note 1 to entry: See SAM-6.

3.1.65 logical unit reset
condition resulting from the events defined by SAM-6

Note 1 to entry: In response to this condition, the logical unit performs the logical unit reset operations described in SAM-6, this standard, and other applicable standards.

3.1.66 logical unit text identifying information

UTF-8 (see 3.1.142) format string associated with a logical unit

Note 1 to entry: UTF-8 format logical unit identifying information is managed by the SET IDENTIFYING INFORMATION command (see 6.41) and the REPORT IDENTIFYING INFORMATION command (see 6.29).

Note 2 to entry: See 5.7.

3.1.67 low power condition

any power condition other than the active power condition (see 5.13.5)

3.1.68 MAM attribute

single unit of MAM (see 3.1.71) information

3.1.69 media changer

device that mechanizes the movement of volumes to and from the SCSI device that records on or reads from the media

Note 1 to entry: See SMC-3.

3.1.70 medium

physical entity that stores data in a nonvolatile manner (i.e., retained through a power cycle) in accordance with commands processed by the device server

3.1.71 medium auxiliary memory (MAM)

memory residing in a volume (e.g., a tape cartridge) that stores medium auxiliary memory attributes (see 7.4)

3.1.72 most significant bit (MSB)

bit or bit position with the largest numerical weighting in a group of bits that, when taken as a whole, represent a numerical value (e.g., in the number 1000b, the bit that is set to one)

3.1.73 name

label of an object that is unique within a specified context and should never change (e.g., the term name and world wide identifier (WWID) may be interchangeable)

3.1.74 Network Address Authority (NAA)

field within a name (see 3.1.73) that specifies the format and length of that name

Note 1 to entry: See 7.7.6.6 and FC-FS-6.

3.1.75 nexus

relationship between two SCSI devices, and the SCSI initiator port and SCSI target port objects within those SCSI devices

Note 1 to entry: See SAM-6.

3.1.76 nonvolatile cache memory

cache memory (see 3.1.17) that retains data through any power cycle

3.1.77 null-padded

type of field in which unused bytes are placed at the end of the field (i.e., highest offset) and are filled with ASCII null (i.e., 00h) characters

Note 1 to entry: See 4.3.2.

3.1.78 null-terminated

type of field in which the last used byte (i.e., highest offset) is required to contain an ASCII null (i.e., 00h) character

Note 1 to entry: See 4.3.2.

3.1.79 one
logical true condition of a variable

3.1.80 page
regular parameter structure or format used by several commands and identified with a value known as a page code

3.1.81 persist through power loss
capability associated with some features that allows an application client to request that a device server maintain information regarding that feature across power cycles

3.1.82 persistent reservation holder
I_T nexus(es) that are allowed to release or change a persistent reservation without preempting it
Note 1 to entry: See 5.14.10.

3.1.83 power cycle
power being removed from and later applied to a SCSI device

3.1.84 power on
condition resulting from the events defined by SAM-6 in which the SCSI device performs the power on operations described in SAM-6, this standard, and the applicable command standards

3.1.85 primary target port asymmetric access state
characteristic that defines the behavior of a target port and the allowable command set for a logical unit when commands and task management functions are routed through the target port maintaining that state
Note 1 to entry: See 5.18.2.1.

3.1.86 primary target port group
set of target ports that are in the same primary target port asymmetric access state (see 3.1.85) at all times
Note 1 to entry: See 5.18.2.1.

3.1.87 primary target port group asymmetric access state
primary target port asymmetric access state (see 3.1.85) common to the set of target ports in a primary target port group (see 3.1.86)
Note 1 to entry: See 5.18.2.1.

3.1.88 protection information
one or more fields appended to each logical block that contain a CRC and device type specific information
Note 1 to entry: See SBC-5 and SSC-5.

3.1.89 protocol identifier
coded value used in various fields to identify the SCSI transport protocol to which other fields apply
Note 1 to entry: See 7.6.1.

3.1.90 protocol specific
requirement that is defined by a SCSI transport protocol standard (see 3.1.109)
Note 1 to entry: See SAM-6.

3.1.91 registered
condition that exists for an I_T nexus following the successful completion of a PERSISTENT RESERVE OUT command with a REGISTER service action, REGISTER AND IGNORE EXISTING KEY service action (see 5.14.7), or REGISTER AND MOVE service action (see 5.14.8) and lasting until the registration is removed (see 5.14.11)

3.1.92 registrant
I_T nexus that is registered (see 3.1.91)

3.1.93 relative port identifier
identifier for a SCSI port (see 3.1.106) that is unique within a SCSI device (see 3.1.101)
Note 1 to entry: Application clients may use the SCSI Ports VPD page (see 7.7.15) to determine relative port identifier values.
Note 2 to entry: See SAM-6.

3.1.94 relative initiator port identifier
relative port identifier (see 3.1.93) for a SCSI initiator port (see 3.1.105)

3.1.95 relative target port identifier
relative port identifier (see 3.1.93) for a SCSI target port (see 3.1.108)

3.1.96 request for comment (RFC)
name given to standards developed by the Internet Engineering Task Force

3.1.97 right-aligned
type of field containing ASCII data in which unused bytes are placed at the start of the field (i.e., lowest offset) and are filled with ASCII space (i.e., 20h) characters
Note 1 to entry: See 4.3.1.

3.1.98 ROD token
kind of token (see 3.1.132) that is a representation of data
Note 1 to entry: See 5.19.6.

3.1.99 S_A binding pair
subsidiary logical unit and administrative logical unit combination that are part of a binding

3.1.100 saturating counter
counter that remains at its maximum value after reaching its maximum value

3.1.101 SCSI device
device that contains one or more SCSI ports that are each connected to a service delivery subsystem and supports a SCSI application protocol
Note 1 to entry: See SAM-6.

3.1.102 SCSI device name
name (see 3.1.73) of a SCSI device that is world wide unique within the protocol of a SCSI domain (see 3.1.103) in which the SCSI device has SCSI ports (see 3.1.106)
Note 1 to entry: The SCSI device name may be made available to other SCSI devices or SCSI ports in protocol specific ways.
Note 2 to entry: See SAM-6.

3.1.103 SCSI domain
interconnection of two or more SCSI devices and a service delivery subsystem

3.1.104 SCSI initiator device
SCSI device (see 3.1.101) containing application clients (see 3.1.5) and SCSI initiator ports (see 3.1.105)
Note 1 to entry: SCSI initiator devices originate device service and task management requests (see SAM-6) to be processed by a SCSI target device (see 3.1.107) and receive device service and task management responses from SCSI target devices.
Note 2 to entry: See SAM-6.

3.1.105 SCSI initiator port
object associated with a SCSI initiator device (see SAM-6) that acts as the connection between application clients and a service delivery subsystem through which requests and responses are routed
Note 1 to entry: See SAM-6.

3.1.106 SCSI port
SCSI initiator port (see 3.1.105) or SCSI target port (see 3.1.108)

3.1.107 SCSI target device
SCSI device (see 3.1.101) containing logical units (see 3.1.61) and SCSI target ports (see 3.1.108)
Note 1 to entry: SCSI target devices receive device service and task management requests (see SAM-6) for processing and send device service and task management responses to SCSI initiator devices.
Note 2 to entry: See SAM-6.

3.1.108 SCSI target port
object associated with a SCSI target device (see SAM-6) object that acts as the connection between device servers and task managers and a service delivery subsystem through which requests and responses are routed
Note 1 to entry: See SAM-6.

3.1.109 SCSI transport protocol standard
SCSI standard that defines a SCSI transport protocol (e.g., FCP-5, SPL-5, SRP, or SBP-3)

3.1.110 SD Association
organization that establishes and maintains standards for SD memory card applications
Note 1 to entry: See https://www.sdcard.org/.

3.1.111 secondary target port asymmetric access state
characteristic indicating a condition that affects the way in which an individual target port participates in its assigned primary target port group (see 3.1.86)
Note 1 to entry: See 5.18.2.1.

3.1.112 secondary target port group
one or more target ports that are in the same secondary target port asymmetric access state (see 3.1.111)
Note 1 to entry: See 5.18.2.1.

3.1.113 Secure Content Storage Association (SCSA)
organization that develops specifications for protecting digital media content
Note 1 to entry: See http://www.vidity.com/about-us/.

3.1.114 sense data
data describing an error, exceptional condition, or completion information
Note 1 to entry: A device server delivers sense data to an application client in the same I_T nexus transaction (see 3.1.46) as the status or as parameter data in response to a REQUEST SENSE command (see 6.36).
Note 2 to entry: See 4.4.

3.1.115 sense key
contents of the SENSE KEY field in sense data (see 4.4)

3.1.116 service action
extension of the operation code (see 4.2.5.1) used to define a command
Note 1 to entry: See 4.2.5.2.

3.1.117 service delivery subsystem
that part of a SCSI domain that transmits service requests to a logical unit or SCSI target device and returns logical unit or SCSI target device responses to a SCSI initiator device
Note 1 to entry: See SAM-6.

3.1.118 standby power condition
one of the standby power conditions
Note 1 to entry: See 5.13.7.

3.1.119 status
one byte of response information that contains a coded value defined in SAM-6, transferred from a device server to an application client upon completion of each command
Note 1 to entry: See SAM-6.

3.1.120 Storage Networking Industry Association (SNIA)
organization that develops and promotes standards for storage management and other storage-related functions
Note 1 to entry: See http://www.snia.org/.

3.1.121 stream device
SCSI device that returns a peripheral device type (see table 150) of 01h (i.e., sequential access) or 03h (i.e., processor)
Note 1 to entry: This term is used in third party copies (see 5.19).

3.1.122 system
one or more SCSI domains operating as a single configuration

3.1.123 tape device
SCSI target device with a peripheral device type of 01h (i.e., sequential access device)

3.1.124 target port
synonymous with SCSI target port (see 3.1.108)

3.1.125 target port asymmetric access state
primary target port asymmetric access state (see 3.1.85) or secondary target port asymmetric access state (see 3.1.111)

3.1.126 target port group
primary target port group (see 3.1.86) or secondary target port group (see 3.1.112)

3.1.127 target port identifier
value by which a SCSI target port (see 3.1.108) is referenced within a SCSI domain (see SAM-6)

3.1.128 target port name
name (see 3.1.73) of a SCSI target port

3.1.129 task set

group of commands within a logical unit, whose interaction is dependent on the task management (i.e., queuing) and ACA rules

Note 1 to entry: The Control mode page (see 7.5.13) defines management capabilities for task sets.

Note 2 to entry: See SAM-6.

3.1.130 TCP port number

one of the data necessary to establish a TCP connection

Note 1 to entry: TCP port numbers may be assigned to protocols that layer on TCP by IANA. IANA maintains a list of TCP port number assignments at http://www.iana.org/assignments/port-numbers.

3.1.131 third-party command

command sent to one SCSI device requesting that an operation be performed involving two other SCSI devices (e.g., the EXTENDED COPY command may perform copy operations between two or more SCSI devices none of which are the SCSI device to which the EXTENDED COPY command was sent)

3.1.132 token

representation of a collection of data (e.g., management data, security data)

3.1.133 Trusted Computing Group (TCG)

organization that develops and promotes open standards for hardware-enabled trusted computing and security technologies

Note 1 to entry: See https://www.trustedcomputinggroup.org.

3.1.134 unbind operation

process by which a binding is removed and a LUN for a subsidiary logical unit is removed from the logical unit inventory

Note 1 to entry: See 5.8.10.

3.1.135 unbounded data counter log parameter

log parameter that contains one or more saturating counter values (see 3.1.100) or wrapping counter values (see 3.1.146)

Note 1 to entry: Other log parameters in the same log page are not affected.

Note 2 to entry: See 7.3.2.2.2.3.

3.1.136 unbound subsidiary logical unit

subsidiary logical unit that does not have a LUN and is not included in the logical unit inventory

3.1.137 unit attention condition

asynchronous status information that a logical unit establishes to report to the SCSI initiator ports associated with one or more I_T nexuses

Note 1 to entry: See SAM-6.

3.1.138 universal time (UT)

time at longitude zero, colloquially known as Greenwich Mean Time

Note 1 to entry: See http://aa.usno.navy.mil/faq/docs/UT.php.

3.1.139 URI Schemes

syntax specifications for UTF-8 (see 3.1.142) format strings that identify resources (see RFC 3986)

Note 1 to entry: IANA maintains a list of schemes for URI and URL names at:
http://www.iana.org/assignments/uri-schemes.

3.1.140 user data
data contained in logical blocks (e.g., see SBC-5) that is not protection information (see 3.1.88)
Note 1 to entry: Each command standard (see 3.1.21) may provide its own definition of user data.

3.1.141 user data segment
contiguous sequence of logical blocks (see SBC-5) or logical objects (see SSC-5)

3.1.142 UTF-8
character set that is a transformation format of the character set defined by ISO 10646
Note 1 to entry: See RFC 2279.

3.1.143 volatile cache memory
cache memory (see 3.1.17) that does not retain data through power cycles

3.1.144 well known logical unit
logical unit that only does specific functions in a SCSI target device
Note 1 to entry: Well known logical units allow an application client to send requests to receive and manage specific information usually relating to a SCSI target device.
Note 2 to entry: See clause 8 and SAM-6.

3.1.145 word
sequence of 16 contiguous bits considered as a unit

3.1.146 wrapping counter
counter that wraps back to zero after reaching its maximum value

3.1.147 zero-padded
type of field in which unused bytes are placed at the end of the field (i.e., highest offset) and are filled with zeros
Note 1 to entry: A zero-padded field contains bytes whose format is not specific, not ASCII characters, or not UTF-8 strings. For fields that are defined to contain ASCII characters or UTF-8 strings, null-padded is used instead of zero-padded.

3.2 Abbreviations and symbols

3.2.1 Abbreviations

See Clause 2 for abbreviations of standards bodies (e.g., ISO). Abbreviations used in this standard:

Abbreviation	Meaning
ACA	Auto Contingent Allegiance (see 3.1.7)
ADC-3	Automation/Drive Interface - Commands - 3
ADT-2	Automation/Drive Interface - Transport Protocol - 2
AOI	IEEE-Administered Organizational Identifier (see 3.1.49)
ASC	Additional Sense Code (see 4.4)
ASCII	American Standard Code for Information Interchange
ASCQ	Additional Sense Code Qualifier (see 4.4)
ASN.1	Abstract Syntax Notation One
ATA	AT Attachment (see www.t13.org)
ATAPI	AT Attachment with Packet Interface (see www.t13.org)

Abbreviation	Meaning
BOP	beginning of partition
CDB	Command Descriptor Block (see 3.1.20)
CFA	CompactFlash Association
CRC	Cyclic Redundancy Check
CSCD	Copy Source or Copy Destination (see 3.1.24)
CSEC	Communications Security Establishment Canada
D_ID	Destination Identifier (defined in FC-FS-3)
EOD	end of data
EOP	end of partition
ELI-48	IEEE Extended Local Identifier, 48-bits (see 3.1.50)
ELI-64	IEEE Extended Local Identifier, 64-bits (see 3.1.50)
EUI-48	IEEE Extended Unique Identifier, 48-bits (see 3.1.51)
EUI-64	IEEE Extended Unique Identifier, 64-bits (see 3.1.51)
FC-FS-3	Fibre Channel Framing and Signaling Interface-3 (see clause 2)
FC-FS-6	Fibre Channel Framing and Signaling Interface-6 (see clause 2)
FC-LS-2	Fibre Channel Link Services-2 (see clause 2)
FC-SP-2	Fibre Channel Security Protocols-2 (see clause 2)
FCP-5	Fibre Channel Protocol for SCSI -5 (see clause 2)
HTTP	Hypertext Transfer Protocol (see RFC 2616)
GUID	Globally Unique IDentifier (see RFC 4122)
IANA	Internet Assigned Numbers Authority (see 3.1.57)
ID	Identifier or Identification
IEEE	Institute of Electrical and Electronics Engineers
IP	Internet Protocol
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
iSCSI	Internet SCSI (see clause 2)
IU	Information Unit
LBA	Logical Block Address
LSB	Least Significant Bit (see 3.1.59)
LUN	Logical Unit Number (see 3.1.64)
MAM	Medium Auxiliary Memory (see 3.1.71)
MMC-6	SCSI Multi-Media Commands - 6 and MMC-6 Amendment 1 (see clause 2)
MSB	Most Significant Bit (see 3.1.72)
n/a	not applicable
NAA	Network Address Authority (see 3.1.74)
NVMe	NVM Express
OCRW	SCSI Specification for Optical Card Reader/Writer (see OCM in clause 2)
OSD	Object-based Storage Devices Commands
PCI	Peripheral Component Interface
PCIe	PCI Express
RAID	Redundant Array of Independent Disks
RBC	SCSI Reduced Block Commands
RDMA	Remote Direct Memory Access (see SRP)
RFC	Request For Comments (see 3.1.96)
ROD	Representation Of Data (see 5.19.6)
SAM-2	SCSI Architecture Model - 2 (see clause 2)
SAM-6	SCSI Architecture Model - 6 (see clause 2)

Abbreviation	Meaning
SAT-3	SCSI / ATA Translation - 3 (see clause 2)
SBC-2	SCSI Block Commands - 2 (see clause 2)
SBC-3	SCSI Block Commands - 3 (see clause 2)
SBC-5	SCSI Block Commands - 5 (see clause 2)
SBP-3	Serial Bus Protocol - 3 (see clause 2)
SCC-2	SCSI Controller Commands -2
SCSA	Secure Content Storage Association
SCSI	Small Computer System Interface
SES-2	SCSI Enclosure Services - 2
SES-3	SCSI Enclosure Services - 3
SFSC	Security Features for SCSI Commands (see clause 2)
SMC-3	SCSI Media Changer Commands - 3 (see clause 2)
SNIA	Storage Networking Industry Association (see 3.1.120)
SOP	SCSI Over PCI Express® (see clause 2)
SPC-2	SCSI Primary Commands - 2 (see clause 2)
SPC-3	SCSI Primary Commands - 3 (see clause 2)
SPC-4	SCSI Primary Commands - 4 (see clause 2)
SPC-5	SCSI Primary Commands - 5 (see clause 2)
SPC-6	SCSI Primary Commands - 6 (this standard)
SPDM	Security Protocol and Data Model (developed by DMTF)
SPI-5	SCSI Parallel Interface - 5
SPL-5	SAS Protocol Layer - 5 (see clause 2)
SRP	SCSI RDMA Protocol (see clause 2)
SSC-5	SCSI Stream Commands - 5 (see clause 2)
TCG	Trusted Computing Group (see 3.1.133)
TCP	Transmission Control Protocol (see RFC 793)
UFS	Universal Flash Storage (developed by JEDEC)
URI	Uniform Resource Identifier (see RFC 3986 and 3.1.139)
URL	Uniform Resource Locator (see RFC 3986 and 3.1.139)
UT	Universal time (see 3.1.138)
USB	Universal Serial Bus
USB-3	Universal Serial Bus - 3.2 (see clause 2)
UUID	Universally Unique IDentifier (see RFC 4122)
VPD	Vital Product Data (see 7.7)
VPG1	Video Performance Guarantee Profile 1
VS	Vendor Specific (see 3.3.12)
XCDB	Extended CDB (see 3.1.39)
ZBC-3	Zoned Block Commands - 3 (see clause 2)

3.2.2 Symbols

Symbols used in this standard:

Symbol	Meaning
||	concatenation
x, xx	any valid value for a bit or field
&	grammatical and
→	segment descriptor transfer data (see 3.7.4)

3.2.3 Mathematical operators

Mathematical operators used in this standard:

Mathematical operator	Meaning
+	plus
−	minus
/	divided by
×	multiplied by
<	less than
≤	less than or equal to
>	greater than
≥	greater than or equal to
≠	not equal to

3.3 Keywords

3.3.1 invalid
keyword used to describe an illegal or unsupported bit, byte, word, field or code value

Note 1 to entry: Receipt by the device server of an invalid bit, byte, word, field or code value shall be reported as an error.

3.3.2 mandatory
keyword indicating an item that is required to be implemented as defined in this standard

3.3.3 may
keyword indicating flexibility of choice with no implied preference

3.3.4 may or may not
keyword indicating flexibility of choice with no implied preference

Note 1 to entry: Significant uses of "may or may not" occur in descriptions where attention is being drawn to the "may not" case.

3.3.5 obsolete
keyword indicating that an item was defined in prior SCSI standards but has been removed from this standard

3.3.6 option, optional
keywords that describe features that are not required to be implemented by this standard

Note 1 to entry: If any optional feature defined by this standard is implemented, then it shall be implemented as defined in this standard.

3.3.7 prohibited
keyword used to describe a feature, function, or coded value that is defined in a non-SCSI standard (i.e., a standard that is not a member of the SCSI family of standards) to which this standard makes a normative reference where the use of said feature, function, or coded value is not allowed for implementations of this standard

3.3.8 reserved
keyword referring to bits, bytes, words, fields and code values that are set aside for future standardization

Note 1 to entry: A reserved bit, byte, word or field shall be set to zero, or in accordance with a future extension to this standard.

Note 2 to entry: Recipients are not required to check reserved bits, bytes, words or fields for zero values.

Note 3 to entry: Receipt of reserved code values in defined fields shall be reported as an error.

3.3.9 restricted
keyword referring to bits, bytes, words, and fields that are set aside for other identified standardization purposes

Note 1 to entry: A restricted bit, byte, word, or field shall be treated as a reserved bit, byte, word or field in the context where the restricted designation appears.

3.3.10 shall
keyword indicating a mandatory requirement

Note 1 to entry: Designers are required to implement all such mandatory requirements to ensure interoperability with other products that conform to this standard.

3.3.11 should
keyword indicating flexibility of choice with a strongly preferred alternative

3.3.12 vendor specific (VS)
something (e.g., a bit, field, code value) that is not defined by this standard

Note 1 to entry: Specification of the referenced item is determined by the SCSI device vendor and may be used differently in various implementations.

3.4 Conventions

Certain words and terms used in this standard have a specific meaning beyond the normal English meaning. These words and terms are defined either in 3.1 or in the text where they first appear. Names of commands, statuses, sense keys, and additional sense codes are in all uppercase (e.g., REQUEST SENSE). Lowercase is used for words having the normal English meaning.

If a CDB length is specified for a particular command (e.g., READ BUFFER(10), READ BUFFER(16), MODE SENSE(10)) and the name of the command is used in a sentence without any CDB length descriptor (e.g., READ BUFFER, MODE SENSE), then the condition described in the sentence applies to all CDB lengths for that command.

The names of fields are in small uppercase (e.g., ALLOCATION LENGTH). When a field name is a concatenation of acronyms, uppercase letters may be used for readability (e.g., NORMACA). Normal case is used when the contents of a field are being discussed. Fields containing only one bit are usually referred to as the name bit instead of the name field.

When the value of the bit or field is not relevant, x or xx appears in place of a specific value.

Lists sequenced by lowercase or uppercase letters show no ordering relationship between the listed items.

EXAMPLE 1 – The following list shows no relationship between the colors named:

    a)   red, specificity one of the following colors:
         A)   crimson; or

      B)   amber;
  b)   blue; or
  c)   green.

Lists sequenced by numbers show an ordering relationship between the listed items.

EXAMPLE 2 – The following list shows the order in which a page is meant to be read:

  1)   top;
  2)   middle; and
  3)   bottom.

Lists are associated with an introductory paragraph or phrase, and are numbered relative to that paragraph or phrase (i.e., all lists begin with an a) or 1) entry).

If a conflict arises between text, tables, or figures, the order of precedence to resolve the conflicts is text; then tables; and finally figures. Not all tables or figures are fully described in the text. Tables show data format and values. Notes do not constitute any requirements for implementors.

3.5 Numeric and character conventions

3.5.1 Numeric conventions

A binary number is represented in this standard by any sequence of digits comprised of only the Arabic numerals 0 and 1 immediately followed by a lower-case b (e.g., 0101b). Underscores or spaces may be included in binary number representations to increase readability or delineate field boundaries (e.g., 0 0101 1010b or 0_0101_1010b).

A hexadecimal number is represented in this standard by any sequence of digits comprised of only the Arabic numerals 0 to 9 and/or the upper-case English letters A to F immediately followed by a lower-case h (e.g., FA23h). Underscores or spaces may be included in hexadecimal number representations to increase readability or delineate field boundaries (e.g., B FD8C FA23h or B_FD8C_FA23h).

A decimal number is represented in this standard by any sequence of digits comprised of only the Arabic numerals 0 to 9 not immediately followed by a lower-case b or lower-case h (e.g., 25).

A range of numeric values is represented in this standard in the form "a to z", where a is the first value included in the range, all values between a and z are included in the range, and z is the last value included in the range (e.g., the representation "0h to 3h" includes the values 0h, 1h, 2h, and 3h).

This standard uses the following conventions for representing decimal numbers:

  a)   the decimal separator (i.e., separating the integer and fractional portions of the number) is a period;
  b)   the thousands separator (i.e., separating groups of three digits in a portion of the number) is a space;
  c)   the thousands separator is used in both the integer portion and the fraction portion of a number; and
  d)   the decimal representation for a year is 1999 not 1 999.

Table 1 shows some examples of decimal numbers represented using various conventions.

Table 1 – Numbering conventions examples

French	English	This standard
0,6	0.6	0.6
3,141 592 65	3.14159265	3.141 592 65
1 000	1,000	1 000
1 323 462,95	1,323,462.95	1 323 462.95

A decimal number represented in this standard with an overline over one or more digits following the decimal point is a number where the overlined digits are infinitely repeating (e.g., $666.\overline{6}$ means 666.666 666… or 666 2/3 and $12.\overline{142\ 857}$ means 12.142 857 142 857… or 12 1/7).

3.5.2 Units of measure

This standard represents values using both decimal units of measure and binary units of measure. Values are represented by the following formats:

a) for values based on decimal units of measure:
   1) numerical value (e.g., 100);
   2) space;
   3) prefix symbol and unit:
      1) decimal prefix symbol (e.g., M) (see table 2); and
      2) unit abbreviation (e.g., B);
   and
b) for values based on binary units of measure:
   1) numerical value (e.g., 1 024);
   2) space;
   3) prefix symbol and unit:
      1) binary prefix symbol (e.g., Gi) (see table 2); and
      2) unit abbreviation (e.g., b).

Table 2 compares the prefix, symbols, and power of the binary and decimal units.

Table 2 – Comparison of decimal prefixes and binary prefixes

Decimal			Binary		
Prefix name	**Prefix symbol**	**Power (base-10)**	**Prefix name**	**Prefix symbol**	**Power (base-2)**
kilo	k	10^3	kibi	Ki	2^{10}
mega	M	10^6	mebi	Mi	2^{20}
giga	G	10^9	gibi	Gi	2^{30}
tera	T	10^{12}	tebi	Ti	2^{40}
peta	P	10^{15}	pebi	Pi	2^{50}
exa	E	10^{18}	exbi	Ei	2^{60}
zetta	Z	10^{21}	zebi	Zi	2^{70}
yotta	Y	10^{24}	yobi	Yi	2^{80}

3.5.3 Byte encoded character strings conventions

When this standard requires one or more bytes to contain specific encoded characters, the specific characters are enclosed in single quotation marks. The single quotation marks identify the start and end of the characters that are required to be encoded but are not themselves to be encoded. The characters that are to be encoded are shown in the case that is to be encoded.

An ASCII space character (i.e., code value 20h) may be represented in a string by the character '¬' (e.g., 'SCSI¬device').

The encoded characters and the single quotation marks that enclose them are preceded by text that specifies the character encoding methodology and the number of characters required to be encoded.

EXAMPLE - Using the notation described in this subclause, stating that the eleven ASCII characters 'SCSI device' represent encoded characters is the same as writing out the following sequence of byte values: 53h 43h 53h 49h 20h 64h 65h 76h 69h 63h 65h.

3.6 Bit and byte ordering

This subclause describes the representation of fields in a table that defines the format of a SCSI structure (e.g., the format of a CDB).

If a field consists of more than one bit and contains a single value (e.g., a number), the least significant bit (LSB) is shown on the right and the most significant bit (MSB) is shown on the left (e.g., in a byte, bit 7 is the MSB and is shown on the left, and bit 0 is the LSB and is shown on the right). The MSB and LSB are not labeled if the field consists of 8 or fewer bits.

If a field consists of more than one byte and contains a single value, the byte containing the MSB is stored at the lowest address and the byte containing the LSB is stored at the highest address (i.e., big-endian byte ordering). The MSB and LSB are labeled.

If a field consists of more than one byte and always contains multiple fields each with their own values (e.g., a descriptor), then there is no MSB and LSB of the field itself and thus there are no MSB and LSB labels. Each individual field has an MSB and LSB that are labeled as appropriate in the table, if any, that describes the format of the sub-structure having multiple fields.

If a field that consists of more than one byte contains either multiple fields each with their own values or a single value, then:

   a) the MSB and LSB are labeled and they apply as described in this subclause whenever the field contains a single value; and
   b) the labels on constituent fields supersede the single value labels whenever the field contains multiple fields.

If a field contains a text string (e.g., ASCII or UTF-8), the MSB label is the MSB of the first character and the LSB label is the LSB of the last character.

When required for clarity, multiple byte fields may be represented with only two rows in a table. This condition is represented by values in the byte number column not increasing by one in each subsequent table row, thus indicating the presence of additional bytes.

3.7 Notation conventions

3.7.1 Notation for procedure calls

In this standard, the model for functional interfaces between objects is a procedure call. Such interfaces are specified using the following notation:

   [Result =] Procedure Name (IN ([input-1] [,input-2] …]), OUT ([output-1] [,output-2] …))

Where:

Result:	A single value representing the outcome of the procedure call.
Procedure Name:	A descriptive name for the function modeled by the procedure call. When the procedure call model is used to describe a SCSI transport protocol service, the procedure name is the same as the service name.
Input-1, Input-2, …:	A comma-separated list of names identifying caller-supplied input arguments.
Output-1, Output-2, …:	A comma-separated list of names identifying output arguments to be returned by the procedure call.
"[…]":	Brackets enclosing optional or conditional arguments.

This notation allows arguments to be specified as inputs and outputs. An interface between entities may require only inputs. If a procedure call has no output arguments, the word OUT, preceding comma, and associated pair of balanced parentheses are omitted.

The following is an example of a procedure call specification:

   Found = Search (IN (Pattern, Item List), OUT ([Item Found]))

Where:

   Found = Flag
              Flag: if set to one, indicates that a matching item was located.

Input Arguments:

   Pattern = …   /* Definition of Pattern argument */
                Argument containing the search pattern.

   Item List = Item<NN>   /* Definition of Item List as an array of NN Item arguments*/
                Contains the items to be searched for a match.

Output Arguments:

   Item Found = Item …   /* Item located by the search procedure call */
                This argument is only returned if the search succeeds.

3.7.2 Notation for state diagrams

All state diagrams use the notation shown in figure 2.
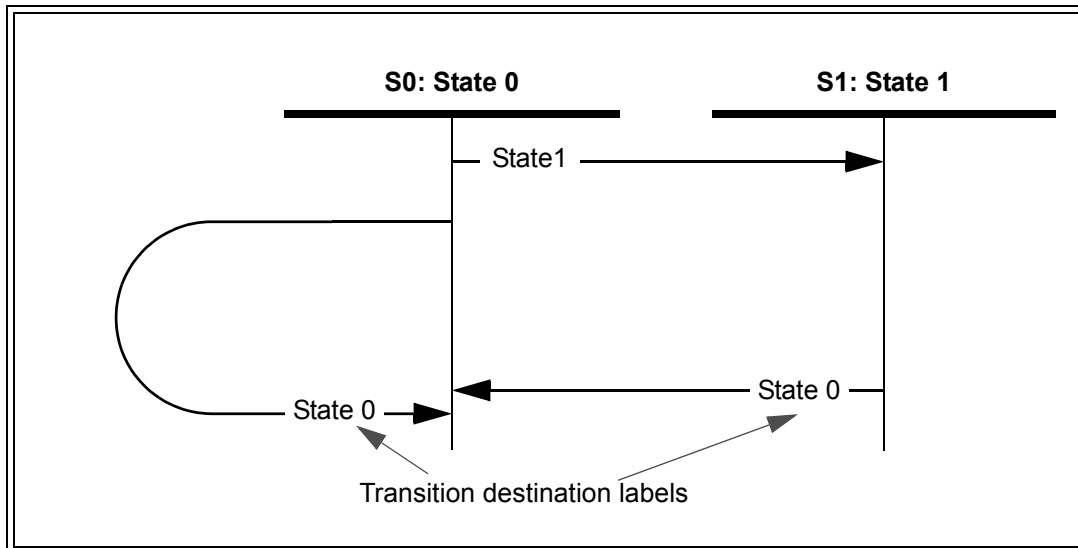
Figure 2 – Example state diagram

The state diagram is followed by subclauses describing the states and state transitions.

Each state and state transition is described in the list with particular attention to the conditions that cause the transition to occur and special conditions related to the transition.

A system described in this manner has the following properties:

   a) time elapses only within discrete states; and
   b) state transitions are logically instantaneous.

3.7.3 Notation for flowcharts

This standard uses flowcharts that ISO 5807:1995 defines as program flowcharts. Figure 3 shows an example flowchart.
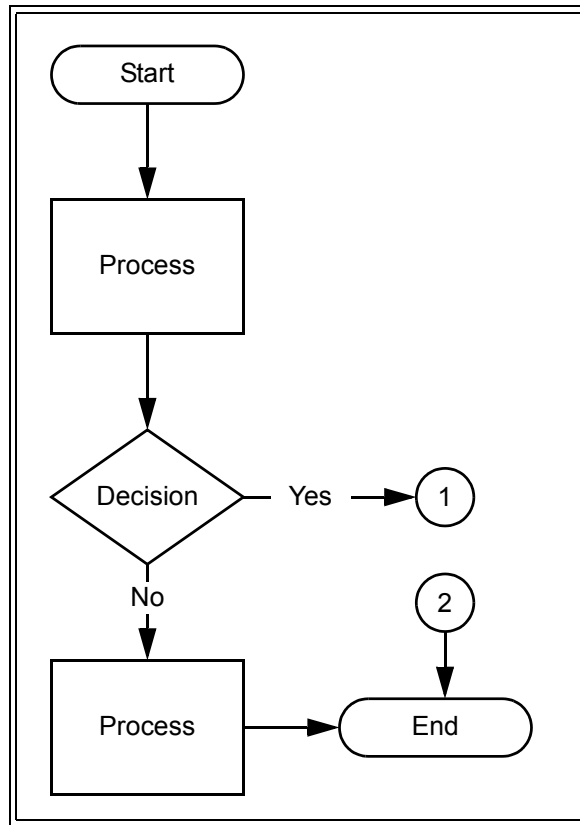
Figure 3 – Example flowchart

The following types of symbols are shown in figure 3:

    a)   a termination (e.g., start and end) symbol;
    b)   a process symbol;
    c)   a decision symbol; and
    d)   a reference (e.g., 1 and 2) symbol.

A termination symbol shows the starting point for the flowchart or the ending point for the flowchart.

A process symbol shows any kind of processing function that occurs as a result of entering this condition from a previous symbol.

A decision symbol shows a point in the progression of the flowchart from which there is more than one exit possibility of which only one is satisfied by the condition described within the decision symbol.

A reference symbol shows a connection to or from another flowchart and has the same number in both the source flowchart and destination flowchart.

3.7.4 Notation for EXTENDED COPY command segment descriptors

The segment descriptors (see 6.6.6) contained in the parameter list for an EXTENDED COPY command (see 6.6) request the copy manager to perform operations on copy sources and copy destinations. The names of segment descriptors indicate this by inserting a right pointing arrow (i.e., →) between a brief description of the copy source and a brief description of the copy destination (e.g., block→stream).

If the segment descriptor requests the transfer of data to the copy destination and another location, an ampersand (i.e., &) is appended to the copy destination with a description of the additional location following the ampersand (e.g., block→stream&application client).

4 General concepts

4.1 General concepts introduction

This standard defines behaviors that are common to all SCSI device models (see clause 5). This standard defines the SCSI commands that are basic to more than one device model and the SCSI commands that may apply to any device model (see clause 6). This standard defines the parameters that are basic to more than one device model (see clause 7).

4.2 Command Descriptor Block

4.2.1 CDB usage and structure

A command is communicated by sending a CDB to the device server. For some commands, the CDB is accompanied by a list of parameters in the Data-Out Buffer. See the specific commands for detailed information.

If an object in a logical unit (e.g., a device server) validates reserved CDB fields and receives a reserved field within the CDB that is not zero, then the logical unit shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

If a logical unit receives a reserved CDB code value in a field other than the OPERATION CODE field, then the logical unit shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

The fixed length CDB formats are described in 4.2.2. The variable length CDB formats are described in 4.2.3. The XCDB format is described in 4.2.4. The CDB fields that are common to most commands are described in 4.2.5. The fields shown in 4.2.2 and 4.2.3 and described in 4.2.5 are used consistently by most commands. Except for the OPERATION CODE field, the SERVICE ACTION field, if any, and the CONTROL byte, the actual usage of any field is described in the standard defining that command. If a device server receives a CDB containing an operation code that is invalid or not supported, the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID COMMAND OPERATION CODE.

For all commands, if there is an invalid parameter in the CDB, the device server shall terminate the command without altering the medium.

The XCDB format (see 4.2.4) is a CDB in which additional information is appended to another CDB. The requirements in this subclause apply to the XCDB and the CDB contained in the XCDB.

4.2.2 Fixed length CDB formats

4.2.2.1 Formats for 6-byte CDBs

4.2.2.1.1 Generic 6-byte CDB format

Table 3 shows the generic format of a 6-byte CDB.

Table 3 – Generic CDB format for 6-byte commands

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE							
1 ••• 4	miscellaneous CDB information							
5	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1.

Miscellaneous CDB information is defined by the standard that defines the command.

The CONTROL byte is defined in SAM-6.

4.2.2.1.2 Typical 6-byte CDB format

Table 4 shows the typical format of a 6-byte CDB, including the location of:

    a)   the TRANSFER LENGTH field, if any;
    b)   the PARAMETER LIST LENGTH field, if any; and
    c)   the ALLOCATION LENGTH field, if any.

Table 4 – Typical CDB format for 6-byte commands

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE							
1 ••• 3	miscellaneous CDB information							
4	TRANSFER LENGTH (if any) PARAMETER LIST LENGTH (if any) ALLOCATION LENGTH (if any)							
5	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1.

Miscellaneous CDB information is defined by the standard that defines the command.

The TRANSFER LENGTH field, if any, is defined in 4.2.5.4.

The PARAMETER LIST LENGTH field, if any, is defined in 4.2.5.5.

The ALLOCATION LENGTH field, if any, is defined in 4.2.5.6.

The CONTROL byte is defined in SAM-6.

4.2.2.2 Formats for 10-byte CDBs

4.2.2.2.1 Generic 10-byte CDB format

Table 5 shows the generic format of a 10-byte CDB, including the location of the SERVICE ACTION field, if any.

Table 5 – Generic CDB format for 10-byte commands

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE							
1	miscellaneous CDB information			SERVICE ACTION (if any) miscellaneous CDB information (if any)				
2 ••• 8	miscellaneous CDB information							
9	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1.

Miscellaneous CDB information is defined by the standard that defines the command.

The SERVICE ACTION field, if any, is defined in 4.2.5.2.

The CONTROL byte is defined in SAM-6.

4.2.2.2.2 Typical 10-byte CDB format

Table 6 shows the typical format of a 10-byte CDB, including the location of:

    a)   the SERVICE ACTION field, if any;
    b)   the LOGICAL BLOCK ADDRESS field, if any;
    c)   the TRANSFER LENGTH field, if any;
    d)   the PARAMETER LIST LENGTH field, if any; and
    e)   the ALLOCATION LENGTH field, if any.

Table 6 – Typical CDB format for 10-byte commands

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE							
1	miscellaneous CDB information			SERVICE ACTION (if any)				
2	(MSB)							
•••				LOGICAL BLOCK ADDRESS (if any)				
5								(LSB)
6	miscellaneous CDB information							
7	(MSB)			TRANSFER LENGTH (if any) PARAMETER LIST LENGTH (if any)				
8				ALLOCATION LENGTH (if any)				(LSB)
9	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1.

Miscellaneous CDB information is defined by the standard that defines the command.

The SERVICE ACTION field, if any, is defined in 4.2.5.2.

The LOGICAL BLOCK ADDRESS field, if any, is defined in 4.2.5.3.

The TRANSFER LENGTH field, if any, is defined in 4.2.5.4.

The PARAMETER LIST LENGTH field, if any, is defined in 4.2.5.5.

The ALLOCATION LENGTH field, if any, is defined in 4.2.5.6.

The CONTROL byte is defined in SAM-6.

4.2.2.3 Formats for 12-byte CDBs

4.2.2.3.1 Generic 12-byte CDB format

Table 7 shows the generic format of a 12-byte CDB, including the location of the SERVICE ACTION field, if any.

Table 7 – Generic CDB format for 12-byte commands

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE							
1	miscellaneous CDB information			SERVICE ACTION (if any) miscellaneous CDB information (if any)				
2 ••• 10	miscellaneous CDB information							
11	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1.

Miscellaneous CDB information is defined by the standard that defines the command.

The SERVICE ACTION field, if any, is defined in 4.2.5.2.

The CONTROL byte is defined in SAM-6.

4.2.2.3.2 Typical 12-byte CDB format

Table 8 shows the typical format of a 12-byte CDB, including the location of:

   a) the SERVICE ACTION field, if any;
   b) the LOGICAL BLOCK ADDRESS field, if any;
   c) the TRANSFER LENGTH field, if any;
   d) the PARAMETER LIST LENGTH field, if any; and
   e) the ALLOCATION LENGTH field, if any.

Table 8 – Typical CDB format for 12-byte commands

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE							
1	miscellaneous CDB information			SERVICE ACTION (if any)				
2	(MSB)							
•••		LOGICAL BLOCK ADDRESS (if any)						
5								(LSB)
6	(MSB)	TRANSFER LENGTH (if any)						
•••		PARAMETER LIST LENGTH (if any)						
9		ALLOCATION LENGTH (if any)						(LSB)
10	miscellaneous CDB information							
11	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1.

Miscellaneous CDB information is defined by the standard that defines the command.

The SERVICE ACTION field, if any, is defined in 4.2.5.2.

The LOGICAL BLOCK ADDRESS field, if any, is defined in 4.2.5.3.

The TRANSFER LENGTH field, if any, is defined in 4.2.5.4.

The PARAMETER LIST LENGTH field, if any, is defined in 4.2.5.5.

The ALLOCATION LENGTH field, if any, is defined in 4.2.5.6.

The CONTROL byte is defined in SAM-6.

4.2.2.3.3 MAINTENANCE IN CDB format

Table 9 shows the generic format of a CDB that uses the MAINTENANCE IN operation code. If the PERIPHERAL DEVICE TYPE field is set to 0Ch (i.e., storage array controller device) or the SCCS bit is set to one in the standard INQUIRY data (see 6.7.2), then the MAINTENANCE IN service action definition in SCC-2 for the specified service action, if any, applies.

Table 9 – Generic CDB format for MAINTENANCE IN commands

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (A3h)							
1	miscellaneous CDB information			SERVICE ACTION				
2 ••• 10	miscellaneous CDB information							
11	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 9 for any command that uses the MAINTENANCE IN CDB format.

Miscellaneous CDB information is defined by the standard that defines the command that uses the MAINTE-NANCE IN CDB format.

The SERVICE ACTION field is defined in 4.2.5.2, and in the standard that defines the command that uses the MAINTENANCE IN CDB format. A numeric ordered listing of service actions associated with the MAINTE-NANCE IN CDB format is provided in E.3.3.

The CONTROL byte is defined in SAM-6.

4.2.2.3.4 MAINTENANCE OUT CDB format

Table 10 shows the generic format of a CDB that uses the MAINTENANCE OUT operation code. If the PERIPHERAL DEVICE TYPE field is set to 0Ch (i.e., storage array controller device) or the SCCS bit is set to one in the standard INQUIRY data (see 6.7.2), then the MAINTENANCE OUT service action definition in SCC-2 for the specified service action, if any, applies.

Table 10 – Generic CDB format for MAINTENANCE OUT commands

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (A4h)							
1	miscellaneous CDB information			SERVICE ACTION				
2 ••• 10	miscellaneous CDB information							
11	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 10 for any command that uses the MAINTENANCE OUT CDB format.

Miscellaneous CDB information is defined by the standard that defines the command that uses the MAINTE-NANCE OUT CDB format.

The SERVICE ACTION field is defined in 4.2.5.2, and in the standard that defines the command that uses the MAINTENANCE OUT CDB format. A numeric ordered listing of service actions associated with the MAINTE-NANCE OUT CDB format is provided in E.3.3.

The CONTROL byte is defined in SAM-6.

4.2.2.3.5 SERVICE ACTION IN(12) CDB format

Table 11 shows the generic format of a CDB that uses the SERVICE ACTION IN(12) operation code.

Table 11 – Generic CDB format for SERVICE ACTION IN(12) commands

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (ABh)							
1	miscellaneous CDB information			SERVICE ACTION				
2 ••• 10	miscellaneous CDB information							
11	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 11 for any command that uses the SERVICE ACTION IN(12) CDB format.

Miscellaneous CDB information is defined by the standard that defines the command that uses the SERVICE ACTION IN(12) CDB format.

The SERVICE ACTION field is defined in 4.2.5.2, and in the standard that defines the command that uses the SERVICE ACTION IN(12) CDB format. A numeric ordered listing of service actions associated with the SERVICE ACTION IN(12) CDB format is provided in table E.4 (see E.3.4).

The CONTROL byte is defined in SAM-6.

4.2.2.3.6 SERVICE ACTION OUT(12) CDB format

Table 12 shows the generic format of a CDB that uses the SERVICE ACTION OUT(12) operation code.

Table 12 – Generic CDB format for SERVICE ACTION OUT(12) commands

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (A9h)							
1	miscellaneous CDB information			SERVICE ACTION				
2 ••• 10	miscellaneous CDB information							
11	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 12 for any command that uses the SERVICE ACTION OUT(12) CDB format.

Miscellaneous CDB information is defined by the standard that defines the command that uses the SERVICE ACTION OUT(12) CDB format.

The SERVICE ACTION field is defined in 4.2.5.2, and in the standard that defines the command that uses the SERVICE ACTION OUT(12) CDB format. A numeric ordered listing of service actions associated with the SERVICE ACTION OUT(12) CDB format is provided in table E.4 (see E.3.4).

The CONTROL byte is defined in SAM-6.

4.2.2.4 Formats for 16-byte CDBs

4.2.2.4.1 Generic 16-byte CDB format

Table 13 shows the generic format of a 16-byte CDB, including the location of the SERVICE ACTION field, if any.

Table 13 – Generic CDB format for 16-byte commands

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE							
1	miscellaneous CDB information			SERVICE ACTION (if any) miscellaneous CDB information (if any)				
2 ••• 14	miscellaneous CDB information							
15	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1.

Miscellaneous CDB information is defined by the standard that defines the command.

The SERVICE ACTION field, if any, is defined in 4.2.5.2.

The CONTROL byte is defined in SAM-6.

4.2.2.4.2 Typical 16-byte CDB format, if eight-byte LBAs not supported

Table 14 shows the typical format of a 16-byte CDB for commands that do not support eight-byte LBA values, including the location of:

   a)   the SERVICE ACTION field, if any;
   b)   the LOGICAL BLOCK ADDRESS field, if any;
   c)   the TRANSFER LENGTH field, if any;
   d)   the PARAMETER LIST LENGTH field, if any; and
   e)   the ALLOCATION LENGTH field, if any.

Table 14 – Typical CDB format for 16-byte commands, if eight-byte LBAs not supported

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE							
1	miscellaneous CDB information			SERVICE ACTION (if any)				
2	(MSB)							
•••				LOGICAL BLOCK ADDRESS (if any)				
5								(LSB)
6								
•••				miscellaneous CDB information				
9								
10	(MSB)			TRANSFER LENGTH (if any)				
•••				PARAMETER LIST LENGTH (if any)				
13				ALLOCATION LENGTH (if any)				(LSB)
14	miscellaneous CDB information							
15	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1.

Miscellaneous CDB information is defined by the standard that defines the command.

The SERVICE ACTION field, if any, is defined in 4.2.5.2.

The LOGICAL BLOCK ADDRESS field, if any, is defined in 4.2.5.3.

The TRANSFER LENGTH field, if any, is defined in 4.2.5.4.

The PARAMETER LIST LENGTH field, if any, is defined in 4.2.5.5.

The ALLOCATION LENGTH field, if any, is defined in 4.2.5.6.

The CONTROL byte is defined in SAM-6.

4.2.2.4.3 Typical 16-byte CDB format with eight-byte LBAs supported

Table 15 shows the typical format of a 16-byte CDB for commands that support eight-byte LBA values, including the location of:

a) the SERVICE ACTION field, if any;
b) the LOGICAL BLOCK ADDRESS field;
c) the TRANSFER LENGTH field, if any;
d) the PARAMETER LIST LENGTH field, if any; and
e) the ALLOCATION LENGTH field, if any.

Table 15 – Typical CDB format for 16-byte commands with eight-byte LBAs supported

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE							
1	miscellaneous CDB information			SERVICE ACTION (if any)				
2	(MSB)							
•••		LOGICAL BLOCK ADDRESS						
9								(LSB)
10	(MSB)		TRANSFER LENGTH (if any)					
•••		PARAMETER LIST LENGTH (if any)						
13		ALLOCATION LENGTH (if any)						(LSB)
14	miscellaneous CDB information							
15	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1.

Miscellaneous CDB information is defined by the standard that defines the command.

The SERVICE ACTION field, if any, is defined in 4.2.5.2.

The LOGICAL BLOCK ADDRESS field is defined in 4.2.5.3.

The TRANSFER LENGTH field, if any, is defined in 4.2.5.4.

The PARAMETER LIST LENGTH field, if any, is defined in 4.2.5.5.

The ALLOCATION LENGTH field, if any, is defined in 4.2.5.6.

The CONTROL byte is defined in SAM-6.

4.2.2.4.4 SERVICE ACTION IN(16) CDB format

Table 16 shows the generic format of a CDB that uses the SERVICE ACTION IN(16) operation code.

Table 16 – Generic CDB format for SERVICE ACTION IN(16) commands

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (9Eh)							
1	miscellaneous CDB information			SERVICE ACTION				
2 ••• 14	miscellaneous CDB information							
15	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 16 for any command that uses the SERVICE ACTION IN(16) CDB format.

Miscellaneous CDB information is defined by the standard that defines the command that uses the SERVICE ACTION IN(16) CDB format.

The SERVICE ACTION field is defined in 4.2.5.2, and in the standard that defines the command that uses the SERVICE ACTION IN(16) CDB format. A numeric ordered listing of service actions associated with the SERVICE ACTION IN(16) CDB format is provided in table E.5 (see E.3.4).

The CONTROL byte is defined in SAM-6.

4.2.2.4.5 SERVICE ACTION OUT(16) CDB format

Table 17 shows the generic format of a CDB that uses the SERVICE ACTION OUT(16) operation code.

Table 17 – Generic CDB format for SERVICE ACTION OUT(16) commands

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (9Fh)							
1	miscellaneous CDB information			SERVICE ACTION				
2 ••• 14	miscellaneous CDB information							
15	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 17 for any command that uses the SERVICE ACTION OUT(16) CDB format.

Miscellaneous CDB information is defined by the standard that defines the command that uses the SERVICE ACTION OUT(16) CDB format.

The SERVICE ACTION field is defined in 4.2.5.2, and in the standard that defines the command that uses the SERVICE ACTION OUT(16) CDB format. A numeric ordered listing of service actions associated with the SERVICE ACTION OUT(16) CDB format is provided in table E.5 (see E.3.4).

The CONTROL byte is defined in SAM-6.

4.2.2.4.6 SERVICE ACTION BIDIRECTIONAL CDB format

Table 18 shows the generic format of a CDB that uses the SERVICE ACTION BIDIRECTIONAL operation code.

Table 18 – Generic CDB format for SERVICE ACTION BIDIRECTIONAL commands

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (9Dh)							
1	miscellaneous CDB information			SERVICE ACTION				
2 ••• 14	miscellaneous CDB information							
15	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 18 for any command that uses the SERVICE ACTION BIDIRECTIONAL CDB format.

Miscellaneous CDB information is defined by the standard that defines the command that uses the SERVICE ACTION BIDIRECTIONAL CDB format.

The SERVICE ACTION field is defined in 4.2.5.2, and in the standard that defines the command that uses the SERVICE ACTION BIDIRECTIONAL CDB format. A numeric ordered listing of service actions associated with the SERVICE ACTION BIDIRECTIONAL CDB format is provided in table E.6 (see E.3.5).

The CONTROL byte is defined in SAM-6.

4.2.3 Variable length CDB formats

4.2.3.1 Generic variable length CDB format

Table 19 shows the generic format of a variable length CDB.

Table 19 – Generic variable length CDB

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (7Fh)							
1	CONTROL							
2 ••• 6	miscellaneous CDB information							
7	ADDITIONAL CDB LENGTH (n-7)							
8	(MSB)							
9	SERVICE ACTION							(LSB)
10 ••• n	miscellaneous CDB information							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 19 for any command that uses the variable length CDB format.

The CONTROL byte is defined in SAM-6.

Miscellaneous CDB information is defined by the standard that defines the command that uses the variable length CDB format.

The ADDITIONAL CDB LENGTH field specifies the number of additional CDB bytes that follow. The value in the ADDITIONAL CDB LENGTH field shall be a multiple of four. If the number of CDB bytes delivered by the service delivery subsystem is not sufficient to contain the number of bytes specified by the ADDITIONAL CDB LENGTH field, then the command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

The SERVICE ACTION field is defined in 4.2.5.2, and in the standard that defines the command that uses the variable length CDB format. The SERVICE ACTION field is required in the variable length CDB format. Lists of service action values ranges associated with the variable length CDB format are provided in E.3.6.

4.2.3.2 Typical 32-byte variable length CDB format

Table 20 shows the typical format of a 32-byte CDB for commands that support eight-byte LBA values, including the location of:

   a) the SERVICE ACTION field;
   b) the LOGICAL BLOCK ADDRESS field, if any;
   c) the TRANSFER LENGTH field, if any;
   d) the PARAMETER LIST LENGTH field, if any; and
   e) the ALLOCATION LENGTH field, if any.

Table 20 – Typical variable length CDB format for 32-byte commands

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (7Fh)							
1	CONTROL							
2 ••• 6	miscellaneous CDB information							
7	ADDITIONAL CDB LENGTH (18h)							
8	(MSB)			SERVICE ACTION				
9								(LSB)
10 11	miscellaneous CDB information							
12 ••• 19	(MSB)			LOGICAL BLOCK ADDRESS (if any)				(LSB)
20 ••• 27	miscellaneous CDB information							
28 ••• 31	(MSB)			TRANSFER LENGTH (if any) PARAMETER LIST LENGTH (if any) ALLOCATION LENGTH (if any)				(LSB)

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 20 for any command that uses the typical variable length CDB format for 32-byte commands.

The CONTROL byte is defined in SAM-6.

Miscellaneous CDB information is defined by the standard that defines the command.

The ADDITIONAL CDB LENGTH field is defined in 4.2.3.1 and shall be set as shown in table 20 for any command that uses the typical variable length CDB format for 32-byte commands.

The SERVICE ACTION field is defined in 4.2.5.2.

The LOGICAL BLOCK ADDRESS field, if any, is defined in 4.2.5.3.

The TRANSFER LENGTH field, if any, is defined in 4.2.5.4.

The PARAMETER LIST LENGTH field, if any, is defined in 4.2.5.5.

The ALLOCATION LENGTH field, if any, is defined in 4.2.5.6.

4.2.4 Extended CDBs

4.2.4.1 XCDB model

Any SCSI CDB except an XCDB may be extended in an XCDB. An XCDB shall be extended by adding additional XCDB descriptors to the existing XCDB.

XCDB descriptors may be:

a) added by application clients and removed by device servers; or
b) added and removed by entities outside the scope of this standard that transport or process CDBs and XCDBs during their transfer from an application client to a device server.

4.2.4.2 The XCDB format

Table 21 shows the format of an XCDB. In an XCDB, the CONTROL byte (see SAM-6) is the CONTROL byte in the CDB field.

Table 21 – XCDB

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (7Eh)							
1	Reserved							
2	(MSB)			LENGTH (n-3)				
3								(LSB)
4								
•••				CDB				
i								
	XCDB descriptor list							
k								
•••				XCDB descriptor [first]				
					⋮			
•••				XCDB descriptor [last]				
n								

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 21 for an XCDB.

The LENGTH field specifies the number of bytes that follow in the XCDB.

The CDB field contains the CDB to which XCDB descriptors are being appended.

Each XCDB descriptor (see table 22) contains fields associated with a specified extension type (see table 23). The command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID XCDB, if:

    a)   an XCDB does not contain at least one XCDB descriptor;
    b)   more than one XCDB descriptor contains the same extension type; or
    c)   the order of extension types in the XCDB descriptors differs from that shown in table 23.

Table 22 – XCDB descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	EXTENSION TYPE							
1								
•••				Extension parameters				
n								

The EXTENSION TYPE field (see table 23) specifies the size and format of the extension parameters that follow in the XCDB descriptor.

Table 23 – EXTENSION TYPE field

Code	Descriptor Order [a]	Description	Extension size (bytes)	Reference
40h		Obsolete		
all others	Reserved			
[a] The order in which XCDB descriptors appear in an XCDB is arranged so that all the XCDB descriptors that follow an XCDB descriptor defined in a future version of this standard are also XCDB descriptors defined in a future version of this standard (i.e., after encountering one unrecognized XCDB descriptor, all subsequent XCDB descriptors are also going to be unrecognized).				

The extension parameters contain additional information whose processing is associated with the CDB in the CDB field. The number, content, and size of the extension parameters depends on the contents of the EXTENSION TYPE field.

4.2.5 Common CDB fields

4.2.5.1 Operation code

The first byte of a SCSI CDB shall contain the OPERATION CODE field (see table 24) specifying the command being requested by the CDB.

Some operation codes are further qualified by a service action code (see 4.2.5.2). In such cases, the operation code and service action code combine to specify the command being requested. The location of the SERVICE ACTION field in the CDB varies depending on the operation code value. Operation codes and service action codes are defined in this standard and command standards.

Table 24 – OPERATION CODE field

Code	Length of CDB	Generic CDB format	Reference
00h to 1Fh	6 byte command	see table 3	4.2.2.1
20h to 5Fh	10 byte command	see table 5	4.2.2.2
60h to 7Dh	Reserved		
7Eh	variable (i.e., extended)	see table 21	4.2.4.2
7Fh	variable	see table 19	4.2.3.1
80h to 9Fh	16 byte command	see table 13	4.2.2.4
A0h to BFh	12 byte command	see table 7	4.2.2.3
C0h to FFh	vendor specific		

4.2.5.2 Service action

The SERVICE ACTION field provides further qualification for the OPERATION CODE field for some commands, allowing for:

  a) unrelated commands that share the same operation code (e.g., the REPORT SUPPORTED OPERATION CODES command and the REPORT TARGET PORT GROUPS command); and
  b) a set of related functions that share the same operation code (e.g., the PERSISTENT RESERVE IN command).

4.2.5.3 Logical block address

The logical block addresses on a logical unit or within a volume or partition shall begin with block zero and be contiguous up to the last logical block of that logical unit or within that volume or partition.

The typical 10-byte CDB format and typical 12-byte CDB format allow 32-bit LOGICAL BLOCK ADDRESS fields. The 16-byte CDB has two typical formats:

  a) one allows a 32-bit LOGICAL BLOCK ADDRESS field (see table 14); and
  b) the other allows a 64-bit LOGICAL BLOCK ADDRESS field (see table 15).

The typical 32-byte variable length CDB format (see table 20) allows a 64-bit LOGICAL BLOCK ADDRESS field.

LOGICAL BLOCK ADDRESS fields in additional parameter data have their length specified for each occurrence. See the specific command descriptions.

4.2.5.4 Transfer length

The TRANSFER LENGTH field specifies the amount of data to be transferred, usually the number of blocks. Some commands use transfer length to specify the requested number of bytes to be sent as defined in the command description.

In commands that use multiple bytes for the TRANSFER LENGTH field, a transfer length of zero specifies that no data transfer shall take place. This condition shall not be considered an error. A value of one or greater specifies the number of blocks or bytes that shall be transferred.

Refer to the specific command description for further information.

4.2.5.5 Parameter list length

The PARAMETER LIST LENGTH field is used to specify the number of bytes available for transfer in the Data-Out Buffer. This field is typically used in CDBs for parameters that are sent to a device server (e.g., mode parameters, diagnostic parameters, log parameters). A parameter length of zero specifies that no data shall be transferred. This condition shall not be considered an error, unless otherwise specified.

4.2.5.6 Allocation length

The ALLOCATION LENGTH field specifies the maximum number of bytes or blocks that an application client has allocated in the Data-In Buffer. The ALLOCATION LENGTH field specifies bytes unless a different requirement is stated in the command definition.

An allocation length of zero specifies that no data shall be transferred. This condition shall not be considered an error.

The device server shall terminate transfers to the Data-In Buffer when the number of bytes or blocks specified by the ALLOCATION LENGTH field have been transferred or when all available data have been transferred, whichever is less. The allocation length is used to limit the maximum amount of variable length data (e.g., mode data, log data, diagnostic data) returned to an application client. If the information being transferred to the Data-In Buffer includes fields containing counts of the number of bytes in some or all of the data (e.g., a PARAMETER DATA LENGTH field, a PAGE LENGTH field, a DESCRIPTOR LENGTH field, an AVAILABLE DATA field), then the contents of these fields shall not be altered to reflect the truncation, if any, that results from an insufficient ALLOCATION LENGTH value, unless the standard that describes the Data-In Buffer format states otherwise.

If the amount of information that is available to be transferred exceeds the maximum value that the ALLOCATION LENGTH field in combination with other fields in the CDB is capable of specifying, then no data shall be transferred and the command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

4.3 Data field requirements

4.3.1 ASCII data field requirements

ASCII data shall contain only ASCII printable characters (i.e., code values 20h to 7Eh). For fields that contain ASCII data that are not defined as left-aligned or right-aligned, the use of ASCII null (i.e., code value 00h) characters is described in 4.3.2.

ASCII data fields described as being left-aligned shall have any unused bytes at the end of the field (i.e., highest offset) and the unused bytes shall be filled with ASCII space characters (i.e., code value 20h).

ASCII data fields described as being right-aligned shall have any unused bytes at the start of the field (i.e., lowest offset) and the unused bytes shall be filled with ASCII space characters (i.e., code value 20h).

4.3.2 Null-terminated data field and null-padded data field requirements

A null-terminated data field shall have:

1) zero or more bytes that contain:
   A) ASCII printable characters (i.e., code values 20h to 7Eh), for fields that are defined as ASCII data fields (see 4.3.1); or
   B) ASCII or UTF-8 characters that are not the ASCII null (i.e., code value 00h) character, for data fields that are not defined as ASCII data fields;
2) followed by one byte that contains the ASCII or UTF-8 null (i.e., code value 00h) character; and
3) followed by zero or more bytes whose contents are ignored.

A null-terminated data field may be specified to be a fixed length. The length specified for a null-terminated data field may be greater than the length required to contain the data for the field. A null-terminated data field may be specified to have a length that is a multiple of a given value (e.g., a multiple of four bytes). When such fields are described as being null-padded, the bytes, if any, between the end of the data and the end of the field shall contain ASCII or UTF-8 null characters.

A null-terminated data field that is also null-padded shall have at least one byte containing an ASCII or UTF-8 null character in the end of the field (i.e., highest offset) and may have more than one byte containing ASCII or UTF-8 null characters to meet the specified field length requirements. If more than one byte in a null-terminated, null-padded field contains the ASCII or UTF-8 null character, then all the bytes containing the ASCII or UTF-8 null character shall be at the end of the field (i.e., only the highest offsets).

4.3.3 Variable type data field requirements

Parameter lists may contain fields or descriptors in which data may be represented in different formats. To indicate which format is being used a field may be defined that contains a code set enumeration (see table 25).

Table 25 – Code set enumeration

Code	Description
0h	Reserved
1h	The associated fields or descriptors contain binary values
2h	The associated fields or descriptors contain ASCII printable characters (i.e., code values 20h to 7Eh)
3h	The associated fields or descriptors contain UTF-8 codes
4h to Fh	Reserved

4.3.4 Port identifier field requirements

The contents of RELATIVE PORT IDENTIFIER fields, RELATIVE INITIATOR PORT IDENTIFIER fields, and RELATIVE TARGET PORT IDENTIFIER fields are defined in table 26.

Table 26 – Relative port identifier values

Value	Description
0h	Reserved
1h	Relative port 1, historically known as port A
2h	Relative port 2, historically known as port B
3h to FFFFh	Relative port 3 to 65 535

4.4 Sense data

4.4.1 Sense data introduction

Sense data shall be returned in the same I_T nexus transaction as the status and as parameter data in response to the REQUEST SENSE command (see 6.36). Sense data returned in the same I_T nexus transaction as the status shall be either fixed format or descriptor format sense data format based on the value of the D_SENSE bit in the Control mode page (see 7.5.13). The REQUEST SENSE command may be used to request either fixed format sense data or descriptor format sense data.

The first byte of all sense data contains the RESPONSE CODE field (see table 27) that indicates the report type and format of the sense data.

Table 27 – Sense data response codes

Response Code	Report type		Sense data format	
	Description	Reference	Description	Reference
00h to 6Fh	Reserved			
70h	Current information	4.4.6	Fixed	4.4.3
71h	Deferred error	4.4.7	Fixed	4.4.3
72h	Current information	4.4.6	Descriptor	4.4.2
73h	Deferred error	4.4.7	Descriptor	4.4.2
74h to 7Eh	Reserved			
7Fh	Vendor specific			

If sense data is returned in the same I_T nexus transaction as the status, the RESPONSE CODE field shall be set to 70h in all unit attention condition sense data in which:

    a) the ADDITIONAL SENSE CODE field is set to 29h; or
    b) the additional sense code is set to MODE PARAMETERS CHANGED.

4.4.2 Descriptor format sense data

4.4.2.1 Descriptor format sense data overview

The descriptor format sense data for response codes 72h (i.e., current information) and 73h (i.e., deferred errors) is defined in table 28.

Table 28 – Descriptor format sense data

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved	RESPONSE CODE (72h or 73h)						
1	Reserved				SENSE KEY			
2	ADDITIONAL SENSE CODE							
3	ADDITIONAL SENSE CODE QUALIFIER							
4	SDAT_OVFL	Reserved						
5	Reserved							
6								
7	ADDITIONAL SENSE LENGTH (n-7)							
Sense data descriptor list								
8 •••	Sense data descriptor (see table 29) [first]							
	⋮							
••• n	Sense data descriptor (see table 29) [last]							

The contents of the RESPONSE CODE field indicate the report type and format of the sense data (see 4.4.1). For descriptor format sense data, the RESPONSE CODE field shall be set to 72h or 73h.

The SENSE KEY field, ADDITIONAL SENSE CODE field, and ADDITIONAL SENSE CODE QUALIFIER field provide a hierarchy of information. The hierarchy provides a top-down approach for an application client to determine information relating to the reported condition.

The SENSE KEY field indicates generic information describing a reported condition. The sense keys are defined in 4.4.8.

The ADDITIONAL SENSE CODE field indicates further information related to the condition reported in the SENSE KEY field. Support of the additional sense codes not required by this standard is optional. For a list of additional sense codes see 4.4.8. If the device server does not have further information related to the reported condition, the ADDITIONAL SENSE CODE field shall be set to zero.

The ADDITIONAL SENSE CODE QUALIFIER field indicates detailed information related to the condition reported in the ADDITIONAL SENSE CODE field. If the condition is reported by the device server, the value returned shall be as defined in 4.4.8. If the device server does not have detailed information related to the reported condition, the ADDITIONAL SENSE CODE QUALIFIER field shall be set to zero.

A sense data overflow (SDAT_OVFL) bit set to one indicates that the device server truncated the sense data to limit the sense data length to less than or equal to the length specified in the MAXIMUM SENSE DATA LENGTH field in the Control Extension mode page (see 7.5.14). A SDAT_OVFL bit set to zero indicates that the device server did not truncate the sense data to limit the sense data length to less than or equal to the length specified in the MAXIMUM SENSE DATA LENGTH field in the Control Extension mode page.

The ADDITIONAL SENSE LENGTH field indicates the number of additional sense bytes that follow. The additional sense length shall be less than or equal to 244 (i.e., limiting the total length of the sense data to 252 bytes). If the sense data is being transferred as parameter data by a REQUEST SENSE command, then the contents of the ADDITIONAL SENSE LENGTH field are not altered based on the allocation length (see 4.2.5.6). If the sense data is being transferred in the same I_T nexus transaction as the status and the sense data is longer than the length specified in the MAXIMUM SENSE DATA LENGTH field in the Control Extension mode page (see 7.5.14), then the device server shall limit the number of sense data bytes to less than or equal to the length specified in the MAXIMUM SENSE DATA LENGTH field in the Control Extension mode page by discarding entire descriptors (i.e., not including a partial descriptor). The maximum total length of the sense data transferred by the device server is indicated in the MAXIMUM SUPPORTED SENSE DATA LENGTH field in the Extended INQUIRY VPD page (see 7.7.7).

Sense data descriptors (see table 29) provide specific sense information. A given type of sense data descriptor shall be included in the sense data only if that descriptor contains valid information.

Table 29 – Sense data descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE							
1	ADDITIONAL LENGTH (n-1)							
2 ••• n	Sense data descriptor specific							

The DESCRIPTOR TYPE field (see table 30) identifies the type of sense data descriptor.

Table 30 – DESCRIPTOR TYPE field (part 1 of 2)

Code	Description	Number of descriptors allowed (maximum)	Reference
00h	Information	1 [a]	4.4.2.2
01h	Command specific information	1 [a]	4.4.2.3
02h	Sense key specific	1 [a]	4.4.2.4
03h	Field replaceable unit	1 [a]	4.4.2.5
04h	Stream commands	1	SSC-5
05h	Block commands	1 [a]	SBC-5

[a] The direct access block device sense data descriptor, if used, is used by a direct access block device instead of the information sense data descriptor, command specific information sense data descriptor, sense key specific sense data descriptor, field replaceable unit sense data descriptor, and block commands sense data descriptor. See SBC-5.

Table 30 – DESCRIPTOR TYPE field (part 2 of 2)

Code	Description	Number of descriptors allowed (maximum)	Reference
06h	OSD object identification	1	OSD
07h	OSD response integrity check value	1	OSD
08h	OSD attribute identification	1	OSD
09h	ATA Status Return	1	SAT-5
0Ah	Another progress indication	32	4.4.2.6
0Bh	User data segment referral	1	SBC-5
0Ch	Forwarded sense data	2	4.4.2.7
0Dh	Direct access block device	1 [a]	SBC-5
0Eh	Device designation	1	4.4.2.8
0Fh	Microcode activation	1	4.4.2.9
10h to 7Fh	Reserved		
80h to FFh	Vendor specific		4.4.2.10

[a] The direct access block device sense data descriptor, if used, is used by a direct access block device instead of the information sense data descriptor, command specific information sense data descriptor, sense key specific sense data descriptor, field replaceable unit sense data descriptor, and block commands sense data descriptor. See SBC-5.

The ADDITIONAL LENGTH field indicates the number of sense data descriptor specific bytes that follow in the sense data descriptor.

4.4.2.2 Information sense data descriptor

The information sense data descriptor (see table 31) is included in the descriptor format sense data if device type information or command specific information is available as defined in this standard or a command standard. See 4.4.4 for device server requirements regarding how values are returned in the INFORMATION field.

Table 31 – Information sense data descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE (00h)							
1	ADDITIONAL LENGTH (0Ah)							
2	VALID (1b)	Reserved						
3	Reserved							
4	(MSB)							
•••			INFORMATION					
11								(LSB)

The DESCRIPTOR TYPE field and ADDITIONAL LENGTH field are described in 4.4.2.1 and shall be set as shown in table 31 for the information sense data descriptor.

The VALID bit shall be set to one.

> NOTE 1 - In SPC-2, in the fixed format sense data (see 4.4.3), and in sense data descriptors other than the information sense data descriptor that contain a VALID bit and an INFORMATION field (e.g., the direct access block device sense data descriptor (see SBC-5)), the VALID bit indicates whether the contents of the INFORMATION field are valid as defined by a command standard. Since the contents of the INFORMATION field are valid whenever the information sense data descriptor is included in the sense data, the only legal value for the VALID bit in the information sense data descriptor is one.

The contents of the INFORMATION field are device type or command specific and are defined in a command standard.

4.4.2.3 Command-specific information sense data descriptor

The command-specific information sense data descriptor (see table 32) is included in the descriptor format sense data if sense data information is available that depends on the command for which the reported condition occurred. See 4.4.5 for device server requirements regarding how values are returned in the COMMAND-SPECIFIC INFORMATION field.

Table 32 – Command-specific information sense data descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE (01h)							
1	ADDITIONAL LENGTH (0Ah)							
2	Reserved							
3	Reserved							
4	(MSB)							
•••			COMMAND-SPECIFIC INFORMATION					
11								(LSB)

The DESCRIPTOR TYPE field and ADDITIONAL LENGTH field are described in 4.4.2.1 and shall be set as shown in table 32 for the command-specific information sense data descriptor.

The contents of the COMMAND-SPECIFIC INFORMATION field are command specific, and are defined in this standard or a command standard.

4.4.2.4 Sense key specific sense data descriptor

4.4.2.4.1 Sense key specific sense data descriptor overview

The sense key specific sense data descriptor (see table 33) is included in the descriptor format sense data if additional information is available about the reported condition described in 4.4.2.1. The format and content of the sense key specific information depends on the value in the SENSE KEY field (see 4.4.2.1).

Table 33 – Sense key specific sense data descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE (02h)							
1	ADDITIONAL LENGTH (06h)							
2	Reserved							
3	Reserved							
4	SKSV (1b)							
5	sense key specific information (see table 34)							
6								
7	Reserved							

The DESCRIPTOR TYPE field and ADDITIONAL LENGTH field are described in 4.4.2.1 and shall be set as shown in table 33 for the sense-key specific sense data descriptor.

The sense-key specific valid (SKSV) bit shall be set to one.

> NOTE 2 - In SPC-2, in the fixed format sense data (see 4.4.3), and in sense data descriptors other than the sense key specific sense data descriptor that contain a VALID bit and an INFORMATION field (e.g., the direct access block device sense data descriptor (see SBC-5)), the SKSV bit indicates whether the sense key specific information is valid as defined by a command standard. Since the sense key specific information is valid whenever a sense key specific sense data descriptor is included in the sense data, the only legal value for the SKSV bit in the sense key specific sense data descriptor is one.

The content and format of the sense key specific information (see table 34) is determined by the value of the SENSE KEY field (see 4.4.2.1).

Table 34 – Sense key specific information definitions (part 1 of 2)

Sense key	Sense key specific information	Reference
ILLEGAL REQUEST	Field pointer	4.4.2.4.2
HARDWARE ERROR, MEDIUM ERROR, or RECOVERED ERROR	Actual retry count	4.4.2.4.3
NO SENSE or NOT READY	Progress indication	4.4.2.4.4
COPY ABORTED	Segment pointer	4.4.2.4.5

Table 34 – Sense key specific information definitions (part 2 of 2)

Sense key	Sense key specific information	Reference
UNIT ATTENTION	Unit attention condition queue overflow	4.4.2.4.6

All other sense keys	In descriptor format sense data:
	  a) the sense key specific sense data descriptor shall not appear in the sense data descriptor list; and
	  b) in other sense data descriptors that contain an SKSV bit and sense key specific information (e.g., the direct access block device sense data descriptor (see SBC-5)), the SKSV bit shall be set to zero.
	In fixed format sense data (see 4.4.3), the SKSV bit shall be set to zero.	

4.4.2.4.2 Field pointer sense key specific information

If the sense key is ILLEGAL REQUEST, the sense key specific information (see table 33) shall have the content and format shown in table 35.

Table 35 – Field pointer sense key specific information

Bit Byte	7	6	5	4	3	2	1	0
0	SKSV	C/D	Reserved		BPV	BIT POINTER		
1	(MSB)	FIELD POINTER						
2								(LSB)

The SKSV bit is described in 4.4.2.4.1 for descriptor format sense data and in 4.4.3 for fixed format sense data.

A command data (C/D) bit set to one indicates that the illegal parameter is in the CDB. A C/D bit set to zero indicates that the illegal parameter is in the data parameters transferred by the application client in the Data-Out Buffer.

A bit pointer valid (BPV) bit set to zero indicates that the value in the BIT POINTER field is not valid. A BPV bit set to one indicates that the BIT POINTER field specifies which bit of the byte designated by the FIELD POINTER field is in error. If a multiple-bit field is in error, the BIT POINTER field shall point to the first bit (i.e., the left-most bit) of the field. If several consecutive bits are reserved, each bit should be treated as a single-bit field.

The FIELD POINTER field indicates which byte of the CDB or of the parameter data was in error. Bytes are numbered starting from zero, as shown in the tables describing the commands and parameters. If a multiple-byte field is in error, the field pointer shall point to the first byte (i.e., the left-most byte) of the field. If several consecutive bytes are reserved, each shall be treated as a single-byte field.

> NOTE 3 - The byte or bytes identified as being in error may not be the bytes that need to be changed to correct the problem.

4.4.2.4.3 Actual retry count sense key specific information

If the sense key is HARDWARE ERROR, MEDIUM ERROR, or RECOVERED ERROR, then the sense key specific information (see table 33) shall have the content and format shown in table 36.

Table 36 – Actual retry count sense key specific information

Bit Byte	7	6	5	4	3	2	1	0
0	SKSV	Reserved						
1	(MSB)	ACTUAL RETRY COUNT						
2								(LSB)

The SKSV bit is described in 4.4.2.4.1 for descriptor format sense data and in 4.4.3 for fixed format sense data.

The ACTUAL RETRY COUNT field contains vendor specific information on the number of retries of the recovery algorithm used in attempting to recover an error or exception condition. This field should be computed in the same way as the retry count fields within the Read-Write Error Recovery mode page (see SBC-5, SSC-5, and MMC-6).

4.4.2.4.4 Progress indication sense key specific information

If the sense key is NO SENSE or NOT READY, the sense key specific information (see table 33) shall have the content and format shown in table 37.

Table 37 – Progress indication sense key specific information

Bit Byte	7	6	5	4	3	2	1	0
0	SKSV	Reserved						
1	(MSB)	PROGRESS INDICATION						
2								(LSB)

The SKSV bit is described in 4.4.2.4.1 for descriptor format sense data and in 4.4.3 for fixed format sense data.

The PROGRESS INDICATION field is a percent complete indication in which the value is a numerator that has 65 536 (i.e., 10000h) as its denominator. The progress indication shall be based upon the total operation. The progress indication numerator should be time related; however, this is not an absolute requirement.

EXAMPLE - Since format time varies with the number of defects encountered, etc., the device server may assign values to various steps within the process, and use these values as the progress indication numerator. The granularity of these steps should be small enough to provide reasonable assurances to the application client that progress is being made.

4.4.2.4.5 Segment pointer sense key specific information

If the sense key is COPY ABORTED, the sense key specific information (see table 33) shall have the content and format shown in table 38.

Table 38 – Segment pointer sense key specific information

Bit Byte	7	6	5	4	3	2	1	0
0	SKSV	Reserved	SD	Reserved	BPV	BIT POINTER		
1	(MSB)	FIELD POINTER						
2								(LSB)

The SKSV bit is described in 4.4.2.4.1 for descriptor format sense data and in 4.4.3 for fixed format sense data.

The segment descriptor (SD) bit indicates whether the field pointer is relative to the start of the parameter list or to the start of a segment descriptor. An SD bit set to zero indicates that the field pointer is relative to the start of the parameter list. An SD bit set to one indicates that the field pointer is relative to the start of the segment descriptor indicated by the third and fourth bytes of the COMMAND-SPECIFIC INFORMATION field (see 5.19.8.4).

A bit pointer valid (BPV) bit set to zero indicates that the value in the BIT POINTER field is not valid. A BPV bit set to one indicates that the BIT POINTER field specifies which bit of the byte designated by the FIELD POINTER field is in error. If a multiple-bit field is in error, the BIT POINTER field shall point to the most-significant (i.e., left-most) bit of the field.

The FIELD POINTER field indicates which byte of the parameter list or segment descriptor was being processed when the error or exception condition was detected.

If the SD bit is set to zero and the byte in error has an offset greater than FFFFh, the FIELD POINTER field shall be set to FFFFh and the BPV bit shall be set to zero.

4.4.2.4.6 Unit attention condition queue overflow sense key specific information

If the sense key is UNIT ATTENTION, the sense key specific information (see table 33) shall have the content and format shown in table 39.

Table 39 – Unit attention condition queue overflow sense key specific information

Bit Byte	7	6	5	4	3	2	1	0
0	SKSV	Reserved						OVERFLOW
1		Reserved						
2								

The SKSV bit is described in 4.4.2.4.1 for descriptor format sense data and in 4.4.3 for fixed format sense data.

An OVERFLOW bit set to one indicates that the unit attention condition queue has overflowed. An OVERFLOW bit set to zero indicates that the unit attention condition queue has not overflowed.

4.4.2.5 Field replaceable unit sense data descriptor

The field replaceable unit sense data descriptor (see table 40) is included in the descriptor format sense data if information is available about a component associated with the sense data.

Table 40 – Field replaceable unit sense data descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE (03h)							
1	ADDITIONAL LENGTH (02h)							
2	Reserved							
3	FIELD REPLACEABLE UNIT CODE							

The DESCRIPTOR TYPE and ADDITIONAL LENGTH fields are described in 4.4.2.1 and shall be set as shown in table 40 for the field replaceable unit sense data descriptor.

Non-zero values in the FIELD REPLACEABLE UNIT CODE field are used to identify a component associated with the sense data. A value of zero in this field indicates that no specific component has been associated with the sense data or that the data is not available. The format of this information is not specified by this standard. Additional information about the field replaceable unit may be available in the ASCII Information VPD page (see 7.7.3), if supported by the device server.

4.4.2.6 Another progress indication sense data descriptor

If the sense key is set to NO SENSE or NOT READY, another progress indication sense data descriptor (see table 41) may be included in the descriptor format sense data to provide a progress indication for one operation other than the one described by the non-descriptor fields in 4.4.2.1. The sense data should include one another progress indication sense data descriptor for each operation for which the device server is able to report progress other than the operation described by the non-descriptor fields in 4.4.2.1.

Table 41 – Another progress indication sense data descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE (0Ah)							
1	ADDITIONAL LENGTH (06h)							
2	ANOTHER SENSE KEY							
3	ANOTHER ADDITIONAL SENSE CODE							
4	ANOTHER ADDITIONAL SENSE CODE QUALIFIER							
5	Reserved							
6	(MSB)			ANOTHER PROGRESS INDICATION				
7								(LSB)

The DESCRIPTOR TYPE field and ADDITIONAL LENGTH field are described in 4.4.2.1 and shall be set as shown in table 41 for the progress indications sense data descriptor.

The ANOTHER SENSE KEY field indicates generic information about the operation for which this another progress indication sense data descriptor provides a progress indication. A list of sense key values is in 4.4.8.

The ANOTHER ADDITIONAL SENSE CODE field indicates further information about the operation for which this another progress indication sense data descriptor provides a progress indication. A list of additional sense codes is in 4.4.8.

The ANOTHER ADDITIONAL SENSE CODE QUALIFIER field indicates detailed information related to the additional sense code for the operation for which this another progress indication sense data descriptor provides a progress indication. The value returned in the ADDITIONAL SENSE CODE QUALIFIER field shall be as defined in 4.4.8.

The ANOTHER PROGRESS INDICATION field indicates a percent complete for the operation indicated by the ANOTHER SENSE KEY field, the ANOTHER ADDITIONAL SENSE CODE field, and the ANOTHER ADDITIONAL SENSE CODE QUALIFIER field. The value in the ANOTHER PROGRESS INDICATION field shall be as defined in 4.4.2.4.4.

4.4.2.7 Forwarded sense data

Forwarded sense data descriptors (see table 42) are included in the descriptor format sense data if status and sense data is available from another device server as part of command completion (e.g., an exception condition returned by a copy target device in an EXTENDED COPY command (see 6.6) during segment descriptor processing).

Table 42 – Forwarded sense data descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE (0Ch)							
1	ADDITIONAL LENGTH (n-1)							
2	FSDT	Reserved			SENSE DATA SOURCE			
3	FORWARDED STATUS							
4 ••• n	FORWARDED SENSE DATA							

The DESCRIPTOR TYPE field is described in 4.4.2.1. The DESCRIPTOR TYPE field shall be set as shown in table 42 for the forwarded sense data descriptor.

The ADDITIONAL LENGTH field shall be set to:

   a) a minimum of 22, if the FORWARDED SENSE DATA field contains fixed format sense data (i.e., the RESPONSE CODE field (see 4.4.1) in the forwarded sense data is 70h or 71h);
   b) a minimum of 10, if the FORWARDED SENSE DATA field contains descriptor format sense data (i.e., the RESPONSE CODE field in the forwarded sense data is 72h or 73h); and
   c) two less than a multiple of four (i.e., the FORWARDED SENSE DATA field is a multiple of four bytes in length).

A forwarded sense data truncated (FSDT) bit set to one indicates that the contents of the FORWARDED SENSE DATA field have been truncated (i.e., the FORWARDED SENSE DATA field does not contain all of the sense data that was supplied). An FSDT bit set to zero indicates that the contents of the FORWARDED SENSE DATA field have not been truncated.

The SENSE DATA SOURCE field (see table 43) indicates the supplier of the forwarded sense data.

Table 43 – SENSE DATA SOURCE field

Code	Description
0h	Unknown
1h	EXTENDED COPY command copy source (see 5.19.8.2)
2h	EXTENDED COPY command copy destination 1 (see 5.19.8.2)
3h	EXTENDED COPY command copy destination 2 (see 5.19.8.2)
4h	EXTENDED COPY command copy destination 3 (see 5.19.8.2)
5h	EXTENDED COPY command copy destination 4 (see 5.19.8.2)
6h	EXTENDED COPY command copy destination 5 (see 5.19.8.2)
7h	EXTENDED COPY command copy destination 6 (see 5.19.8.2)
8h	EXTENDED COPY command copy destination 7 (see 5.19.8.2)
9h	EXTENDED COPY command copy destination 8 (see 5.19.8.2)
all others	Reserved

The FORWARDED STATUS field contains the status code (see SAM-6) returned by the supplier of the forwarded sense data at the same time that the forwarded sense data was returned.

The FORWARDED SENSE DATA field contains the forwarded sense data. The FORWARDED SENSE DATA field is a zero-padded field whose length is a multiple of four bytes.

4.4.2.8 Device designation sense data descriptor

The device designation sense data descriptor (see table 44) is included in the descriptor format sense data if device designation information is available.

Table 44 – Device designation sense data descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE (0Eh)							
1	ADDITIONAL LENGTH (n-1)							
2	Reserved							
3	DESCRIPTOR USAGE REASON							
4 ••• n	Device designation descriptor							

The DESCRIPTOR TYPE field and ADDITIONAL LENGTH field are described in 4.4.2.1. The DESCRIPTOR TYPE field shall be set as shown in table 44 for the device designation sense data descriptor.

The DESCRIPTOR USAGE REASON field (see table 45) indicates the reason for inclusion of the device designation information.

Table 45 – DESCRIPTOR USAGE REASON field

Code	Description	Reference
00h	The reason is not known.	

01h	The device designation descriptor indicates the logical unit to which the application client should:
	   a) send this command; and
	   b) any subsequent commands with the same operation code and service action.
		5.8.9.6

02h	The device designation descriptor indicates the logical unit to which the application client should send this command.	5.8.9.6
03h	The device designation descriptor indicates an administrative logical unit to which the subsidiary logical unit has a new binding.	5.8.11
04h	The device designation descriptor indicates an administrative logical unit to which the subsidiary logical unit has an existing binding.	5.8.8.4
all others	Reserved	

The device designation descriptor is a designation descriptor (see 7.7.6.1).

The designation descriptor shall contain:

   a) an ASSOCIATION field set to 00b (i.e., logical unit);
   b) the DESIGNATOR field set to indicate the logical unit; and
   c) a DESIGNATOR TYPE field set to:
      A) 2h (i.e., EUI);
      B) 3h (i.e., NAA);
      C) 8h (i.e., SCSI name string); or
      D) Ah (i.e., UUID).

4.4.2.9 Microcode activation sense data descriptor

The microcode activation sense data descriptor (see table 46) is included in the descriptor format sense data, if the deferred microcode contains information that the device server may use to return the fields contained in this descriptor.

Table 46 – Microcode activation sense data descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE (0Fh)							
1	ADDITIONAL LENGTH (06h)							
2 ••• 5	Reserved							
6	(MSB)			MICROCODE ACTIVATION TIME				
7								(LSB)

The DESCRIPTOR TYPE field and ADDITIONAL LENGTH field are described in 4.4.2.1 and shall be set as shown in table 46 for the microcode activation sense data descriptor.

The MICROCODE ACTIVATION TIME field indicates the time in seconds that the device server expects to take to activate the deferred microcode. A MICROCODE ACTIVATION TIME field set to zero indicates that the time to activate deferred microcode is unknown.

The time the device server expects to take to activate the deferred microcode:

    a) begins at the time when the device server processes:
        A) a WRITE BUFFER command (see 6.49) with the MODE field set to 0Fh (i.e., activate deferred microcode); or
        B) another enabled activation method (see 5.5.2);
        and
    b) ends at the time when the device server is ready to respond to INQUIRY commands (see 6.7) with the new microcode value contained in the PRODUCT REVISION LEVEL field and has established a unit attention condition with the additional sense code set to MICROCODE HAS BEEN CHANGED.

4.4.2.10 Vendor specific sense data descriptors

Vendor specific sense data descriptors (see table 47) may be included in the descriptor format sense data if vendor specific data is available that further defines the nature of the reported condition.

Table 47 – Vendor specific sense data descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE (80h to FFh)							
1	ADDITIONAL LENGTH (n-1)							
2 ••• n	Vendor specific							

The DESCRIPTOR TYPE field and ADDITIONAL LENGTH field are described in 4.4.2.1. The DESCRIPTOR TYPE field shall be set as shown in table 47 for the vendor specific sense data descriptor.

4.4.3 Fixed format sense data

The fixed format sense data for response codes 70h (current information) and 71h (deferred errors) is defined in table 48.

Table 48 – Fixed format sense data

Bit Byte	7	6	5	4	3	2	1	0
0	VALID	RESPONSE CODE (70h or 71h)						
1	Reserved							
2	FILEMARK	EOM	ILI	SDAT_OVFL	SENSE KEY			
3	(MSB)	INFORMATION						
•••								
6								(LSB)
7	ADDITIONAL SENSE LENGTH (n-7)							
8	(MSB)	COMMAND-SPECIFIC INFORMATION						
•••								
11								(LSB)
12	ADDITIONAL SENSE CODE							
13	ADDITIONAL SENSE CODE QUALIFIER							
14	FIELD REPLACEABLE UNIT CODE							
15	SKSV	sense key specific information (see 4.4.2.4)						
16								
17								
18	Additional sense bytes							
•••								
n								

A VALID bit set to zero indicates that the INFORMATION field is not defined in this standard or any other command standard. A VALID bit set to one indicates the INFORMATION field contains valid information as defined in this standard or a command standard. See 4.4.4 for device server requirements regarding the VALID bit.

The contents of the RESPONSE CODE field indicate the report type and format of the sense data (see 4.4.1). For fixed format sense data, the RESPONSE CODE field shall be set to 70h or 71h.

The meaning of the FILEMARK bit is device type or command specific (e.g., see the SSC-5 READ command and SPACE command for examples of FILEMARK bit usage) and the bit is defined in a command standard.

The meaning of the end-of-medium (EOM) bit is device type or command specific (e.g., see the SSC-5 READ command, SPACE command, and WRITE command for examples of EOM bit usage) and the bit is defined in a command standard.

The meaning of the incorrect length indicator (ILI) bit is device type or command specific (e.g., see the SSC-5 READ command an example of ILI bit usage) and the bit is defined in a command standard.

The SDAT_OVFL bit, SENSE KEY field, ADDITIONAL SENSE CODE field, and ADDITIONAL SENSE CODE QUALIFIER field are described in 4.4.2.1.

The contents of the INFORMATION field are device type or command specific and are defined in a command standard. See 4.4.4 for device server requirements regarding how values are returned in the INFORMATION field.

The ADDITIONAL SENSE LENGTH field indicates the number of additional sense bytes that follow. The additional sense length shall be less than or equal to 244 (i.e., limiting the total length of the sense data to 252 bytes). If the sense data is being returned as parameter data by a REQUEST SENSE command, then the contents of the ADDITIONAL SENSE LENGTH field are not altered based on the allocation length (see 4.2.5.6). If the sense data is being returned in the same I_T nexus transaction as the status and the sense data is longer than the length specified in the MAXIMUM SENSE DATA LENGTH field in the Control Extension mode page (see 7.5.14), then the device server shall limit the number of sense data bytes to less than or equal to the length specified in the MAXIMUM SENSE DATA LENGTH field in the Control Extension mode page. The maximum total length of the sense data returned by the device server is indicated in the MAXIMUM SUPPORTED SENSE DATA LENGTH field in the Extended INQUIRY VPD page (see 7.7.7).

The contents of the COMMAND-SPECIFIC INFORMATION field are command specific, and are defined in this standard or a command standard. The COMMAND-SPECIFIC INFORMATION field should be ignored in sense data:

   a) for a command or operation for which the COMMAND-SPECIFIC INFORMATION field is not defined; or
   b) that is not related to a command or operation (e.g., pollable sense data (see 5.12)).

See 4.4.5 for device server requirements regarding how values are returned in the COMMAND-SPECIFIC INFOR-MATION field.

The FIELD REPLACEABLE UNIT CODE field is described in 4.4.2.5.

A sense-key specific valid (SKSV) bit set to one indicates the sense key specific information is valid as defined in this standard. An SKSV bit set to zero indicates that the content and format of the sense key specific information is not as defined by this standard.

The sense key specific information is described in 4.4.2.4.

The additional sense bytes may contain:

   a) information related to conditions detected during the processing of an EXTENDED COPY command (see 5.19.8.4); and/or
   b) vendor specific data that further defines the nature of the reported condition.

4.4.4 Returning a value in the INFORMATION field in the sense data

To return a value less than or equal to FFFF FFFFh in the INFORMATION field:

   a) if fixed format sense data (see 4.4.3) is being returned, the device server shall set the VALID bit to one and shall set the INFORMATION field to the value; and
   b) if descriptor format sense data (see 4.4.2) is being returned and a sense data descriptor that contains a VALID bit and an INFORMATION field is being returned (e.g., the information descriptor (see 4.4.2.2) or the direct access block device sense data descriptor (see SBC-5)), then the device server shall set the VALID bit to one, the first four bytes of the INFORMATION field to zero, and the next four bytes of the INFORMATION field to the value.

To return a value greater than FFFF FFFFh in the INFORMATION field:

   a)   if fixed format sense data (see 4.4.3) is being returned, the device server shall set the VALID bit to zero
        and shall set the INFORMATION field to a vendor specific value. The value is not able to be reported;
        and
   b)   if descriptor format sense data (see 4.4.2) is being returned and a sense data descriptor that contains
        a VALID bit and an INFORMATION field is being returned (e.g., the information descriptor (see 4.4.2.2) or
        the direct access block device sense data descriptor (see SBC-5)), then the device server shall set
        the VALID bit to one and shall set the INFORMATION field to the value.

To return sense data and not return a value in the INFORMATION field:

   a)   if fixed format sense data (see 4.4.3) is being returned, the device server shall set the VALID bit to zero
        and shall set the INFORMATION field to a vendor specific value; and
   b)   if descriptor format sense data (see 4.4.2) is being returned, then:
        A)   the device server shall not return an information descriptor (see 4.4.2.2); and
        B)   if a sense data descriptor other than an information descriptor that contains a VALID bit and an
             INFORMATION field is being returned (e.g., the direct access block device sense data descriptor
             (see SBC-5)), then the device server shall set the VALID bit to zero and shall set the INFORMATION
             field to a vendor specific value.

4.4.5 Returning a value in the COMMAND-SPECIFIC INFORMATION field in the sense data

To return a value less than or equal to FFFF FFFFh in the COMMAND-SPECIFIC INFORMATION field:

   a)   if fixed format sense data (see 4.4.3) is being returned, the device server shall set the
        COMMAND-SPECIFIC INFORMATION field to the value; and
   b)   if descriptor format sense data (see 4.4.2) is being returned and a sense data descriptor that contains
        a COMMAND-SPECIFIC INFORMATION field is being returned (e.g., the command-specific information
        descriptor (see 4.4.2.3) or the direct access block device sense data descriptor (see SBC-5)), then
        the device server shall set the first four bytes of the COMMAND-SPECIFIC INFORMATION field to zero, and
        the next four bytes of the COMMAND-SPECIFIC INFORMATION field to the value.

To return a value greater than FFFF FFFFh in the COMMAND-SPECIFIC INFORMATION field:

   a)   if fixed format sense data (see 4.4.3) is being returned, the device server shall set the
        COMMAND-SPECIFIC INFORMATION field to a vendor specific value. The value is not able to be reported;
        and
   b)   if descriptor format sense data (see 4.4.2) is being returned and a sense data descriptor that contains
        a COMMAND-SPECIFIC INFORMATION field is being returned (e.g., the command-specific information
        descriptor (see 4.4.2.3) or the direct access block device sense data descriptor (see SBC-5)), then
        the device server shall set the COMMAND-SPECIFIC INFORMATION field to the value.

To return sense data and not return a value in the COMMAND-SPECIFIC INFORMATION field:

   a)   if fixed format sense data (see 4.4.3) is being returned, the device server shall set the
        COMMAND-SPECIFIC INFORMATION field to a vendor specific value; and
   b)   if descriptor format sense data (see 4.4.2) is being returned, then:
        A)   the device server shall not return a command-specific information descriptor (see 4.4.2.3); and
        B)   if a sense data descriptor that contains a COMMAND-SPECIFIC INFORMATION field is being returned
             (e.g., the direct access block device sense data descriptor (see SBC-5)), then the device server
             shall set the COMMAND-SPECIFIC INFORMATION field to a vendor specific value.

4.4.6 Current information

Response codes 70h and 72h (i.e., current information) indicate that the sense data is:

a) the result of an error, exception condition, or protocol specific failure that is associated with CHECK CONDITION status; or
b) additional information that is associated with a status other than CHECK CONDITION.

Current information includes:

a) errors generated during processing of a command terminated with CHECK CONDITION status;
b) errors not related to any command that are detected during processing of a command (e.g., disk servomechanism failures, off-track errors, or power-up test errors); and
c) referral information (see SBC-5) associated with GOOD status.

4.4.7 Deferred errors

Response codes 71h and 73h (deferred error) indicate that the sense data is the result of an error or exception condition that occurred during processing of a previous command for which GOOD status or CONDITION MET status has already been returned. Such commands are associated with the use of the immediate bit and with some forms of caching. Device servers that implement these features shall implement deferred error reporting.

The deferred error may be indicated by returning CHECK CONDITION status to an application client accessed through a defined I_T nexus as described in this subclause.

If a command terminates with CHECK CONDITION status and the sense data describes a deferred error, the terminated command shall not have been processed. After the device server detects a deferred error condition, the device server shall return a deferred error according to the following rules:

a) if no external intervention is necessary to recover a deferred error, a deferred error indication shall not be returned unless required by the error handling parameters of a mode page (e.g., the Informational Exceptions Control mode page defined by SBC-5 and SSC-5). The occurrence of the error may be logged;
b) if it is possible to associate a deferred error with an I_T nexus and with a particular function or a particular subset of data, and the error is either unrecovered or required to be reported by the mode parameters, then a deferred error indication shall be returned for a command received on the I_T nexus associated with the deferred error. If a command received on an I_T nexus other than the I_T nexus associated with the deferred error attempts to access the particular function or subset of data associated with the deferred error and the TST field equals 000b (see 7.5.13), then the device server shall complete the command with BUSY status or ACA ACTIVE status according to the requirements in SAM-6. If a command received on an I_T nexus other than the I_T nexus associated with the deferred error attempts to access the particular function or subset of data associated with the deferred error and the TST field equals 001b, then the command attempting the access shall not be blocked by the deferred error and the cause of the deferred error may result in an error being reported for the command attempting the access;
c) if the device server is unable to associate a deferred error with an I_T nexus or with a particular subset of data, then the device server shall return a deferred error for one command received on each I_T nexus. If multiple deferred errors have accumulated for an I_T nexus, then:
   A) one error shall be returned; and
   B) only the last error should be returned;

    d)   if the SCSI target device is unable to associate a deferred error with a particular logical unit, the SCSI target device shall establish a deferred error for every logical unit and shall return the deferred error for one command received on each I_T nexus associated with each logical unit; or

    e)   if a command has never been an enabled command, and a deferred error occurs, the device server shall terminate the command with CHECK CONDITION status and deferred error information returned in the sense data. If a deferred error occurs after a command becomes an enabled command and the command is affected by the error, then the device server shall terminate the command with CHECK CONDITION status and the current error information shall be returned in the sense data. In this case, if the current error information does not adequately define the deferred error condition, a deferred error may still exist after the current error information has been returned. If a deferred error occurs after a command has become an enabled command and the command completes successfully, then the device server may choose to return the deferred error information after the completion of the current command in conjunction with a subsequent command that has not begun processing.

NOTE 4 - A deferred error may indicate that an operation was unsuccessful long after GOOD status was returned. If the application client is unable to replicate or recover from other sources the data that is being written using cached or buffered write operations, then synchronization commands should be performed before the critical data is destroyed. This is necessary for actions taken when deferred errors occur in the storing of the data. The synchronizing process should provide the necessary commands to allow returning CHECK CONDITION status and subsequent returning of deferred error sense information after all cached or buffered operations are completed.

4.4.8 Sense key and additional sense code definitions

The sense keys are defined in table 49.

Table 49 – Sense key descriptions (part 1 of 2)

Sense Key	Description
0h	**NO SENSE:** Indicates that there is no specific sense key information to be reported. This may occur for a successful command or for a command that is terminated with CHECK CONDITION status (e.g., as a result of the FILEMARK bit, EOM bit, or ILI bit being set to one).
1h	**RECOVERED ERROR:** Indicates that the command completed successfully, with some recovery action performed by the device server. Details may be determined by examining the sense data (e.g., the INFORMATION field). If multiple recovered errors occur during one command, the choice of which error to report (e.g., first, last, most severe) is vendor specific.
2h	**NOT READY:** Indicates that the logical unit is not accessible. Operator intervention may be required to correct this condition.
3h	**MEDIUM ERROR:** Indicates that the command terminated with a non-recovered error condition that may have been caused by a flaw in the medium or an error in the recorded data. This sense key may also be returned if the device server is unable to distinguish between a flaw in the medium and a specific hardware failure (i.e., sense key 4h).
4h	**HARDWARE ERROR:** Indicates that the device server detected a non-recoverable hardware failure (e.g., controller failure, device failure, or parity error) while performing the command or during a self test.

Table 49 – Sense key descriptions (part 2 of 2)

Sense Key	Description

5h	**ILLEGAL REQUEST:** Indicates that:
	    a) the command was addressed to an incorrect logical unit number (see SAM-6);
	    b) the command had an invalid task attribute (see SAM-6);
	    c) the command was addressed to a logical unit whose current configuration prohibits processing the command;
	    d) there was an illegal parameter in the CDB; or
	    e) there was an illegal parameter in the additional parameters supplied as data for some commands (e.g., PERSISTENT RESERVE OUT).
	If the device server detects an invalid parameter in the CDB, the device server shall terminate the command without altering the medium. If the device server detects an invalid parameter in the additional parameters supplied as data, then the device server may have already altered the medium.

6h	**UNIT ATTENTION:** Indicates that a unit attention condition has been established (e.g., the removable medium may have been changed, a logical unit reset occurred). See SAM-6.

7h	**DATA PROTECT:** Indicates that the device server attempted to process a command that:
	    a) reads or writes a protected logical block; or
	    b) prepares a protected logical block for reading or writing.
	The read operation or write operation, if any, was not performed on that logical block.

8h	**BLANK CHECK:** Indicates that blank or non-blank medium was encountered when not expected.
9h	**VENDOR SPECIFIC:** This sense key is available for reporting vendor specific conditions.
Ah	**COPY ABORTED:** Indicates a third-party copy command (see 5.19.3) was aborted after some data was transferred but before all data was transferred.
Bh	**ABORTED COMMAND:** Indicates that the device server aborted the command. The application client may be able to recover by trying the command again.
Ch	Reserved
Dh	**VOLUME OVERFLOW:** Indicates that a buffered SCSI target device has reached the end of partition and data may remain in the buffer that has not been written to the medium. One or more RECOVER BUFFERED DATA command(s) may be sent to read the unwritten data from the buffer. See SSC-5.
Eh	**MISCOMPARE:** Indicates that the source data did not match the data read from the medium.
Fh	**COMPLETED:** Indicates there is command completed sense data (see SAM-6) to be reported. This may occur for a successful command.

The additional sense codes (i.e., the ADDITIONAL SENSE CODE field and ADDITIONAL SENSE CODE QUALIFIER field values in sense data) are defined in table 50.

Table 50 – ASC and ASCQ assignments (part 1 of 21)

```
                D – Direct Access Block Device (SBC-5)                    Device Type
              . Z – Host Managed Zoned Block Device (ZBC-3)               column keys
              .   T – Sequential Access Device (SSC-5)                    blank = code not used
              .     P – Processor Device (SPC-2)                          not blank = code used
              .     . R – C/DVD Device (MMC-6)
              .     .   O – Optical Memory Block Device (SBC)
              .     .     M – Media Changer Device (SMC-3)
              .     .     . A – Storage Array Device (SCC-2)
              .     .     .   E – SCSI Enclosure Services device (SES-3)
              .     .     .     B – Simplified Direct Access (Reduced Block) device (RBC)
              .     .     .     . K – Optical Card Reader/Writer device (OCRW)
              .     .     .     .   V – Automation/Device Interface device (ADC-4)
              .     .     .     .     F – Object-based Storage Device (OSD-2)

              .     .   .  .  .  .
 ASC ASCQ   D Z T P R O M A E B K V F   Description
```

ASC	ASCQ	Flags	Description
20h	0Bh	DZTPROMAEBK	ACCESS DENIED - ACL LUN CONFLICT
20h	08h	DZTPROMAEBK	ACCESS DENIED - ENROLLMENT CONFLICT
20h	01h	DZTPROMAEBK	ACCESS DENIED - INITIATOR PENDING-ENROLLED
20h	09h	DZTPROMAEBK	ACCESS DENIED - INVALID LU IDENTIFIER
20h	03h	DZTPROMAEBK	ACCESS DENIED - INVALID MGMT ID KEY
20h	0Ah	DZTPROMAEBK	ACCESS DENIED - INVALID PROXY TOKEN
20h	02h	DZTPROMAEBK	ACCESS DENIED - NO ACCESS RIGHTS
4Bh	03h	DZTPROMAEBK	ACK/NAK TIMEOUT
67h	02h	A	ADD LOGICAL UNIT FAILED
13h	00h	DZ O BK	ADDRESS MARK NOT FOUND FOR DATA FIELD
12h	00h	DZ O BK	ADDRESS MARK NOT FOUND FOR ID FIELD
26h	13h	D	APPLICATION TAG MODE PAGE IS INVALID
67h	08h	A	ASSIGN FAILURE OCCURRED
27h	03h	T R	ASSOCIATED WRITE PROTECT
2Ah	06h	DZTPROMAEBKVF	ASYMMETRIC ACCESS STATE CHANGED
47h	04h	DZTPROMAEBKVF	ASYNCHRONOUS INFORMATION PROTECTION ERROR DETECTED
44h	71h	DZT B	ATA DEVICE FAILED SET FEATURES
67h	0Bh	DZT B	ATA DEVICE FEATURE NOT ENABLED
00h	1Dh	DZT B	ATA PASS THROUGH INFORMATION AVAILABLE
00h	21h	DZ	ATOMIC COMMAND ABORTED DUE TO ACA
67h	06h	A	ATTACHMENT OF LOGICAL UNIT FAILED
21h	09h	DZ	ATTEMPT TO ACCESS GAP ZONE
21h	06h	DZ	ATTEMPT TO READ INVALID DATA
00h	11h	R	AUDIO PLAY OPERATION IN PROGRESS
00h	12h	R	AUDIO PLAY OPERATION PAUSED
00h	14h	R	AUDIO PLAY OPERATION STOPPED DUE TO ERROR
00h	13h	R	AUDIO PLAY OPERATION SUCCESSFULLY COMPLETED
74h	40h	DZT R MAEBKV	AUTHENTICATION FAILED
66h	00h		AUTOMATIC DOCUMENT FEEDER COVER UP [a]
66h	01h		AUTOMATIC DOCUMENT FEEDER LIFT UP [a]
55h	06h	DZT ROM B	AUXILIARY MEMORY OUT OF SPACE
11h	12h	DZT ROM B	AUXILIARY MEMORY READ ERROR
0Ch	0Bh	DZT ROM B	AUXILIARY MEMORY WRITE ERROR
00h	04h	T	BEGINNING-OF-PARTITION/MEDIUM DETECTED
3Fh	18h	D	BIND COMPLETED
3Fh	19h	D	BIND REDIRECTED

A numeric ordered listing of the ASC and ASCQ assignments is provided in clause E.2.

[a] This additional sense code is used by a device type that is no longer represented in this table.

Table 50 – ASC and ASCQ assignments (part 2 of 21)

D – Direct Access Block Device (SBC-5)	Device Type
. Z – Host Managed Zoned Block Device (ZBC-3)	column keys
. T – Sequential Access Device (SSC-5)	blank = code not used
. P – Processor Device (SPC-2)	not blank = code used
. . R – C/DVD Device (MMC-6)	
. . O – Optical Memory Block Device (SBC)	
. . M – Media Changer Device (SMC-3)	
. . . A – Storage Array Device (SCC-2)	
. . . E – SCSI Enclosure Services device (SES-3)	
. . B – Simplified Direct Access (Reduced Block) device (RBC)	
. . . K – Optical Card Reader/Writer device (OCRW)	
. . . V – Automation/Device Interface device (ADC-4)	
. . . F – Object-based Storage Device (OSD-2)	

ASC	ASCQ	DZTPROMAEBKVF	Description
0Ch	06h	DZT O B	BLOCK NOT COMPRESSIBLE
14h	04h	T	BLOCK SEQUENCE ERROR
29h	03h	DZTPROMAEBKVF	BUS DEVICE RESET FUNCTION OCCURRED
11h	0Eh	DZT RO B	CANNOT DECOMPRESS USING DECLARED ALGORITHM
30h	06h	DZT RO B	CANNOT FORMAT MEDIUM - INCOMPATIBLE MEDIUM
30h	02h	DZT RO BK	CANNOT READ MEDIUM - INCOMPATIBLE FORMAT
30h	01h	DZT RO BK	CANNOT READ MEDIUM - UNKNOWN FORMAT
30h	08h	R	CANNOT WRITE - APPLICATION CODE MISMATCH
30h	05h	DZT RO BK	CANNOT WRITE MEDIUM - INCOMPATIBLE FORMAT
30h	04h	DZT RO BK	CANNOT WRITE MEDIUM - UNKNOWN FORMAT
2Ah	09h	DZ	CAPACITY DATA HAS CHANGED
52h	00h	T	CARTRIDGE FAULT
73h	00h	R	CD CONTROL ERROR
24h	01h	DZTPRO AEBKVF	CDB DECRYPTION ERROR
3Fh	02h	DZTPROM BK	CHANGED OPERATING DEFINITION
11h	06h	RO B	CIRC UNRECOVERED ERROR
30h	03h	DZT R M K	CLEANING CARTRIDGE INSTALLED
30h	07h	DZT ROMAEBKVF	CLEANING FAILURE
30h	0Ah	DZT RO AEBK	CLEANING REQUEST REJECTED
00h	17h	DZT ROMAEBKVF	CLEANING REQUESTED
30h	13h	M	CLEANING VOLUME EXPIRED
4Ah	00h	DZTPROMAEBKVF	COMMAND PHASE ERROR
67h	0Ch	D	COMMAND REJECTED
2Ch	00h	DZTPROMAEBKVF	COMMAND SEQUENCE ERROR
2Eh	01h	DZ OM B	COMMAND TIMEOUT BEFORE PROCESSING
2Eh	02h	DZ OM B	COMMAND TIMEOUT DURING PROCESSING
2Eh	03h	DZ OM B	COMMAND TIMEOUT DURING PROCESSING DUE TO ERROR RECOVERY
6Eh	00h	A	COMMAND TO LOGICAL UNIT FAILED
2Fh	00h	DZTPROMAEBKVF	COMMANDS CLEARED BY ANOTHER INITIATOR
2Fh	02h	DZTPROMAEBKVF	COMMANDS CLEARED BY DEVICE SERVER
2Fh	01h	DZ	COMMANDS CLEARED BY POWER LOSS NOTIFICATION
3Fh	04h	DZT ROMAEBK	COMPONENT DEVICE ATTACHED
0Ch	04h	DZT O B	COMPRESSION CHECK MISCOMPARE ERROR
27h	06h	R F	CONDITIONAL WRITE PROTECT
67h	00h	A	CONFIGURATION FAILURE
67h	01h	A	CONFIGURATION OF INCAPABLE LOGICAL UNITS FAILED
6Fh	07h	R	CONFLICT IN BINDING NONCE RECORDING
00h	1Eh	DZT R MAEBKV	CONFLICTING SA CREATION REQUEST
4Bh	07h	DZTPROMAEBK F	CONNECTION LOST

A numeric ordered listing of the ASC and ASCQ assignments is provided in clause E.2.

^a This additional sense code is used by a device type that is no longer represented in this table.

Table 50 – ASC and ASCQ assignments (part 3 of 21)

			Description
		D – Direct Access Block Device (SBC-5)	Device Type
		. Z – Host Managed Zoned Block Device (ZBC-3)	column keys
		. T – Sequential Access Device (SSC-5)	blank = code not used
		. P – Processor Device (SPC-2)	not blank = code used
		. . R – C/DVD Device (MMC-6)	
		. . O – Optical Memory Block Device (SBC)	
		. . M – Media Changer Device (SMC-3)	
		. . . A – Storage Array Device (SCC-2)	
		. . . E – SCSI Enclosure Services device (SES-3)	
		. . . B – Simplified Direct Access (Reduced Block) device (RBC)	
		. . . . K – Optical Card Reader/Writer device (OCRW)	
		. . . . V – Automation/Device Interface device (ADC-4)	
		. . . . F – Object-based Storage Device (OSD-2)	

ASC	ASCQ	D Z T P R O M A E B K V F	Description
5Dh	25h	D Z B	CONTROLLER IMPENDING FAILURE ACCESS TIMES TOO HIGH
5Dh	27h	D Z B	CONTROLLER IMPENDING FAILURE CHANNEL PARAMETRICS
5Dh	28h	D Z B	CONTROLLER IMPENDING FAILURE CONTROLLER DETECTED
5Dh	22h	D Z B	CONTROLLER IMPENDING FAILURE DATA ERROR RATE TOO HIGH
5Dh	2Ch	D Z B	CONTROLLER IMPENDING FAILURE DRIVE CALIBRATION RETRY COUNT
5Dh	21h	D Z B	CONTROLLER IMPENDING FAILURE DRIVE ERROR RATE TOO HIGH
5Dh	20h	D Z B	CONTROLLER IMPENDING FAILURE GENERAL HARD DRIVE FAILURE
5Dh	23h	D Z B	CONTROLLER IMPENDING FAILURE SEEK ERROR RATE TOO HIGH
5Dh	2Ah	D Z B	CONTROLLER IMPENDING FAILURE SEEK TIME PERFORMANCE
5Dh	2Bh	D Z B	CONTROLLER IMPENDING FAILURE SPIN-UP RETRY COUNT
5Dh	26h	D Z B	CONTROLLER IMPENDING FAILURE START UNIT TIMES TOO HIGH
5Dh	29h	D Z B	CONTROLLER IMPENDING FAILURE THROUGHPUT PERFORMANCE
5Dh	24h	D Z B	CONTROLLER IMPENDING FAILURE TOO MANY BLOCK REASSIGNS
2Bh	00h	D Z T P R O K	COPY CANNOT EXECUTE SINCE HOST CANNOT DISCONNECT
6Fh	00h	R	COPY PROTECTION KEY EXCHANGE FAILURE - AUTHENTICATION FAILURE
6Fh	02h	R	COPY PROTECTION KEY EXCHANGE FAILURE - KEY NOT ESTABLISHED
6Fh	01h	R	COPY PROTECTION KEY EXCHANGE FAILURE - KEY NOT PRESENT
26h	0Dh	D Z T P R O K	COPY SEGMENT GRANULARITY VIOLATION
26h	15h	T	COPY SOURCE OR COPY DESTINATION NOT AUTHORIZED
0Dh	05h	D Z T P R O A K	COPY TARGET DEVICE DATA OVERRUN
0Dh	04h	D Z T P R O A K	COPY TARGET DEVICE DATA UNDERRUN
0Dh	02h	D Z T P R O A K	COPY TARGET DEVICE NOT REACHABLE
67h	07h	A	CREATION OF LOGICAL UNIT FAILED
74h	04h	T	CRYPTOGRAPHIC INTEGRITY VALIDATION FAILED
73h	10h	R	CURRENT POWER CALIBRATION AREA ALMOST FULL
73h	11h	R	CURRENT POWER CALIBRATION AREA IS FULL
2Ch	04h	R	CURRENT PROGRAM AREA IS EMPTY
2Ch	03h	R	CURRENT PROGRAM AREA IS NOT EMPTY
30h	09h	R	CURRENT SESSION NOT FIXATED FOR APPEND
5Dh	35h	D Z B	DATA CHANNEL IMPENDING FAILURE ACCESS TIMES TOO HIGH
5Dh	37h	D Z B	DATA CHANNEL IMPENDING FAILURE CHANNEL PARAMETRICS
5Dh	38h	D Z B	DATA CHANNEL IMPENDING FAILURE CONTROLLER DETECTED
5Dh	32h	D Z B	DATA CHANNEL IMPENDING FAILURE DATA ERROR RATE TOO HIGH
5Dh	3Ch	D Z B	DATA CHANNEL IMPENDING FAILURE DRIVE CALIBRATION RETRY COUNT
5Dh	31h	D Z B	DATA CHANNEL IMPENDING FAILURE DRIVE ERROR RATE TOO HIGH
5Dh	30h	D Z B	DATA CHANNEL IMPENDING FAILURE GENERAL HARD DRIVE FAILURE
5Dh	33h	D Z B	DATA CHANNEL IMPENDING FAILURE SEEK ERROR RATE TOO HIGH

A numeric ordered listing of the ASC and ASCQ assignments is provided in clause E.2.

[a] This additional sense code is used by a device type that is no longer represented in this table.

Table 50 – ASC and ASCQ assignments (part 4 of 21)

		D – Direct Access Block Device (SBC-5)														Device Type
		. Z – Host Managed Zoned Block Device (ZBC-3)														column keys
		. T – Sequential Access Device (SSC-5)														blank = code not used
		. P – Processor Device (SPC-2)														not blank = code used
		. . R – C/DVD Device (MMC-6)														
		. . O – Optical Memory Block Device (SBC)														
		. . M – Media Changer Device (SMC-3)														
		. . . A – Storage Array Device (SCC-2)														
		. . . E – SCSI Enclosure Services device (SES-3)														
		. . . B – Simplified Direct Access (Reduced Block) device (RBC)														
		. . . . K – Optical Card Reader/Writer device (OCRW)														
		. . . . V – Automation/Device Interface device (ADC-4)														
		. . . . F – Object-based Storage Device (OSD-2)														
ASC	ASCQ	D	Z	T	P	R	O	M	A	E	B	K	V	F	Description
5Dh	3Ah	D	Z								B				DATA CHANNEL IMPENDING FAILURE SEEK TIME PERFORMANCE
5Dh	3Bh	D	Z								B				DATA CHANNEL IMPENDING FAILURE SPIN-UP RETRY COUNT
5Dh	36h	D	Z								B				DATA CHANNEL IMPENDING FAILURE START UNIT TIMES TOO HIGH
5Dh	39h	D	Z								B				DATA CHANNEL IMPENDING FAILURE THROUGHPUT PERFORMANCE
5Dh	34h	D	Z								B				DATA CHANNEL IMPENDING FAILURE TOO MANY BLOCK REASSIGNS
55h	0Ah	D	Z					M							DATA CURRENTLY UNAVAILABLE
26h	05h	D	Z	T	P	R	O		A		B	K			DATA DECRYPTION ERROR
26h	10h			T											DATA DECRYPTION KEY FAIL LIMIT REACHED
2Ah	0Dh			T											DATA ENCRYPTION CAPABILITIES CHANGED
74h	21h			T											DATA ENCRYPTION CONFIGURATION PREVENTED
2Ah	13h			T											DATA ENCRYPTION KEY INSTANCE COUNTER HAS CHANGED
2Ah	11h			T											DATA ENCRYPTION PARAMETERS CHANGED BY ANOTHER I_T NEXUS
2Ah	12h			T											DATA ENCRYPTION PARAMETERS CHANGED BY VENDOR SPECIFIC EVENT
0Ch	05h	D	Z	T			O				B				DATA EXPANSION OCCURRED DURING COMPRESSION
69h	00h								A						DATA LOSS ON LOGICAL UNIT
4Bh	05h	D	Z	T	P	R	O	M	A	E	B	K			DATA OFFSET ERROR
41h	00h	D	Z												DATA PATH FAILURE (SHOULD USE 40 NN)
47h	01h	D	Z	T	P	R	O	M	A	E	B	K	V	F	DATA PHASE CRC ERROR DETECTED
4Bh	00h	D	Z	T	P	R	O	M	A	E	B	K	V	F	DATA PHASE ERROR
11h	07h						O				B				DATA RE-SYNCHRONIZATION ERROR
16h	03h	D	Z				O				B	K			DATA SYNC ERROR - DATA AUTO-REALLOCATED
16h	01h	D	Z				O				B	K			DATA SYNC ERROR - DATA REWRITTEN
16h	04h	D	Z				O				B	K			DATA SYNC ERROR - RECOMMEND REASSIGNMENT
16h	02h	D	Z				O				B	K			DATA SYNC ERROR - RECOMMEND REWRITE
16h	00h	D	Z				O				B	K			DATA SYNCHRONIZATION MARK ERROR
53h	0Ch							M							DATA TRANSFER DEVICE ERROR - EJECT FAILED
53h	0Dh							M							DATA TRANSFER DEVICE ERROR - LIBRARY COMMUNICATION FAILED
53h	09h							M							DATA TRANSFER DEVICE ERROR - LOAD FAILED
53h	0Ah							M							DATA TRANSFER DEVICE ERROR - UNLOAD FAILED
53h	0Bh							M							DATA TRANSFER DEVICE ERROR - UNLOAD MISSING
3Bh	1Bh							M							DATA TRANSFER DEVICE INSERTED
3Bh	1Ah							M							DATA TRANSFER DEVICE REMOVED
4Bh	0Ah	D	Z	T	P	R	O	M	A	E	B	K		F	DATA-IN BUFFER ERROR
4Bh	09h	D	Z	T	P	R	O	M	A	E	B	K		F	DATA-IN BUFFER OVERFLOW - DATA BUFFER DESCRIPTOR AREA
4Bh	08h	D	Z	T	P	R	O	M	A	E	B	K		F	DATA-IN BUFFER OVERFLOW - DATA BUFFER SIZE
4Bh	0Dh	D	Z	T	P	R	O	M	A	E	B	K		F	DATA-OUT BUFFER ERROR
4Bh	0Ch	D	Z	T	P	R	O	M	A	E	B	K		F	DATA-OUT BUFFER OVERFLOW - DATA BUFFER DESCRIPTOR AREA
4Bh	0Bh	D	Z	T	P	R	O	M	A	E	B	K		F	DATA-OUT BUFFER OVERFLOW - DATA BUFFER SIZE

A numeric ordered listing of the ASC and ASCQ assignments is provided in clause E.2.

[a] This additional sense code is used by a device type that is no longer represented in this table.

Table 50 – ASC and ASCQ assignments (part 5 of 21)

	D – Direct Access Block Device (SBC-5)		Device Type	
	. Z – Host Managed Zoned Block Device (ZBC-3)		column keys	
	. T – Sequential Access Device (SSC-5)		blank = code not used	
	. P – Processor Device (SPC-2)		not blank = code used	
	. R – C/DVD Device (MMC-6)			
	. . O – Optical Memory Block Device (SBC)			
	. . M – Media Changer Device (SMC-3)			
	. . . A – Storage Array Device (SCC-2)			
	. . . E – SCSI Enclosure Services device (SES-3)			
	. . . B – Simplified Direct Access (Reduced Block) device (RBC)			
	. . . . K – Optical Card Reader/Writer device (OCRW)			
	. . . . V – Automation/Device Interface device (ADC-4)			
	. . . . F – Object-based Storage Device (OSD-2)			

ASC	ASCQ	DZTPROMAEBKVF	Description
11h	0Dh	DZT RO B	DE-COMPRESSION CRC ERROR
71h	00h	T	DECOMPRESSION EXCEPTION LONG ALGORITHM ID
70h	NNh	T	DECOMPRESSION EXCEPTION SHORT ALGORITHM ID OF NN
19h	00h	DZ O K	DEFECT LIST ERROR
19h	03h	DZ O K	DEFECT LIST ERROR IN GROWN LIST
19h	02h	DZ O K	DEFECT LIST ERROR IN PRIMARY LIST
19h	01h	DZ O K	DEFECT LIST NOT AVAILABLE
1Ch	00h	DZ O BK	DEFECT LIST NOT FOUND
32h	01h	DZ O BK	DEFECT LIST UPDATE FAILURE
0Ch	0Fh	R	DEFECTS IN ERROR WINDOW
31h	04h	DZ	DEPOPULATION FAILED
04h	24h	DZ	DEPOPULATION IN PROGRESS
38h	08h	DZ	DEPOPULATION INTERRUPTED
31h	05h	DZ	DEPOPULATION RESTORATION FAILED
04h	25h	DZ	DEPOPULATION RESTORATION IN PROGRESS
38h	09h	DZ	DEPOPULATION RESTORATION INTERRUPTED
2Ch	11h	D	DESCRIPTOR FORMAT SENSE DATA REQUIRED
3Fh	05h	DZT ROMAEBK	DEVICE IDENTIFIER CHANGED
29h	04h	DZTPROMAEBKVF	DEVICE INTERNAL RESET
40h	NNh	DZTPROMAEBKVF	DIAGNOSTIC FAILURE ON COMPONENT NN (80h-FFh)
74h	08h	DZT R M E VF	DIGITAL SIGNATURE VALIDATION FAILURE
66h	02h		DOCUMENT JAM IN AUTOMATIC DOCUMENT FEEDER [a]
66h	03h		DOCUMENT MISS FEED AUTOMATIC IN DOCUMENT FEEDER [a]
6Fh	05h	R	DRIVE REGION MUST BE PERMANENT/REGION RESET COUNT ERROR
6Fh	0Ah	R	DRIVE-HOST PAIRING SUSPENDED
53h	07h	M	DUPLICATE VOLUME IDENTIFIER
3Fh	0Fh	DZTPROMAEBKVF	ECHO BUFFER OVERWRITTEN
3Bh	18h	M	ELEMENT DISABLED
3Bh	19h	M	ELEMENT ENABLED
53h	08h	M	ELEMENT STATUS UNKNOWN
72h	04h	R	EMPTY OR PARTIALLY WRITTEN RESERVED TRACK
34h	00h	DZTPROMAEBKVF	ENCLOSURE FAILURE
35h	05h	DZT ROMAEBKVF	ENCLOSURE SERVICES CHECKSUM ERROR
35h	00h	DZTPROMAEBKVF	ENCLOSURE SERVICES FAILURE
35h	03h	DZTPROMAEBKVF	ENCLOSURE SERVICES TRANSFER FAILURE
35h	04h	DZTPROMAEBKVF	ENCLOSURE SERVICES TRANSFER REFUSED
35h	02h	DZTPROMAEBKVF	ENCLOSURE SERVICES UNAVAILABLE
74h	0Ah	T	ENCRYPTED BLOCK NOT RAW READ ENABLED
74h	0Dh	T	ENCRYPTION ALGORITHM DISABLED

A numeric ordered listing of the ASC and ASCQ assignments is provided in clause E.2.

[a] This additional sense code is used by a device type that is no longer represented in this table.

Table 50 – ASC and ASCQ assignments (part 6 of 21)

```
          D – Direct Access Block Device (SBC-5)                    Device Type
          . Z – Host Managed Zoned Block Device (ZBC-3)             column keys
          .  T – Sequential Access Device (SSC-5)                   blank = code not used
          .   P – Processor Device (SPC-2)                          not blank = code used
          .   . R – C/DVD Device (MMC-6)
          .   .  O – Optical Memory Block Device (SBC)
          .   .   M – Media Changer Device (SMC-3)
          .   .   . A – Storage Array Device (SCC-2)
          .   .   .  E – SCSI Enclosure Services device (SES-3)
          .   .   .   B – Simplified Direct Access (Reduced Block) device (RBC)
          .   .   .   . K – Optical Card Reader/Writer device (OCRW)
          .   .   .   .  V – Automation/Device Interface device (ADC-4)
          .   .   .   .   F – Object-based Storage Device (OSD-2)
          .   .   .   .   .
 ASC ASCQ D Z T P R O M A E B K V F   Description
```

ASC	ASCQ	Device Types	Description
74h	09h	T	ENCRYPTION MODE MISMATCH ON READ
74h	07h	T	ENCRYPTION PARAMETERS NOT USEABLE
3Bh	0Fh	R	END OF MEDIUM REACHED
63h	00h	R	END OF USER AREA ENCOUNTERED ON THIS TRACK
00h	05h	T	END-OF-DATA DETECTED
14h	03h	T	END-OF-DATA NOT FOUND
00h	02h	T	END-OF-PARTITION/MEDIUM DETECTED
51h	00h	D Z T R O	ERASE FAILURE
51h	01h	D Z R	ERASE FAILURE - INCOMPLETE ERASE OPERATION DETECTED
00h	18h	T	ERASE OPERATION IN PROGRESS
74h	05h	T	ERROR DECRYPTING DATA
0Dh	00h	D Z T P R O A K	ERROR DETECTED BY THIRD PARTY TEMPORARY INITIATOR
2Ah	0Ah	D Z T	ERROR HISTORY I_T NEXUS CLEARED
2Ah	0Bh	D Z T	ERROR HISTORY SNAPSHOT RELEASED
0Ah	00h	D Z T P R O M A E B K V F	ERROR LOG OVERFLOW
11h	10h	R	ERROR READING ISRC NUMBER
11h	0Fh	R	ERROR READING UPC/EAN NUMBER
2Ah	0Ch	F	ERROR RECOVERY ATTRIBUTES HAVE CHANGED
11h	02h	D Z T R O B K	ERROR TOO LONG TO CORRECT
38h	06h	B	ESN - DEVICE BUSY CLASS EVENT
38h	04h	B	ESN - MEDIA CLASS EVENT
38h	02h	B	ESN - POWER MANAGEMENT CLASS EVENT
38h	00h	B	EVENT STATUS NOTIFICATION
03h	02h	T	EXCESSIVE WRITE ERRORS
67h	04h	A	EXCHANGE OF LOGICAL UNIT FAILED
67h	0Dh	D	EXPLICIT BIND NOT ALLOWED
00h	20h	D Z T P B	EXTENDED COPY INFORMATION AVAILABLE
74h	6Fh	T	EXTERNAL DATA ENCRYPTION CONTROL ERROR
74h	6Eh	T	EXTERNAL DATA ENCRYPTION CONTROL TIMEOUT
74h	61h	V	EXTERNAL DATA ENCRYPTION KEY MANAGER ACCESS ERROR
74h	62h	V	EXTERNAL DATA ENCRYPTION KEY MANAGER ERROR
74h	63h	V	EXTERNAL DATA ENCRYPTION KEY NOT FOUND
74h	64h	V	EXTERNAL DATA ENCRYPTION REQUEST NOT AUTHORIZED
3Bh	07h		FAILED TO SENSE BOTTOM-OF-FORM [a]
3Bh	06h		FAILED TO SENSE TOP-OF-FORM [a]
5Dh	00h	D Z T P R O M A E B K V F	FAILURE PREDICTION THRESHOLD EXCEEDED
5Dh	FFh	D Z T P R O M A E B K V F	FAILURE PREDICTION THRESHOLD EXCEEDED (FALSE)
26h	16h	D Z	FAST COPY NOT POSSIBLE
00h	01h	T	FILEMARK DETECTED

A numeric ordered listing of the ASC and ASCQ assignments is provided in clause E.2.

[a] This additional sense code is used by a device type that is no longer represented in this table.

Table 50 – ASC and ASCQ assignments (part 7 of 21)

			Device Type
D – Direct Access Block Device (SBC-5)			column keys
. Z – Host Managed Zoned Block Device (ZBC-3)			blank = code not used
. T – Sequential Access Device (SSC-5)			not blank = code used
. P – Processor Device (SPC-2)			
. R – C/DVD Device (MMC-6)			
. O – Optical Memory Block Device (SBC)			
. M – Media Changer Device (SMC-3)			
. A – Storage Array Device (SCC-2)			
. E – SCSI Enclosure Services device (SES-3)			
. B – Simplified Direct Access (Reduced Block) device (RBC)			
. K – Optical Card Reader/Writer device (OCRW)			
. V – Automation/Device Interface device (ADC-4)			
. F – Object-based Storage Device (OSD-2)			

ASC	ASCQ	D Z T P R O M A E B K V F	Description
14h	02h	T	FILEMARK OR SETMARK NOT FOUND
5Dh	65h	D Z · · · · · · · B	FIRMWARE IMPENDING FAILURE ACCESS TIMES TOO HIGH
5Dh	67h	D Z · · · · · · · B	FIRMWARE IMPENDING FAILURE CHANNEL PARAMETRICS
5Dh	68h	D Z · · · · · · · B	FIRMWARE IMPENDING FAILURE CONTROLLER DETECTED
5Dh	62h	D Z · · · · · · · B	FIRMWARE IMPENDING FAILURE DATA ERROR RATE TOO HIGH
5Dh	6Ch	D Z · · · · · · · B	FIRMWARE IMPENDING FAILURE DRIVE CALIBRATION RETRY COUNT
5Dh	61h	D Z · · · · · · · B	FIRMWARE IMPENDING FAILURE DRIVE ERROR RATE TOO HIGH
5Dh	60h	D Z · · · · · · · B	FIRMWARE IMPENDING FAILURE GENERAL HARD DRIVE FAILURE
5Dh	63h	D Z · · · · · · · B	FIRMWARE IMPENDING FAILURE SEEK ERROR RATE TOO HIGH
5Dh	6Ah	D Z · · · · · · · B	FIRMWARE IMPENDING FAILURE SEEK TIME PERFORMANCE
5Dh	6Bh	D Z · · · · · · · B	FIRMWARE IMPENDING FAILURE SPIN-UP RETRY COUNT
5Dh	66h	D Z · · · · · · · B	FIRMWARE IMPENDING FAILURE START UNIT TIMES TOO HIGH
5Dh	69h	D Z · · · · · · · B	FIRMWARE IMPENDING FAILURE THROUGHPUT PERFORMANCE
5Dh	64h	D Z · · · · · · · B	FIRMWARE IMPENDING FAILURE TOO MANY BLOCK REASSIGNS
09h	02h	R O · · · · K	FOCUS SERVO FAILURE
31h	01h	D Z · · R O · · · B	FORMAT COMMAND FAILED
28h	02h	R	FORMAT-LAYER MAY HAVE CHANGED
58h	00h	O	GENERATION DOES NOT EXIST
1Ch	02h	D Z · · · O · · · B K	GROWN DEFECT LIST NOT FOUND
5Dh	15h	D Z · · · · · · · B	HARDWARE IMPENDING FAILURE ACCESS TIMES TOO HIGH
5Dh	17h	D Z · · · · · · · B	HARDWARE IMPENDING FAILURE CHANNEL PARAMETRICS
5Dh	18h	D Z · · · · · · · B	HARDWARE IMPENDING FAILURE CONTROLLER DETECTED
5Dh	12h	D Z · · · · · · · B	HARDWARE IMPENDING FAILURE DATA ERROR RATE TOO HIGH
5Dh	1Ch	D Z · · · · · · · B	HARDWARE IMPENDING FAILURE DRIVE CALIBRATION RETRY COUNT
5Dh	11h	D Z · · · · · · · B	HARDWARE IMPENDING FAILURE DRIVE ERROR RATE TOO HIGH
5Dh	10h	D Z · · · · · · · B	HARDWARE IMPENDING FAILURE GENERAL HARD DRIVE FAILURE
5Dh	1Dh	D Z · · · · · · · B	HARDWARE IMPENDING FAILURE POWER LOSS PROTECTION CIRCUIT
5Dh	13h	D Z · · · · · · · B	HARDWARE IMPENDING FAILURE SEEK ERROR RATE TOO HIGH
5Dh	1Ah	D Z · · · · · · · B	HARDWARE IMPENDING FAILURE SEEK TIME PERFORMANCE
5Dh	1Bh	D Z · · · · · · · B	HARDWARE IMPENDING FAILURE SPIN-UP RETRY COUNT
5Dh	16h	D Z · · · · · · · B	HARDWARE IMPENDING FAILURE START UNIT TIMES TOO HIGH
5Dh	19h	D Z · · · · · · · B	HARDWARE IMPENDING FAILURE THROUGHPUT PERFORMANCE
5Dh	14h	D Z · · · · · · · B	HARDWARE IMPENDING FAILURE TOO MANY BLOCK REASSIGNS
27h	01h	D Z T · R O · · · B K	HARDWARE WRITE PROTECTED
09h	04h	D Z T · R O · · · B	HEAD SELECT FAULT
00h	06h	D Z T P R O M A E B K V F	I/O PROCESS TERMINATED
10h	00h	D Z · · · O · · · B K	ID CRC OR ECC ERROR
5Eh	03h	D Z T P R O · A · · K	IDLE CONDITION ACTIVATED BY COMMAND
5Eh	01h	D Z T P R O · A · · K	IDLE CONDITION ACTIVATED BY TIMER

A numeric ordered listing of the ASC and ASCQ assignments is provided in clause E.2.

[a] This additional sense code is used by a device type that is no longer represented in this table.

Table 50 – ASC and ASCQ assignments (part 8 of 21)

D – Direct Access Block Device (SBC-5)			Device Type
. Z – Host Managed Zoned Block Device (ZBC-3)			column keys
. T – Sequential Access Device (SSC-5)			blank = code not used
. P – Processor Device (SPC-2)			not blank = code used
. . R – C/DVD Device (MMC-6)			
. . O – Optical Memory Block Device (SBC)			
. . M – Media Changer Device (SMC-3)			
. . . A – Storage Array Device (SCC-2)			
. . . E – SCSI Enclosure Services device (SES-3)			
. . . B – Simplified Direct Access (Reduced Block) device (RBC)			
. . . . K – Optical Card Reader/Writer device (OCRW)			
. . . . V – Automation/Device Interface device (ADC-4)			
. . . . F – Object-based Storage Device (OSD-2)			

ASC	ASCQ	DZTPROMAEBKVF	Description
5Eh	06h	DZTPRO A K	IDLE_B CONDITION ACTIVATED BY COMMAND
5Eh	05h	DZTPRO A K	IDLE_B CONDITION ACTIVATED BY TIMER
5Eh	08h	DZTPRO A K	IDLE_C CONDITION ACTIVATED BY COMMAND
5Eh	07h	DZTPRO A K	IDLE_C CONDITION ACTIVATED BY TIMER
20h	0Ch	T	ILLEGAL COMMAND WHEN NOT IN APPEND-ONLY MODE
20h	06h	T	ILLEGAL COMMAND WHILE IN EXPLICIT ADDRESS MODE
20h	07h	T	ILLEGAL COMMAND WHILE IN IMPLICIT ADDRESS MODE
20h	04h	T	ILLEGAL COMMAND WHILE IN WRITE CAPABLE STATE
22h	00h	DZ	ILLEGAL FUNCTION (USE 20 00, 24 00, OR 26 00)
64h	00h	R	ILLEGAL MODE FOR THIS TRACK
2Ch	05h	B	ILLEGAL POWER CONDITION REQUEST
2Ah	07h	DZTPROMAEBKVF	IMPLICIT ASYMMETRIC ACCESS STATE TRANSITION FAILED
28h	01h	DZT ROM B	IMPORT OR EXPORT ELEMENT ACCESSED
28h	03h	M	IMPORT/EXPORT ELEMENT ACCESSED, MEDIUM CHANGED
30h	00h	DZT ROM BK	INCOMPATIBLE MEDIUM INSTALLED
30h	12h	M	INCOMPATIBLE VOLUME QUALIFIER
30h	11h	M	INCOMPATIBLE VOLUME TYPE
11h	08h	T	INCOMPLETE BLOCK READ
26h	11h	T	INCOMPLETE KEY-ASSOCIATED DATA SET
0Ch	10h	DZ	INCOMPLETE MULTIPLE ATOMIC WRITE OPERATIONS
0Dh	03h	DZTPRO A K	INCORRECT COPY TARGET DEVICE TYPE
74h	03h	T	INCORRECT DATA ENCRYPTION KEY
74h	0Bh	T	INCORRECT ENCRYPTION PARAMETERS
0Eh	02h	DZTPROMAEBK F	INFORMATION UNIT TOO LONG
0Eh	01h	DZTPROMAEBK F	INFORMATION UNIT TOO SHORT
47h	03h	DZTPROMAEBKVF	INFORMATION UNIT iuCRC ERROR DETECTED
6Ah	00h	A	INFORMATIONAL, REFER TO LOG
48h	00h	DZTPROMAEBKVF	INITIATOR DETECTED ERROR MESSAGE RECEIVED
4Bh	06h	DZTPROMAEBK	INITIATOR RESPONSE TIMEOUT
26h	0Bh	DZTPRO K	INLINE DATA LENGTH EXCEEDED
3Fh	03h	DZTPROMAEBKVF	INQUIRY DATA HAS CHANGED
3Fh	15h	DZTPR MAEBK	INSPECT REFERRALS SENSE DESCRIPTORS
55h	05h	DZTPROMAEBK	INSUFFICIENT ACCESS CONTROL RESOURCES
6Fh	06h	R	INSUFFICIENT BLOCK COUNT FOR BINDING NONCE RECORDING
6Fh	08h	R	INSUFFICIENT PERMISSION
55h	0Bh	DZTPROMAEBKVF	INSUFFICIENT POWER FOR OPERATION
55h	04h	DZTPROMAE K	INSUFFICIENT REGISTRATION RESOURCES
55h	02h	DZTPROMAE K	INSUFFICIENT RESERVATION RESOURCES
55h	03h	DZTPROMAE K	INSUFFICIENT RESOURCES

A numeric ordered listing of the ASC and ASCQ assignments is provided in clause E.2.

a   This additional sense code is used by a device type that is no longer represented in this table.

Table 50 – ASC and ASCQ assignments (part 9 of 21)

		D – Direct Access Block Device (SBC-5)	Device Type
		. Z – Host Managed Zoned Block Device (ZBC-3)	column keys
		. T – Sequential Access Device (SSC-5)	blank = code not used
		. P – Processor Device (SPC-2)	not blank = code used
		. R – C/DVD Device (MMC-6)	
		. . O – Optical Memory Block Device (SBC)	
		. . M – Media Changer Device (SMC-3)	
		. . . A – Storage Array Device (SCC-2)	
		. . . E – SCSI Enclosure Services device (SES-3)	
		. . . B – Simplified Direct Access (Reduced Block) device (RBC)	
		. . . . K – Optical Card Reader/Writer device (OCRW)	
		. . . . V – Automation/Device Interface device (ADC-4)	
		. . . . F – Object-based Storage Device (OSD-2)	
		. . . . .	

ASC	ASCQ	D Z T P R O M A E B K V F	Description
55h	11h	D	INSUFFICIENT RESOURCES TO BIND
55h	0Ch	D Z T P B	INSUFFICIENT RESOURCES TO CREATE ROD
55h	0Dh	D Z T P B	INSUFFICIENT RESOURCES TO CREATE ROD TOKEN
2Eh	00h	D Z R O M B	INSUFFICIENT TIME FOR OPERATION
55h	0Eh	D Z	INSUFFICIENT ZONE RESOURCES
55h	0Fh	D Z	INSUFFICIENT ZONE RESOURCES TO COMPLETE WRITE
44h	00h	D Z T P R O M A E B K V F	INTERNAL TARGET FAILURE
21h	02h	R	INVALID ADDRESS FOR WRITE
3Dh	00h	D Z T P R O M A E K	INVALID BITS IN IDENTIFY MESSAGE
2Ch	02h		INVALID COMBINATION OF WINDOWS SPECIFIED
20h	00h	D Z T P R O M A E B K V F	INVALID COMMAND OPERATION CODE
26h	0Fh	F	INVALID DATA-OUT BUFFER INTEGRITY CHECK VALUE
6Fh	09h	R	INVALID DRIVE-HOST PAIRING SERVER
21h	01h	D Z T R O M B K	INVALID ELEMENT ADDRESS
24h	09h	D Z	INVALID FAST FORMAT
24h	00h	D Z T P R O M A E B K V F	INVALID FIELD IN CDB
0Eh	03h	D Z T P R M A E B K F	INVALID FIELD IN COMMAND INFORMATION UNIT
26h	00h	D Z T P R O M A E B K V F	INVALID FIELD IN PARAMETER LIST
0Eh	00h	D Z T P R O M A E B K F	INVALID INFORMATION UNIT
49h	00h	D Z T P R O M A E B K V F	INVALID MESSAGE ERROR
26h	0Ch	D Z T P R O K	INVALID OPERATION FOR COPY SOURCE OR DESTINATION
64h	01h	R	INVALID PACKET SIZE
26h	0Eh	D Z T P R O M A E B K	INVALID PARAMETER WHILE PORT IS ENABLED
26h	04h	D Z T P R O M A E B K V F	INVALID RELEASE OF PERSISTENT RESERVATION
74h	12h	D Z T R M A E B K V	INVALID SA USAGE
4Bh	01h	D Z T P R O M A E B K	INVALID TARGET PORT TRANSFER TAG RECEIVED
23h	00h	D Z T P B	INVALID TOKEN OPERATION, CAUSE NOT REPORTABLE
23h	0Ah	D Z T P B	INVALID TOKEN OPERATION, INVALID TOKEN LENGTH
23h	03h	D Z T P B	INVALID TOKEN OPERATION, REMOTE ROD TOKEN CREATION NOT SUPPORTED
23h	02h	D Z T P B	INVALID TOKEN OPERATION, REMOTE TOKEN USAGE NOT SUPPORTED
23h	08h	D Z T P B	INVALID TOKEN OPERATION, TOKEN CANCELLED
23h	05h	D Z T P B	INVALID TOKEN OPERATION, TOKEN CORRUPT
23h	09h	D Z T P B	INVALID TOKEN OPERATION, TOKEN DELETED
23h	07h	D Z T P B	INVALID TOKEN OPERATION, TOKEN EXPIRED
23h	06h	D Z T P B	INVALID TOKEN OPERATION, TOKEN REVOKED
23h	04h	D Z T P B	INVALID TOKEN OPERATION, TOKEN UNKNOWN
23h	01h	D Z T P B	INVALID TOKEN OPERATION, UNSUPPORTED TOKEN TYPE
21h	03h	R	INVALID WRITE CROSSING LAYER JUMP

A numeric ordered listing of the ASC and ASCQ assignments is provided in clause E.2.

[a] This additional sense code is used by a device type that is no longer represented in this table.

Table 50 – ASC and ASCQ assignments (part 10 of 21)

	D – Direct Access Block Device (SBC-5)		Device Type	
	. Z – Host Managed Zoned Block Device (ZBC-3)		column keys	
	. T – Sequential Access Device (SSC-5)		blank = code not used	
	. P – Processor Device (SPC-2)		not blank = code used	
	. R – C/DVD Device (MMC-6)			
	. . O – Optical Memory Block Device (SBC)			
	. . M – Media Changer Device (SMC-3)			
	. . . A – Storage Array Device (SCC-2)			
	. . . E – SCSI Enclosure Services device (SES-3)			
	. . . B – Simplified Direct Access (Reduced Block) device (RBC)			
	. . . . K – Optical Card Reader/Writer device (OCRW)			
	. . . . V – Automation/Device Interface device (ADC-4)			
	. . . . F – Object-based Storage Device (OSD-2)			
	. . . . .			

ASC	ASCQ	DZTPROMAEBKVF	Description
24h	08h	DZT R MAEBKV	INVALID XCDB
29h	07h	DZTPROMAEBKVF	I_T NEXUS LOSS OCCURRED
11h	05h	RO B	L-EC UNCORRECTABLE ERROR
60h	00h		LAMP FAILURE ª
14h	07h	T	LOCATE OPERATION FAILURE
00h	19h	T	LOCATE OPERATION IN PROGRESS
5Bh	02h	DZTPROM K	LOG COUNTER AT MAXIMUM
5Bh	00h	DZTPROM K	LOG EXCEPTION
5Bh	03h	DZTPROM K	LOG LIST CODES EXHAUSTED
2Ah	02h	DZT ROMAE K	LOG PARAMETERS CHANGED
21h	00h	DZT RO BK	LOGICAL BLOCK ADDRESS OUT OF RANGE
10h	02h	DZT O	LOGICAL BLOCK APPLICATION TAG CHECK FAILED
10h	01h	DZT O	LOGICAL BLOCK GUARD CHECK FAILED
10h	04h	T	LOGICAL BLOCK PROTECTION ERROR ON RECOVER BUFFERED DATA
10h	05h	T	LOGICAL BLOCK PROTECTION METHOD ERROR
10h	03h	DZT O	LOGICAL BLOCK REFERENCE TAG CHECK FAILED
74h	71h	DZT R M E V	LOGICAL UNIT ACCESS NOT AUTHORIZED
08h	03h	DZT ROM BK	LOGICAL UNIT COMMUNICATION CRC ERROR (ULTRA-DMA/32)
08h	00h	DZT ROMAEBKVF	LOGICAL UNIT COMMUNICATION FAILURE
08h	02h	DZT ROMAEBKVF	LOGICAL UNIT COMMUNICATION PARITY ERROR
08h	01h	DZT ROMAEBKVF	LOGICAL UNIT COMMUNICATION TIME-OUT
05h	00h	DZT ROMAEBKVF	LOGICAL UNIT DOES NOT RESPOND TO SELECTION
4Ch	00h	DZTPROMAEBKVF	LOGICAL UNIT FAILED SELF-CONFIGURATION
3Eh	03h	DZTPROMAEBKVF	LOGICAL UNIT FAILED SELF-TEST
3Eh	01h	DZTPROMAEBKVF	LOGICAL UNIT FAILURE
5Dh	02h	R	LOGICAL UNIT FAILURE PREDICTION THRESHOLD EXCEEDED
3Eh	00h	DZTPROMAEBKVF	LOGICAL UNIT HAS NOT SELF-CONFIGURED YET
04h	01h	DZTPROMAEBKVF	LOGICAL UNIT IS IN PROCESS OF BECOMING READY
04h	0Ah	DZTPROMAEBKVF	LOGICAL UNIT NOT ACCESSIBLE, ASYMMETRIC ACCESS STATE TRANSITION
04h	0Bh	DZTPROMAEBKVF	LOGICAL UNIT NOT ACCESSIBLE, TARGET PORT IN STANDBY STATE
04h	0Ch	DZTPROMAEBKVF	LOGICAL UNIT NOT ACCESSIBLE, TARGET PORT IN UNAVAILABLE STATE
68h	00h	A	LOGICAL UNIT NOT CONFIGURED
04h	18h	M	LOGICAL UNIT NOT READY, A DOOR IS OPEN
04h	1Ch	DZT MAEB	LOGICAL UNIT NOT READY, ADDITIONAL POWER USE NOT YET GRANTED
04h	23h	DZ	LOGICAL UNIT NOT READY, AFFILIATION REQUIRED
04h	10h	DZT ROM B	LOGICAL UNIT NOT READY, AUXILIARY MEMORY NOT ACCESSIBLE
04h	17h	M	LOGICAL UNIT NOT READY, CALIBRATION REQUIRED

A numeric ordered listing of the ASC and ASCQ assignments is provided in clause E.2.

ª   This additional sense code is used by a device type that is no longer represented in this table.

Table 50 – ASC and ASCQ assignments (part 11 of 21)

		D – Direct Access Block Device (SBC-5)	Device Type
		. Z – Host Managed Zoned Block Device (ZBC-3)	column keys
		. T – Sequential Access Device (SSC-5)	blank = code not used
		. P – Processor Device (SPC-2)	not blank = code used
		. . R – C/DVD Device (MMC-6)	
		. . O – Optical Memory Block Device (SBC)	
		. . M – Media Changer Device (SMC-3)	
		. . . A – Storage Array Device (SCC-2)	
		. . . E – SCSI Enclosure Services device (SES-3)	
		. . . B – Simplified Direct Access (Reduced Block) device (RBC)	
		. . . . K – Optical Card Reader/Writer device (OCRW)	
		. . . . V – Automation/Device Interface device (ADC-4)	
		. . . . F – Object-based Storage Device (OSD-2)	
		. . . . .	
ASC	ASCQ	DZTPROMAEBKVF	Description
04h	00h	DZTPROMAEBKVF	LOGICAL UNIT NOT READY, CAUSE NOT REPORTABLE
04h	1Dh	DZ	LOGICAL UNIT NOT READY, CONFIGURATION IN PROGRESS
04h	16h	M	LOGICAL UNIT NOT READY, CONFIGURATION REQUIRED
04h	04h	DZT RO B	LOGICAL UNIT NOT READY, FORMAT IN PROGRESS
04h	21h	DZTPROMAEBKVF	LOGICAL UNIT NOT READY, HARD RESET REQUIRED
04h	02h	DZTPROMAEBKVF	LOGICAL UNIT NOT READY, INITIALIZING COMMAND REQUIRED
04h	20h	DZTPROMAEBKVF	LOGICAL UNIT NOT READY, LOGICAL UNIT RESET REQUIRED
04h	08h	R	LOGICAL UNIT NOT READY, LONG WRITE IN PROGRESS
04h	03h	DZTPROMAEBKVF	LOGICAL UNIT NOT READY, MANUAL INTERVENTION REQUIRED
04h	1Eh	DZ	LOGICAL UNIT NOT READY, MICROCODE ACTIVATION REQUIRED
04h	1Fh	DZTPROMAEBKVF	LOGICAL UNIT NOT READY, MICROCODE DOWNLOAD REQUIRED
04h	11h	DZT RO AEB VF	LOGICAL UNIT NOT READY, NOTIFY (ENABLE SPINUP) REQUIRED
04h	12h	M V	LOGICAL UNIT NOT READY, OFFLINE
04h	19h	M	LOGICAL UNIT NOT READY, OPERATING IN SEQUENTIAL MODE
04h	07h	DZTPROMAEBKVF	LOGICAL UNIT NOT READY, OPERATION IN PROGRESS
04h	22h	DZTPROMAEBKVF	LOGICAL UNIT NOT READY, POWER CYCLE REQUIRED
04h	05h	DZT O A BK F	LOGICAL UNIT NOT READY, REBUILD IN PROGRESS
04h	06h	DZT O A BK	LOGICAL UNIT NOT READY, RECALCULATION IN PROGRESS
04h	15h	M	LOGICAL UNIT NOT READY, ROBOTICS DISABLED
04h	13h	DZT R MAEBKV	LOGICAL UNIT NOT READY, SA CREATION IN PROGRESS
04h	1Bh	DZ B	LOGICAL UNIT NOT READY, SANITIZE IN PROGRESS
04h	0Eh	DZT R MAEBKVF	LOGICAL UNIT NOT READY, SECURITY SESSION IN PROGRESS
04h	09h	DZTPROMAEBKVF	LOGICAL UNIT NOT READY, SELF-TEST IN PROGRESS
04h	14h	DZ B	LOGICAL UNIT NOT READY, SPACE ALLOCATION IN PROGRESS
04h	1Ah	DZ B	LOGICAL UNIT NOT READY, START STOP UNIT COMMAND IN PROGRESS
04h	0Dh	F	LOGICAL UNIT NOT READY, STRUCTURE CHECK REQUIRED
25h	00h	DZTPROMAEBKVF	LOGICAL UNIT NOT SUPPORTED
27h	02h	DZT RO BK	LOGICAL UNIT SOFTWARE WRITE PROTECTED
00h	1Fh	DZT B	LOGICAL UNIT TRANSITIONING TO ANOTHER POWER CONDITION
3Eh	04h	DZTPROMAEBKVF	LOGICAL UNIT UNABLE TO UPDATE SELF-TEST LOG
5Eh	00h	DZTPRO A K	LOW POWER CONDITION ON
55h	10h	DZ	MAXIMUM NUMBER OF STREAMS OPEN
55h	08h	T	MAXIMUM NUMBER OF SUPPLEMENTAL DECRYPTION KEYS EXCEEDED
15h	01h	DZT ROM BK	MECHANICAL POSITIONING ERROR
3Bh	16h	R	MECHANICAL POSITIONING OR CHANGER ERROR
5Dh	01h	R B	MEDIA FAILURE PREDICTION THRESHOLD EXCEEDED
5Dh	73h	DZ B	MEDIA IMPENDING FAILURE ENDURANCE LIMIT MET
53h	00h	DZT ROM BK	MEDIA LOAD OR EJECT FAILED
6Fh	04h	R	MEDIA REGION CODE IS MISMATCHED TO LOGICAL UNIT REGION

A numeric ordered listing of the ASC and ASCQ assignments is provided in clause E.2.

^a This additional sense code is used by a device type that is no longer represented in this table.

Table 50 – ASC and ASCQ assignments (part 12 of 21)

			Device Type
D – Direct Access Block Device (SBC-5)			column keys
. Z – Host Managed Zoned Block Device (ZBC-3)			blank = code not used
. T – Sequential Access Device (SSC-5)			not blank = code used
. P – Processor Device (SPC-2)			
. R – C/DVD Device (MMC-6)			
. O – Optical Memory Block Device (SBC)			
. M – Media Changer Device (SMC-3)			
. A – Storage Array Device (SCC-2)			
. E – SCSI Enclosure Services device (SES-3)			
. B – Simplified Direct Access (Reduced Block) device (RBC)			
. K – Optical Card Reader/Writer device (OCRW)			
. V – Automation/Device Interface device (ADC-4)			
. F – Object-based Storage Device (OSD-2)			

ASC	ASCQ	DZTPROMAEBKVF	Description
3Fh	11h	DZT ROM B	MEDIUM AUXILIARY MEMORY ACCESSIBLE
55h	09h	M	MEDIUM AUXILIARY MEMORY NOT ACCESSIBLE
3Bh	0Dh	DZT ROM BK	MEDIUM DESTINATION ELEMENT FULL
31h	00h	DZT RO BK	MEDIUM FORMAT CORRUPTED
3Fh	10h	DZT ROM B	MEDIUM LOADABLE
3Bh	13h	DZT ROM BK	MEDIUM MAGAZINE INSERTED
3Bh	14h	DZT ROM BK	MEDIUM MAGAZINE LOCKED
3Bh	11h	DZT ROM BK	MEDIUM MAGAZINE NOT ACCESSIBLE
3Bh	12h	DZT ROM BK	MEDIUM MAGAZINE REMOVED
3Bh	15h	DZT ROM BK	MEDIUM MAGAZINE UNLOCKED
30h	10h	R	MEDIUM NOT FORMATTED
3Ah	00h	DZT ROM BK	MEDIUM NOT PRESENT
3Ah	03h	DZT ROM B	MEDIUM NOT PRESENT - LOADABLE
3Ah	04h	DZT RO B	MEDIUM NOT PRESENT - MEDIUM AUXILIARY MEMORY ACCESSIBLE
3Ah	01h	DZT ROM BK	MEDIUM NOT PRESENT - TRAY CLOSED
3Ah	02h	DZT ROM BK	MEDIUM NOT PRESENT - TRAY OPEN
53h	02h	DZT ROM BK	MEDIUM REMOVAL PREVENTED
53h	03h	M	MEDIUM REMOVAL PREVENTED BY DATA TRANSFER ELEMENT
2Ah	15h	T M V	MEDIUM REMOVAL PREVENTION PREEMPTED
3Bh	0Eh	DZT ROM BK	MEDIUM SOURCE ELEMENT EMPTY
53h	04h	T	MEDIUM THREAD OR UNTHREAD FAILURE
43h	00h	DZTPROMAEBKVF	MESSAGE ERROR
3Fh	01h	DZTPROMAEBKVF	MICROCODE HAS BEEN CHANGED
3Fh	16h	DZTPROMAEBKVF	MICROCODE HAS BEEN CHANGED WITHOUT RESET
21h	08h	DZ	MISALIGNED WRITE COMMAND
1Dh	00h	DZT RO BK	MISCOMPARE DURING VERIFY OPERATION
1Dh	01h	DZ B	MISCOMPARE VERIFY OF UNMAPPED LBA
11h	0Ah	DZT O BK	MISCORRECTED ERROR
2Ah	01h	DZT ROMAEBKVF	MODE PARAMETERS CHANGED
67h	03h	A	MODIFICATION OF LOGICAL UNIT FAILED
69h	01h	A	MULTIPLE LOGICAL UNIT FAILURES
07h	00h	DZT ROM BK	MULTIPLE PERIPHERAL DEVICES SELECTED
11h	03h	DZT O BK	MULTIPLE READ ERRORS
0Ch	0Eh	DZT O BK	MULTIPLE WRITE ERRORS
67h	09h	A	MULTIPLY ASSIGNED LOGICAL UNIT
4Bh	04h	DZTPROMAEBK	NAK RECEIVED
00h	00h	DZTPROMAEBKVF	NO ADDITIONAL SENSE INFORMATION
00h	15h	R	NO CURRENT AUDIO STATUS TO RETURN
32h	00h	DZ O BK	NO DEFECT SPARE LOCATION AVAILABLE

A numeric ordered listing of the ASC and ASCQ assignments is provided in clause E.2.

[a] This additional sense code is used by a device type that is no longer represented in this table.

Table 50 – ASC and ASCQ assignments (part 13 of 21)

		D – Direct Access Block Device (SBC-5)	Device Type
		. Z – Host Managed Zoned Block Device (ZBC-3)	column keys
		. T – Sequential Access Device (SSC-5)	blank = code not used
		. P – Processor Device (SPC-2)	not blank = code used
		. . R – C/DVD Device (MMC-6)	
		. . O – Optical Memory Block Device (SBC)	
		. . M – Media Changer Device (SMC-3)	
		. . . A – Storage Array Device (SCC-2)	
		. . . E – SCSI Enclosure Services device (SES-3)	
		. . . B – Simplified Direct Access (Reduced Block) device (RBC)	
		. . . . K – Optical Card Reader/Writer device (OCRW)	
		. . . . V – Automation/Device Interface device (ADC-4)	
		. . . . F – Object-based Storage Device (OSD-2)	

ASC	ASCQ	D Z T P R O M A E B K V F	Description
11h	09h	T	NO GAP FOUND
01h	00h	D Z O B K	NO INDEX/SECTOR SIGNAL
72h	07h	R	NO MORE TEST ZONE EXTENSIONS ARE ALLOWED
72h	05h	R	NO MORE TRACK RESERVATIONS ALLOWED
06h	00h	D Z R O M B K	NO REFERENCE POSITION FOUND
02h	00h	D Z R O B K	NO SEEK COMPLETE
03h	01h	T	NO WRITE CURRENT
24h	06h	F	NONCE NOT UNIQUE
24h	07h	F	NONCE TIMESTAMP OUT OF RANGE
20h	0Fh	D	NOT A CONGLOMERATE LOGICAL UNIT
20h	0Eh	D	NOT A SUBSIDIARY LOGICAL UNIT
20h	0Dh	D	NOT AN ADMINISTRATIVE LOGICAL UNIT
28h	00h	D Z T P R O M A E B K V F	NOT READY TO READY CHANGE, MEDIUM MAY HAVE CHANGED
2Ch	0Bh	T	NOT RESERVED
00h	16h	D Z T P R O M A E B K V F	OPERATION IN PROGRESS
5Ah	01h	D Z T R O M B K	OPERATOR MEDIUM REMOVAL REQUEST
5Ah	00h	D Z T P R O B K	OPERATOR REQUEST OR STATE CHANGE INPUT
5Ah	03h	D Z T R O A B K	OPERATOR SELECTED WRITE PERMIT
5Ah	02h	D Z T R O A B K	OPERATOR SELECTED WRITE PROTECT
2Ch	0Ch	D Z	ORWRITE GENERATION DOES NOT MATCH
61h	02h		OUT OF FOCUS [a]
4Eh	00h	D Z T P R O M A E B K V F	OVERLAPPED COMMANDS ATTEMPTED
00h	23h	D Z	OVERLAPPING ATOMIC COMMAND IN PROGRESS
2Dh	00h	T	OVERWRITE ERROR ON UPDATE IN PLACE
20h	05h	T	Obsolete
24h	02h	T	Obsolete
24h	03h	T	Obsolete
63h	01h	R	PACKET DOES NOT FIT IN AVAILABLE SPACE
3Bh	05h		PAPER JAM [a]
1Ah	00h	D Z T P R O M A E B K V F	PARAMETER LIST LENGTH ERROR
26h	01h	D Z T P R O M A E B K V F	PARAMETER NOT SUPPORTED
26h	02h	D Z T P R O M A E B K V F	PARAMETER VALUE INVALID
2Ah	00h	D Z T R O M A E B K V F	PARAMETERS CHANGED
69h	02h	A	PARITY/DATA MISMATCH
1Fh	00h	D Z O K	PARTIAL DEFECT LIST TRANSFER
2Ch	0Ah	F	PARTITION OR COLLECTION CONTAINS USER OBJECTS
4Bh	14h	D Z T P R O M A E B K F	PCIE ACS VIOLATION
4Bh	10h	D Z T P R O M A E B K F	PCIE COMPLETER ABORT
4Bh	0Fh	D Z T P R O M A E B K F	PCIE COMPLETION TIMEOUT

A numeric ordered listing of the ASC and ASCQ assignments is provided in clause E.2.

[a] This additional sense code is used by a device type that is no longer represented in this table.

Table 50 – ASC and ASCQ assignments (part 14 of 21)

			Description
		D – Direct Access Block Device (SBC-5)	Device Type
		. Z – Host Managed Zoned Block Device (ZBC-3)	column keys
		. T – Sequential Access Device (SSC-5)	blank = code not used
		. P – Processor Device (SPC-2)	not blank = code used
		. R – C/DVD Device (MMC-6)	
		. . O – Optical Memory Block Device (SBC)	
		. M – Media Changer Device (SMC-3)	
		. . A – Storage Array Device (SCC-2)	
		. E – SCSI Enclosure Services device (SES-3)	
		. B – Simplified Direct Access (Reduced Block) device (RBC)	
		. K – Optical Card Reader/Writer device (OCRW)	
		. V – Automation/Device Interface device (ADC-4)	
		. F – Object-based Storage Device (OSD-2)	

ASC	ASCQ	D Z T P R O M A E B K V F	Description
4Bh	12h	D Z T P R O M A E B K F	PCIE ECRC CHECK FAILED
4Bh	0Eh	D Z T P R O M A E B K F	PCIE FABRIC ERROR
4Bh	11h	D Z T P R O M A E B K F	PCIE POISONED TLP RECEIVED
4Bh	15h	D Z T P R O M A E B K F	PCIE TLP PREFIX BLOCKED
4Bh	13h	D Z T P R O M A E B K F	PCIE UNSUPPORTED REQUEST
03h	00h	D Z T O B K	PERIPHERAL DEVICE WRITE FAULT
27h	05h	T R	PERMANENT WRITE PROTECT
2Ch	06h	R	PERSISTENT PREVENT CONFLICT
44h	01h	D Z T P M A E B K V F	PERSISTENT RESERVATION INFORMATION LOST
27h	04h	T R	PERSISTENT WRITE PROTECT
47h	06h	D Z T M A E B K V F	PHY TEST FUNCTION IN PROGRESS
50h	02h	T	POSITION ERROR RELATED TO TIMING
3Bh	0Ch	T	POSITION PAST BEGINNING OF MEDIUM
3Bh	0Bh		POSITION PAST END OF MEDIUM [a]
15h	02h	D Z T R O B K	POSITIONING ERROR DETECTED BY READ OF MEDIUM
73h	01h	R	POWER CALIBRATION AREA ALMOST FULL
73h	03h	R	POWER CALIBRATION AREA ERROR
73h	02h	R	POWER CALIBRATION AREA IS FULL
29h	01h	D Z T P R O M A E B K V F	POWER ON OCCURRED
29h	00h	D Z T P R O M A E B K V F	POWER ON, RESET, OR BUS DEVICE RESET OCCURRED
5Eh	41h	B	POWER STATE CHANGE TO ACTIVE
5Eh	47h	B K	POWER STATE CHANGE TO DEVICE CONTROL
5Eh	42h	B	POWER STATE CHANGE TO IDLE
5Eh	45h	B	POWER STATE CHANGE TO SLEEP
5Eh	43h	B	POWER STATE CHANGE TO STANDBY
42h	00h	D Z	POWER-ON OR SELF-TEST FAILURE (SHOULD USE 40 NN)
2Ch	07h	D Z T P R O M A E B K V F	PREVIOUS BUSY STATUS
2Ch	09h	D Z T P R O M E B K V F	PREVIOUS RESERVATION CONFLICT STATUS
2Ch	08h	D Z T P R O M A E B K V F	PREVIOUS TASK SET FULL STATUS
1Ch	01h	D Z O B K	PRIMARY DEFECT LIST NOT FOUND
2Ah	08h	D Z T R O M A E B K V F	PRIORITY CHANGED
73h	05h	R	PROGRAM MEMORY AREA IS FULL
73h	04h	R	PROGRAM MEMORY AREA UPDATE FAILURE
00h	07h	T	PROGRAMMABLE EARLY WARNING DETECTED
47h	05h	D Z T P R O M A E B K V F	PROTOCOL SERVICE CRC ERROR
55h	07h	F	QUOTA ERROR
40h	00h	D Z	RAM FAILURE (SHOULD USE 40 NN)
15h	00h	D Z T R O M B K	RANDOM POSITIONING ERROR
73h	17h	R	RDZ IS FULL

A numeric ordered listing of the ASC and ASCQ assignments is provided in clause E.2.

[a] This additional sense code is used by a device type that is no longer represented in this table.

Table 50 – ASC and ASCQ assignments (part 15 of 21)

		D – Direct Access Block Device (SBC-5)		

```
                 D – Direct Access Block Device (SBC-5)                    Device Type
                 . Z – Host Managed Zoned Block Device (ZBC-3)             column keys
                 .  T – Sequential Access Device (SSC-5)                   blank = code not used
                 .   P – Processor Device (SPC-2)                          not blank = code used
                 .   . R – C/DVD Device (MMC-6)
                 .   . O – Optical Memory Block Device (SBC)
                 .   .   M – Media Changer Device (SMC-3)
                 .   .   . A – Storage Array Device (SCC-2)
                 .   .   .  E – SCSI Enclosure Services device (SES-3)
                 .   .   .   B – Simplified Direct Access (Reduced Block) device (RBC)
                 .   .   .   . K – Optical Card Reader/Writer device (OCRW)
                 .   .   .   .  V – Automation/Device Interface device (ADC-4)
                 .   .   .   .   F – Object-based Storage Device (OSD-2)
                 .   .   .   .   .
ASC  ASCQ   D Z T P R O M A E B K V F   Description
```

ASC	ASCQ	DZTPROMAEBKVF	Description
21h	07h	DZ	READ BOUNDARY VIOLATION
11h	13h	DZTPRO AEBKVF	READ ERROR - FAILED RETRANSMISSION REQUEST
11h	14h	DZ	READ ERROR - LBA MARKED BAD BY APPLICATION CLIENT
11h	11h	R	READ ERROR - LOSS OF STREAMING
6Fh	03h	R	READ OF SCRAMBLED SECTOR WITHOUT AUTHENTICATION
3Bh	0Ah		READ PAST BEGINNING OF MEDIUM ᵃ
3Bh	09h		READ PAST END OF MEDIUM ᵃ
3Bh	17h	F	READ PAST END OF USER OBJECT
11h	01h	DZT RO BK	READ RETRIES EXHAUSTED
6Ch	00h	A	REBUILD FAILURE OCCURRED
6Dh	00h	A	RECALCULATE FAILURE OCCURRED
14h	01h	DZT RO BK	RECORD NOT FOUND
14h	06h	DZT O BK	RECORD NOT FOUND - DATA AUTO-REALLOCATED
14h	05h	DZT O BK	RECORD NOT FOUND - RECOMMEND REASSIGNMENT
14h	00h	DZT RO BK	RECORDED ENTITY NOT FOUND
18h	02h	DZ RO BK	RECOVERED DATA - DATA AUTO-REALLOCATED
18h	05h	DZ RO BK	RECOVERED DATA - RECOMMEND REASSIGNMENT
18h	06h	DZ RO BK	RECOVERED DATA - RECOMMEND REWRITE
17h	05h	DZ RO BK	RECOVERED DATA USING PREVIOUS SECTOR ID
18h	03h	R	RECOVERED DATA WITH CIRC
18h	07h	DZ O BK	RECOVERED DATA WITH ECC - DATA REWRITTEN
18h	01h	DZ RO BK	RECOVERED DATA WITH ERROR CORR. & RETRIES APPLIED
18h	00h	DZT RO BK	RECOVERED DATA WITH ERROR CORRECTION APPLIED
18h	04h	R	RECOVERED DATA WITH L-EC
18h	08h	R	RECOVERED DATA WITH LINKING
17h	03h	DZT RO BK	RECOVERED DATA WITH NEGATIVE HEAD OFFSET
17h	00h	DZT RO BK	RECOVERED DATA WITH NO ERROR CORRECTION APPLIED
17h	02h	DZT RO BK	RECOVERED DATA WITH POSITIVE HEAD OFFSET
17h	01h	DZT RO BK	RECOVERED DATA WITH RETRIES
17h	04h	RO B	RECOVERED DATA WITH RETRIES AND/OR CIRC APPLIED
17h	06h	DZ O BK	RECOVERED DATA WITHOUT ECC - DATA AUTO-REALLOCATED
17h	09h	DZ RO BK	RECOVERED DATA WITHOUT ECC - DATA REWRITTEN
17h	07h	DZ RO BK	RECOVERED DATA WITHOUT ECC - RECOMMEND REASSIGNMENT
17h	08h	DZ RO BK	RECOVERED DATA WITHOUT ECC - RECOMMEND REWRITE
1Eh	00h	DZ O BK	RECOVERED ID WITH ECC CORRECTION
3Fh	06h	DZT ROMAEB	REDUNDANCY GROUP CREATED OR MODIFIED
3Fh	07h	DZT ROMAEB	REDUNDANCY GROUP DELETED
6Bh	01h	A	REDUNDANCY LEVEL GOT BETTER
6Bh	02h	A	REDUNDANCY LEVEL GOT WORSE

A numeric ordered listing of the ASC and ASCQ assignments is provided in clause E.2.

ᵃ This additional sense code is used by a device type that is no longer represented in this table.

Table 50 – ASC and ASCQ assignments (part 16 of 21)

	D – Direct Access Block Device (SBC-5)		Device Type
	. Z – Host Managed Zoned Block Device (ZBC-3)		column keys
	. T – Sequential Access Device (SSC-5)		blank = code not used
	. P – Processor Device (SPC-2)		not blank = code used
	. . R – C/DVD Device (MMC-6)		
	. . O – Optical Memory Block Device (SBC)		
	. . M – Media Changer Device (SMC-3)		
	. . . A – Storage Array Device (SCC-2)		
	. . . E – SCSI Enclosure Services device (SES-3)		
	. . . B – Simplified Direct Access (Reduced Block) device (RBC)		
	. . . . K – Optical Card Reader/Writer device (OCRW)		
	. . . . V – Automation/Device Interface device (ADC-4)		
	. . . . F – Object-based Storage Device (OSD-2)		
	. . . . .		

ASC	ASCQ	D Z T P R O M A E B K V F	Description
2Ah	05h	D Z T P R O M A E	REGISTRATIONS PREEMPTED
67h	05h	A	REMOVE OF LOGICAL UNIT FAILED
3Fh	0Eh	D Z T P R O M A E	REPORTED LUNS DATA HAS CHANGED
3Bh	08h	T	REPOSITION ERROR
2Ah	03h	D Z T P R O M A E K	RESERVATIONS PREEMPTED
2Ah	04h	D Z T P R O M A E	RESERVATIONS RELEASED
2Ch	0Dh	D Z	RESET WRITE POINTER NOT ALLOWED
00h	1Ah	T	REWIND OPERATION IN PROGRESS
36h	00h		RIBBON, INK, OR TONER FAILURE [a]
73h	06h	R	RMA/PMA IS ALMOST FULL
72h	06h	R	RMZ EXTENSION IS NOT ALLOWED
37h	00h	D Z T R O M A E B K V F	ROUNDED PARAMETER
5Ch	00h	D Z O	RPL STATUS CHANGE
2Ah	14h	D Z T R M A E B K V	SA CREATION CAPABILITIES DATA HAS CHANGED
74h	30h	D Z T R M A E B K V	SA CREATION PARAMETER NOT SUPPORTED
74h	10h	D Z T R M A E B K V	SA CREATION PARAMETER VALUE INVALID
74h	11h	D Z T R M A E B K V	SA CREATION PARAMETER VALUE REJECTED
31h	03h	D Z B	SANITIZE COMMAND FAILED
39h	00h	D Z T R O M A E K	SAVING PARAMETERS NOT SUPPORTED
62h	00h		SCAN HEAD POSITIONING ERROR [a]
29h	02h	D Z T P R O M A E B K V F	SCSI BUS RESET OCCURRED
47h	00h	D Z T P R O M A E B K V F	SCSI PARITY ERROR
47h	02h	D Z T P R O M A E B K V F	SCSI PARITY ERROR DETECTED DURING ST DATA PHASE
54h	00h	P	SCSI TO HOST SYSTEM INTERFACE FAILURE
24h	04h	F	SECURITY AUDIT VALUE FROZEN
74h	79h	D Z	SECURITY CONFLICT IN TRANSLATED DEVICE
74h	00h	T	SECURITY ERROR
24h	05h	F	SECURITY WORKING KEY FROZEN
45h	00h	D Z T P R O M A E B K V F	SELECT OR RESELECT FAILURE
3Bh	00h	T	SEQUENTIAL POSITIONING ERROR
5Dh	45h	D Z B	SERVO IMPENDING FAILURE ACCESS TIMES TOO HIGH
5Dh	47h	D Z B	SERVO IMPENDING FAILURE CHANNEL PARAMETRICS
5Dh	48h	D Z B	SERVO IMPENDING FAILURE CONTROLLER DETECTED
5Dh	42h	D Z B	SERVO IMPENDING FAILURE DATA ERROR RATE TOO HIGH
5Dh	4Ch	D Z B	SERVO IMPENDING FAILURE DRIVE CALIBRATION RETRY COUNT
5Dh	41h	D Z B	SERVO IMPENDING FAILURE DRIVE ERROR RATE TOO HIGH
5Dh	40h	D Z B	SERVO IMPENDING FAILURE GENERAL HARD DRIVE FAILURE
5Dh	43h	D Z B	SERVO IMPENDING FAILURE SEEK ERROR RATE TOO HIGH
5Dh	4Ah	D Z B	SERVO IMPENDING FAILURE SEEK TIME PERFORMANCE

A numeric ordered listing of the ASC and ASCQ assignments is provided in clause E.2.

[a] This additional sense code is used by a device type that is no longer represented in this table.

Table 50 – ASC and ASCQ assignments (part 17 of 21)

			Description
		D – Direct Access Block Device (SBC-5)	Device Type
		. Z – Host Managed Zoned Block Device (ZBC-3)	column keys
		. T – Sequential Access Device (SSC-5)	blank = code not used
		. P – Processor Device (SPC-2)	not blank = code used
		. . R – C/DVD Device (MMC-6)	
		. . O – Optical Memory Block Device (SBC)	
		. . M – Media Changer Device (SMC-3)	
		. . . A – Storage Array Device (SCC-2)	
		. . . E – SCSI Enclosure Services device (SES-3)	
		. . . B – Simplified Direct Access (Reduced Block) device (RBC)	
		. . . K – Optical Card Reader/Writer device (OCRW)	
		. . . V – Automation/Device Interface device (ADC-4)	
		. . . F – Object-based Storage Device (OSD-2)	

ASC	ASCQ	DZTPROMAEBKVF	Description
5Dh	4Bh	DZ B	SERVO IMPENDING FAILURE SPIN-UP RETRY COUNT
5Dh	46h	DZ B	SERVO IMPENDING FAILURE START UNIT TIMES TOO HIGH
5Dh	49h	DZ B	SERVO IMPENDING FAILURE THROUGHPUT PERFORMANCE
5Dh	44h	DZ B	SERVO IMPENDING FAILURE TOO MANY BLOCK REASSIGNS
72h	00h	R	SESSION FIXATION ERROR
72h	03h	R	SESSION FIXATION ERROR - INCOMPLETE TRACK IN SESSION
72h	01h	R	SESSION FIXATION ERROR WRITING LEAD-IN
72h	02h	R	SESSION FIXATION ERROR WRITING LEAD-OUT
00h	1Bh	T	SET CAPACITY OPERATION IN PROGRESS
67h	0Ah	DZTPROMAEBKVF	SET TARGET PORT GROUPS COMMAND FAILED
00h	03h	T	SETMARK DETECTED
3Bh	04h		SLEW FAILURE [a]
47h	7Fh	DZTPROMAEBK	SOME COMMANDS CLEARED BY ISCSI PROTOCOL EVENT
2Fh	03h	DZTPROMAEBKVF	SOME COMMANDS CLEARED BY QUEUING LAYER EVENT
27h	07h	DZ B	SPACE ALLOCATION FAILED WRITE PROTECT
5Dh	03h	R	SPARE AREA EXHAUSTION PREDICTION THRESHOLD EXCEEDED
3Fh	08h	DZT ROMAEB	SPARE CREATED OR MODIFIED
3Fh	09h	DZT ROMAEB	SPARE DELETED
5Dh	55h	DZ B	SPINDLE IMPENDING FAILURE ACCESS TIMES TOO HIGH
5Dh	57h	DZ B	SPINDLE IMPENDING FAILURE CHANNEL PARAMETRICS
5Dh	58h	DZ B	SPINDLE IMPENDING FAILURE CONTROLLER DETECTED
5Dh	52h	DZ B	SPINDLE IMPENDING FAILURE DATA ERROR RATE TOO HIGH
5Dh	5Ch	DZ B	SPINDLE IMPENDING FAILURE DRIVE CALIBRATION RETRY COUNT
5Dh	51h	DZ B	SPINDLE IMPENDING FAILURE DRIVE ERROR RATE TOO HIGH
5Dh	50h	DZ B	SPINDLE IMPENDING FAILURE GENERAL HARD DRIVE FAILURE
5Dh	53h	DZ B	SPINDLE IMPENDING FAILURE SEEK ERROR RATE TOO HIGH
5Dh	5Ah	DZ B	SPINDLE IMPENDING FAILURE SEEK TIME PERFORMANCE
5Dh	5Bh	DZ B	SPINDLE IMPENDING FAILURE SPIN-UP RETRY COUNT
5Dh	56h	DZ B	SPINDLE IMPENDING FAILURE START UNIT TIMES TOO HIGH
5Dh	59h	DZ B	SPINDLE IMPENDING FAILURE THROUGHPUT PERFORMANCE
5Dh	54h	DZ B	SPINDLE IMPENDING FAILURE TOO MANY BLOCK REASSIGNS
09h	03h	RO	SPINDLE SERVO FAILURE
5Ch	02h	DZ O	SPINDLES NOT SYNCHRONIZED
5Ch	01h	DZ O	SPINDLES SYNCHRONIZED
5Eh	04h	DZTPRO A K	STANDBY CONDITION ACTIVATED BY COMMAND
5Eh	02h	DZTPRO A K	STANDBY CONDITION ACTIVATED BY TIMER
5Eh	0Ah	DZTPRO A K	STANDBY_Y CONDITION ACTIVATED BY COMMAND
5Eh	09h	DZTPRO A K	STANDBY_Y CONDITION ACTIVATED BY TIMER
6Bh	00h	A	STATE CHANGE HAS OCCURRED

A numeric ordered listing of the ASC and ASCQ assignments is provided in clause E.2.

[a] This additional sense code is used by a device type that is no longer represented in this table.

Table 50 – ASC and ASCQ assignments (part 18 of 21)

		D – Direct Access Block Device (SBC-5)															Device Type		
		. Z – Host Managed Zoned Block Device (ZBC-3)															column keys		
		. T – Sequential Access Device (SSC-5)															blank = code not used		
		. P – Processor Device (SPC-2)															not blank = code used		
		. R – C/DVD Device (MMC-6)																	
		. . O – Optical Memory Block Device (SBC)																	
		. . M – Media Changer Device (SMC-3)																	
		. . . A – Storage Array Device (SCC-2)																	
		. . . E – SCSI Enclosure Services device (SES-3)																	
		. . . B – Simplified Direct Access (Reduced Block) device (RBC)																	
		. . . . K – Optical Card Reader/Writer device (OCRW)																	
		. . . . V – Automation/Device Interface device (ADC-4)																	
		. . . . F – Object-based Storage Device (OSD-2)																	

ASC	ASCQ	D	Z	T	P	R	O	M	A	E	B	K	V	F	Description
2Ch	0Fh	D	Z												STREAM NOT OPEN
3Fh	1Ah	D													SUBSIDIARY BINDING CHANGED
68h	01h	D	Z												SUBSIDIARY LOGICAL UNIT NOT CONFIGURED
1Bh	00h	D	Z	T	P	R	O	M	A	E	B	K	V	F	SYNCHRONOUS DATA TRANSFER ERROR
55h	01h	D	Z				O				B	K			SYSTEM BUFFER FULL
55h	00h				P										SYSTEM RESOURCE FAILURE
4Dh	NNh	D	Z	T	P	R	O	M	A	E	B	K	V	F	TAGGED OVERLAPPED COMMANDS (NN = TASK TAG)
33h	00h			T											TAPE LENGTH ERROR
3Bh	03h														TAPE OR ELECTRONIC VERTICAL FORMS UNIT NOT READY [a]
3Bh	01h			T											TAPE POSITION ERROR AT BEGINNING-OF-MEDIUM
3Bh	02h			T											TAPE POSITION ERROR AT END-OF-MEDIUM
26h	14h			T											TAPE STREAM MIRRORING PREVENTED
3Fh	00h	D	Z	T	P	R	O	M	A	E	B	K	V	F	TARGET OPERATING CONDITIONS HAVE CHANGED
38h	07h	D	Z												THIN PROVISIONING SOFT THRESHOLD REACHED
0Dh	01h	D	Z	T	P	R	O		A			K			THIRD PARTY DEVICE FAILURE
5Bh	01h	D	Z	T	P	R	O	M				K			THRESHOLD CONDITION MET
26h	03h	D	Z	T	P	R	O	M	A	E		K			THRESHOLD PARAMETERS NOT SUPPORTED
3Eh	02h	D	Z	T	P	R	O	M	A	E	B	K	V	F	TIMEOUT ON LOGICAL UNIT
2Ah	10h	D	Z	T				M		E			V		TIMESTAMP CHANGED
3Bh	1Ch			T											TOO MANY LOGICAL OBJECTS ON PARTITION TO SUPPORT OPERATION
26h	08h	D	Z	T	P	R	O					K			TOO MANY SEGMENT DESCRIPTORS
26h	06h	D	Z	T	P	R	O					K			TOO MANY TARGET DESCRIPTORS
2Ch	01h														TOO MANY WINDOWS SPECIFIED [a]
4Bh	02h	D	Z	T	P	R	O	M	A	E	B	K			TOO MUCH WRITE DATA
09h	00h	D	Z	T		R	O				B				TRACK FOLLOWING ERROR
09h	01h					R	O					K			TRACKING SERVO FAILURE
29h	06h	D	Z	T	P	R	O	M	A	E	B	K	V	F	TRANSCEIVER MODE CHANGED TO LVD
29h	05h	D	Z	T	P	R	O	M	A	E	B	K	V	F	TRANSCEIVER MODE CHANGED TO SINGLE-ENDED
61h	01h														UNABLE TO ACQUIRE VIDEO [a]
74h	01h			T											UNABLE TO DECRYPT DATA
74h	0Ch	D	Z	T		R		M	A	E	B	K	V		UNABLE TO DECRYPT PARAMETER LIST
57h	00h					R									UNABLE TO RECOVER TABLE-OF-CONTENTS
21h	04h	D	Z												UNALIGNED WRITE COMMAND
74h	02h			T											UNENCRYPTED DATA ENCOUNTERED WHILE DECRYPTING
26h	0Ah	D	Z	T	P	R	O					K			UNEXPECTED INEXACT SEGMENT
74h	06h			T											UNKNOWN SIGNATURE VERIFICATION KEY
53h	01h			T											UNLOAD TAPE FAILURE
08h	04h	D	Z	T	P	R	O					K			UNREACHABLE COPY TARGET
11h	00h	D	Z	T		R	O				B	K			UNRECOVERED READ ERROR

A numeric ordered listing of the ASC and ASCQ assignments is provided in clause E.2.

[a] This additional sense code is used by a device type that is no longer represented in this table.

Table 50 – ASC and ASCQ assignments (part 19 of 21)

```
          D – Direct Access Block Device (SBC-5)                        Device Type
          . Z – Host Managed Zoned Block Device (ZBC-3)                 column keys
          .  T – Sequential Access Device (SSC-5)                       blank = code not used
          .   P – Processor Device (SPC-2)                              not blank = code used
          .   . R – C/DVD Device (MMC-6)
          .   .  O – Optical Memory Block Device (SBC)
          .   .   M – Media Changer Device (SMC-3)
          .   .   . A – Storage Array Device (SCC-2)
          .   .    . E – SCSI Enclosure Services device (SES-3)
          .   .    .  B – Simplified Direct Access (Reduced Block) device (RBC)
          .   .    .  . K – Optical Card Reader/Writer device (OCRW)
          .   .    .   . V – Automation/Device Interface device (ADC-4)
          .   .    .     F – Object-based Storage Device (OSD-2)
          .   .    .   .
ASC ASCQ  D Z T P R O M A E B K V F   Description
```

ASC	ASCQ	Device types	Description
11h	04h	DZ O BK	UNRECOVERED READ ERROR - AUTO REALLOCATE FAILED
11h	0Bh	DZ O BK	UNRECOVERED READ ERROR - RECOMMEND REASSIGNMENT
11h	0Ch	DZ O BK	UNRECOVERED READ ERROR - RECOMMEND REWRITE THE DATA
46h	00h	DZTPROM BK	UNSUCCESSFUL SOFT RESET
35h	01h	DZTPROMAEBKVF	UNSUPPORTED ENCLOSURE FUNCTION
26h	09h	DZTPRO K	UNSUPPORTED SEGMENT DESCRIPTOR TYPE CODE
26h	07h	DZTPRO K	UNSUPPORTED TARGET DESCRIPTOR TYPE CODE
2Ch	10h	DZ	UNWRITTEN DATA IN ZONE
59h	00h	O	UPDATED BLOCK READ
26h	12h	T	VENDOR SPECIFIC KEY REFERENCE NOT FOUND
00h	1Ch	T	VERIFY OPERATION IN PROGRESS
09h	05h	DZT RO B	VIBRATION INDUCED TRACKING ERROR
61h	00h		VIDEO ACQUISITION ERROR [a]
65h	00h	DZTPROMAEBKVF	VOLTAGE FAULT
53h	05h	M	VOLUME IDENTIFIER INVALID
53h	06h	M	VOLUME IDENTIFIER MISSING
3Fh	0Ah	DZT ROMAEBK	VOLUME SET CREATED OR MODIFIED
3Fh	0Ch	DZT ROMAEBK	VOLUME SET DEASSIGNED
3Fh	0Bh	DZT ROMAEBK	VOLUME SET DELETED
3Fh	0Dh	DZT ROMAEBK	VOLUME SET REASSIGNED
0Bh	00h	DZTPROMAEBKVF	WARNING
0Bh	05h	DZTPRO AEBKVF	WARNING - BACKGROUND MEDIUM SCAN DETECTED MEDIUM ERROR
0Bh	04h	DZTPRO AEBKVF	WARNING - BACKGROUND PRE-SCAN DETECTED MEDIUM ERROR
0Bh	03h	DZTPROMAEBKVF	WARNING - BACKGROUND SELF-TEST FAILED
0Bh	07h	DZTPROMAEBKVF	WARNING - DEGRADED POWER TO NON-VOLATILE CACHE
0Bh	09h	DZ	WARNING - DEVICE STATISTICS NOTIFICATION ACTIVE
0Bh	02h	DZTPROMAEBKVF	WARNING - ENCLOSURE DEGRADED
0Bh	0Eh	DZTPROMAEBKV	WARNING - HIGH CRITICAL HUMIDITY LIMIT EXCEEDED
0Bh	0Ah	DZTPROMAEBKV	WARNING - HIGH CRITICAL TEMPERATURE LIMIT EXCEEDED
0Bh	10h	DZTPROMAEBKV	WARNING - HIGH OPERATING HUMIDITY LIMIT EXCEEDED
0Bh	0Ch	DZTPROMAEBKV	WARNING - HIGH OPERATING TEMPERATURE LIMIT EXCEEDED
0Bh	0Fh	DZTPROMAEBKV	WARNING - LOW CRITICAL HUMIDITY LIMIT EXCEEDED
0Bh	0Bh	DZTPROMAEBKV	WARNING - LOW CRITICAL TEMPERATURE LIMIT EXCEEDED
0Bh	11h	DZTPROMAEBKV	WARNING - LOW OPERATING HUMIDITY LIMIT EXCEEDED
0Bh	0Dh	DZTPROMAEBKV	WARNING - LOW OPERATING TEMPERATURE LIMIT EXCEEDED
0Bh	13h	DZTPROMAEBKVF	WARNING - MICROCODE DIGITAL SIGNATURE VALIDATION FAILURE
0Bh	12h	DZTPROMAEBKVF	WARNING - MICROCODE SECURITY AT RISK
0Bh	06h	DZTPROMAEBKVF	WARNING - NON-VOLATILE CACHE NOW VOLATILE
0Bh	14h	DZ	WARNING - PHYSICAL ELEMENT STATUS CHANGE

A numeric ordered listing of the ASC and ASCQ assignments is provided in clause E.2.

[a] This additional sense code is used by a device type that is no longer represented in this table.

Table 50 – ASC and ASCQ assignments (part 20 of 21)

			Device Type
	D – Direct Access Block Device (SBC-5)		column keys
	. Z – Host Managed Zoned Block Device (ZBC-3)		blank = code not used
	. T – Sequential Access Device (SSC-5)		not blank = code used
	. P – Processor Device (SPC-2)		
	. . R – C/DVD Device (MMC-6)		
	. . O – Optical Memory Block Device (SBC)		
	. . M – Media Changer Device (SMC-3)		
	. . . A – Storage Array Device (SCC-2)		
	. . . E – SCSI Enclosure Services device (SES-3)		
	. . . B – Simplified Direct Access (Reduced Block) device (RBC)		
	. . . . K – Optical Card Reader/Writer device (OCRW)		
	. . . . V – Automation/Device Interface device (ADC-4)		
	. . . . F – Object-based Storage Device (OSD-2)		

ASC	ASCQ	D Z T P R O M A E B K V F	Description
0Bh	08h	D Z T P R O M A E B K V F	WARNING - POWER LOSS EXPECTED
0Bh	01h	D Z T P R O M A E B K V F	WARNING - SPECIFIED TEMPERATURE EXCEEDED
2Ch	13h	D Z T P R O M A E B K V F	WELL KNOWN LOGICAL UNIT ACCESS REQUIRED
30h	0Dh	T	WORM MEDIUM - INTEGRITY CHECK
30h	0Ch	T	WORM MEDIUM - OVERWRITE ATTEMPTED
11h	15h	D Z	WRITE AFTER SANITIZE REQUIRED
50h	00h	T	WRITE APPEND ERROR
50h	01h	T	WRITE APPEND POSITION ERROR
21h	05h	D Z	WRITE BOUNDARY VIOLATION
0Ch	00h	D Z T R	WRITE ERROR
0Ch	02h	D Z O B K	WRITE ERROR - AUTO REALLOCATION FAILED
0Ch	12h	D Z	WRITE ERROR - INSUFFICIENT ZONE RESOURCES
0Ch	09h	R	WRITE ERROR - LOSS OF STREAMING
0Ch	0Dh	D Z T P R O A E B K V F	WRITE ERROR - NOT ENOUGH UNSOLICITED DATA
0Ch	0Ah	R	WRITE ERROR - PADDING BLOCKS ADDED
0Ch	03h	D Z O B K	WRITE ERROR - RECOMMEND REASSIGNMENT
0Ch	01h	D Z K	WRITE ERROR - RECOVERED WITH AUTO REALLOCATION
0Ch	08h	R	WRITE ERROR - RECOVERY FAILED
0Ch	07h	D Z R	WRITE ERROR - RECOVERY NEEDED
0Ch	11h	D Z	WRITE ERROR - RECOVERY SCAN NEEDED
0Ch	0Ch	D Z T P R O A E B K V F	WRITE ERROR - UNEXPECTED UNSOLICITED DATA
27h	00h	D Z T R O B K	WRITE PROTECTED
2Ch	12h	D Z	ZONE IS INACTIVE
2Ch	0Eh	D Z	ZONE IS OFFLINE
27h	08h	D Z	ZONE IS READ ONLY
2Ah	16h	D Z	ZONE RESET WRITE POINTER RECOMMENDED
3Fh	17h	D Z	ZONE TRANSITION TO FULL
31h	02h	R	ZONED FORMATTING FAILED DUE TO SPARE LINKING
3Fh	12h	D Z T P R M A E B K F	iSCSI IP ADDRESS ADDED

A numeric ordered listing of the ASC and ASCQ assignments is provided in clause E.2.

a This additional sense code is used by a device type that is no longer represented in this table.

Table 50 – ASC and ASCQ assignments (part 21 of 21)

		D – Direct Access Block Device (SBC-5)	Device Type
		. Z – Host Managed Zoned Block Device (ZBC-3)	column keys
		. T – Sequential Access Device (SSC-5)	blank = code not used
		. P – Processor Device (SPC-2)	not blank = code used
		. . R – C/DVD Device (MMC-6)	
		. . O – Optical Memory Block Device (SBC)	
		. . M – Media Changer Device (SMC-3)	
		. . . A – Storage Array Device (SCC-2)	
		. . . E – SCSI Enclosure Services device (SES-3)	
		. . . B – Simplified Direct Access (Reduced Block) device (RBC)	
		. . . . K – Optical Card Reader/Writer device (OCRW)	
		. . . . V – Automation/Device Interface device (ADC-4)	
		. . . . F – Object-based Storage Device (OSD-2)	
		. . . . .	
ASC	ASCQ	D Z T P R O M A E B K V F	Description
3Fh	14h	D Z T P R M A E B K F	iSCSI IP ADDRESS CHANGED
3Fh	13h	D Z T P R M A E B K F	iSCSI IP ADDRESS REMOVED
80h	xxh	\	
Through		>	Vendor specific
FFh	xxh	/	
xxh	80h	\	
Through		>	Vendor specific qualification of standard ASC
xxh	FFh	/	
		All codes not shown are reserved.	
A numeric ordered listing of the ASC and ASCQ assignments is provided in clause E.2.			
^a This additional sense code is used by a device type that is no longer represented in this table.			

5 Model common to all device types

5.1 Introduction to the model common to all device types

5.1.1 Overview

This model describes some of the general characteristics expected of most SCSI devices. This model is not intended to alter any requirements defined elsewhere in SCSI. Devices conforming to this standard shall conform to SAM-6.

5.1.2 Important commands for all SCSI device servers

5.1.2.1 Commands implemented by all SCSI device servers

This standard defines the following mandatory commands (see 6.1):

    a) the INQUIRY command (see 5.1.2.3);
    b) the REPORT LUNS command (see 5.1.2.4); and
    c) the TEST UNIT READY command (see 5.1.2.5).

These commands are used to discover a logical unit's capabilities, to discover the system configuration, and to determine whether a logical unit is ready.

If the device server is able to process commands after an error occurs that prohibits normal command completion, then the device server may include a field replaceable unit code in the sense data when returning CHECK CONDITION status for commands other than the INQUIRY command (see 6.7), the REPORT LUNS command (see 6.30), and the REQUEST SENSE command (see 6.36). If the sense data includes a field replaceable unit code, then an application client may use the INQUIRY command to request the corresponding ASCII Information VPD page (see 7.7.3), if any, which contains ASCII information about the field replaceable unit causing the error.

5.1.2.2 Commands recommended for all SCSI device servers

Support for the REQUEST SENSE command is recommended to provide compatibility with application clients designed to use previous versions of this standard or status polling features defined by command standards.

5.1.2.3 Using the INQUIRY command

The INQUIRY command (see 6.7) may be used by an application client to determine the configuration of a logical unit. Device servers respond with information that includes their device type and standard version and may include the manufacturer's identification, model number, and other information.

The Device Identification VPD page (see 7.7.6) returned in response to an INQUIRY command with the EVPD bit set to one and the PAGE CODE field set to 83h contains identifying information for the logical unit, the target port, and the SCSI target device.

The INQUIRY command may return incomplete information until the device serve completes the power on process (see 6.7.1).

5.1.2.4 Using the REPORT LUNS command

The REPORT LUNS command (see 6.30) may be used by an application client to request a logical unit inventory report of the logical units that are accessible to the I_T nexus on which the command is sent.

The application client may select different types of logical unit inventories to be reported. Examples of using different logical unit inventory report types are shown in Annex B.

5.1.2.5 Using the TEST UNIT READY command

The TEST UNIT READY command (see 6.46) allows an application client to poll a logical unit until it is ready without allocating space for returned data. The TEST UNIT READY command may be used to check the media status of logical units with removable media. Device servers should respond promptly to indicate the current status of the SCSI target device.

5.1.2.6 Using the REQUEST SENSE command

The REQUEST SENSE command (see 6.36) may be used by an application client to poll the status of some background operations and to clear interlocked unit attention conditions (see 7.5.13).

5.1.3 Implicit head of queue

Each of the following commands may be processed by the task manager as if the command has a task attribute of HEAD OF QUEUE (see SAM-6) if the command is received with a SIMPLE task attribute or an ORDERED task attribute:

   a) INQUIRY; and
   b) REPORT LUNS.

See SAM-6 for additional rules on implicit head of queue processing.

5.2 Command duration limits

An application client uses a command duration limit to specify the scheduling and processing of a duration limited command (see SAM-6). If a device server determines that it is unable to complete processing of a duration limited command before expiration of the duration expiration time, then the device server may terminate the processing of that command (see SAM-6).

Device servers that support command duration limits shall:

   a) support one or more commands that are capable of specifying a duration limit descriptor, if any, to be used by the device server when processing a command (see SBC-5);
   b) for each command that is capable of specifying a command duration limit descriptor index set to a non-zero value, report that capability in the RWCDLP bit and the CDLP field (see 6.32.2); and
   c) indicate support in the RWCDLP bit and the CDLP field for:
       A) the Command Duration Limit A mode page (see 7.5.9);
       B) the Command Duration Limit B mode page (see 7.5.10);
       C) the Command Duration Limit T2A mode page (see 7.5.11); or
       D) the Command Duration Limit T2B mode page (see 7.5.12).

To determine the command duration limit information that applies to a command whose CDB contains a non-zero duration limit descriptor index, the device server uses:

1) the values in the RWCDLP bit and in the CDLP field in the parameter data returned by the REPORT SUPPORTED OPERATION CODES command (see 6.32) for this command to determine which command duration limit mode page, if any, applies the CDB; and
2) the command duration limit descriptor specified by the duration limit descriptor index in the CDB.

EXAMPLE – A duration limit descriptor index of 001b selects the command duration limit information contained in the first command duration limit descriptor. A duration limit descriptor index of 010b selects the command duration limit information contained in the second command limit duration descriptor. A duration limit descriptor index of 111b selects the command duration limit information contained in the seventh command limit duration descriptor.

5.3 Device clocks and timestamps

A timestamp may be included in data logged or recorded by a device server based on the contents of a device clock saturating counter described in this subclause.

Device clocks may be managed with:

a) the REPORT TIMESTAMP command (see 6.35);
b) the SET TIMESTAMP command (see 6.44);
c) the Control Extension mode page (see 7.5.14); and
d) methods outside the scope of this standard.

A device clock is initialized by a:

a) power on reset or hard reset that sets a device clock to zero;
b) SET TIMESTAMP command that sets a device clock to a specified value; or
c) method outside the scope of this standard.

The TCMOS bit in the Control Extension mode page (see 7.5.14) specifies whether the device server allows a device clock to be initialized by methods outside the scope of this standard. The SCSIP bit in the Control Extension mode page (see 7.5.14) specifies whether methods outside the scope of this standard take precedence over the SET TIMESTAMP command for initializing a device clock.

After a device clock is initialized, the device server shall increment it by one every millisecond, plus or minus a vendor specific tolerance.

A device clock shall not be affected by an I_T nexus loss or a logical unit reset.

If a device clock is initialized by means other than the SET TIMESTAMP command (see 6.44), the device server shall establish a unit attention condition for the SCSI initiator port associated with every I_T nexus (see SAM-6), with the additional sense code set to TIMESTAMP CHANGED.

The format of a device clock value is shown in table 51.

Table 51 – Device clock value

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
•••				TIMESTAMP				
5								(LSB)

The TIMESTAMP field contains the value of a device clock.

A data structure that contains a device clock value may indicate the most recent event that initialized that device clock by associating a timestamp origin value (see table 52) with that device clock value.

Table 52 – Timestamp origin value

Code	Description
000b	Device clock initialized to zero at power on or as the result of a hard reset
001b	Reserved
010b	Device clock initialized by the SET TIMESTAMP command (see 6.44)
011b	Device clock initialized by methods outside the scope of this standard
100b to 111b	Reserved

5.4 Device specific background functions

5.4.1 Introduction to device specific background functions

Device specific background functions are SCSI target device specific functions that have no specific association with application client initiated operations. A device specific background function is initiated if:

a) a device specific event associated with the function occurs (e.g., a timer expires or a counter reaches its limit); and
b) the function is enabled.

If conditions are met to initiate more than one device specific background function (e.g., more than one device specific event occurs), then the order of performing the functions is device specific. Other device server processes (e.g., processing a command) may or may not have any impact on events associated with device specific background functions.

Device specific background functions do not include self-test operations (see 5.15) or background scan operations (see SBC-5).

Device specific background functions:

a) may include background functions for the informational exception conditions that are managed using the Informational Exceptions Control mode page (see applicable command standard);
b) may include regular, device specific self testing or saving of device specific data;
c) may require the logical unit to be in a different power condition to be performed (e.g., a logical unit may require being in the active power condition to access the medium for some functions);

    d)   may be enabled or disabled via the EBF bit in the Informational Exceptions Control mode page;

    e)   shall be affected by the PERF bit and the LOGERR bit in the Informational Exceptions Control mode page, if the background function is associated with informational exception conditions;

    f)   should be processed relative to power conditions based on the setting in the PM_BG_PRECEDENCE field in the Power Condition mode page (see 7.5.18);

    g)   may have impact on the SCSI target device's performance (e.g., if a logical unit is performing a background function, and the device server receives a command from an application client that requires access to the logical unit, then the logical unit may take a short period of time (e.g., two seconds) to suspend the background function before the logical unit is able to process the command);

    h)   shall not affect power condition timers as defined in the Power Condition mode page;

    i)   shall not affect timers defined in the Background Control mode page (see SBC-5); and

    j)   shall have no negative impact on the reliability of the logical unit.

5.4.2 Suspending and resuming device specific background functions

The SCSI target device shall suspend a device specific background function in progress if:

    a)   any of the following are true:
       A)   a command or task management function is processed that requires the device specific background function to be suspended; or
       B)   a SCSI event (e.g., a reset event) (see SAM-6) occurs that requires the device specific background function to be suspended;
       or

    b)   all of the following are true:
       A)   a power condition timer defined in the Power Condition mode page (see 7.5.18) expires;
       B)   the PM_BG_PRECEDENCE field in the Power Condition mode page is set to 10b; and
       C)   the SCSI target device is unable to continue performing the device specific background function in the power condition associated with the timer that expired.

The SCSI target device may suspend a device specific background function in progress if:

    a)   a power condition timer defined in the Power Condition mode page (see 7.5.18) expires;

    b)   the PM_BG_PRECEDENCE field in the Power Condition mode page is set to 00b; and

    c)   the SCSI target device is unable to continue performing the device-specific background function in the power condition associated with the timer that expired.

If a device specific background function is suspended, the device server shall not stop any process that causes a device specific background function to be initiated (e.g., not stop any timers or counters associated with device specific background functions).

A suspended device specific background function may be resumed if:

    a)   there are no commands in the task set to be processed;

    b)   there are no task management functions to be processed;

    c)   there are no SCSI events to be processed;

    d)   no ACA condition (see SAM-6) exists;

    e)   the PM_BG_PRECEDENCE field in the Power Condition mode page (see 7.5.18) is set to 00b; or

    f)   the PM_BG_PRECEDENCE field in the Power Condition mode page is set to 10b, and no power condition timer defined in the Power Condition mode page has expired.

5.5 Downloading and activating microcode

5.5.1 Downloading microcode

SCSI target devices may use microcode (e.g., firmware) that is stored in nonvolatile storage. Microcode may be changeable by an application client using the WRITE BUFFER command (see 6.49). The WRITE BUFFER command provides multiple methods for downloading microcode to the SCSI target device and activating the microcode.

Downloading microcode involves the following steps:

1) **Download:** the application client transfers complete microcode from the Data-Out Buffer to the device server in one or more WRITE BUFFER commands; and
2) **Save:** if defined by the download microcode mode, the device server saves the microcode to nonvolatile storage.

If downloaded microcode is not activated by the WRITE BUFFER command that downloaded that microcode, then that microcode is defined as deferred microcode until that microcode is activated. While the deferred microcode is present and has not been activated, the device server should provide pollable sense data (see 5.12.2.2) with:

a) the sense key set to NO SENSE;
b) the additional sense code set to DEFERRED MICROCODE IS PENDING; and
c) if descriptor format sense data is supported, a microcode activation sense data descriptor (see 4.4.2.9).

The SCSI target device begins using the new microcode for the first time after it is activated (see 5.5.2) as part of the response to an event defined by the download microcode mode.

Table 53 defines the WRITE BUFFER download microcode modes with respect to the steps described in this subclause.

Table 53 – WRITE BUFFER download microcode modes

Mode	Code	Down-load [a]	Save [b]	Activate [c]
Download microcode and activate	04h	yes [d]	no	yes
Download microcode, save, and activate	05h	yes [d]	yes	optional
Download microcode with offsets and activate	06h	yes [e]	no	yes
Download microcode with offsets, save, and activate	07h	yes [e]	yes	optional
Download microcode with offsets, select activation events, save, and defer activate [f]	0Dh	yes [e]	yes	no
Download microcode with offsets, save, and defer activate [f]	0Eh	yes [e]	yes	no
Activate deferred microcode [g]	0Fh	no	no	yes

[a] Entries in the Download column are as follows. For modes labeled yes, the application client delivers microcode in the WRITE BUFFER command(s). For modes labeled no, the application client does not deliver microcode with the WRITE BUFFER command.

[b] Entries in the Save column are as follows. For modes labeled yes, the device server shall save the microcode to nonvolatile storage for use after each subsequent power on or hard reset, and shall not return GOOD status for the final command in the WRITE BUFFER sequence (i.e., the series of WRITE BUFFER commands that downloads the microcode) until the microcode has been saved. For modes labeled no, the device server shall discard the microcode on the next power on or hard reset.

[c] Entries in the Activate column are as follows. For modes labeled yes, the device server shall activate the microcode (see 5.5.2) after completion of the final command in the WRITE BUFFER sequence (i.e., the series of WRITE BUFFER commands that downloads the microcode and activates it). For modes labeled optional, the device server may or may not activate the microcode image upon completion of the final command in the WRITE BUFFER sequence. For modes labeled no, the device server shall not activate the microcode upon completion of the final command in the WRITE BUFFER sequence.

[d] The application client delivers microcode in a vendor specific number of WRITE BUFFER commands (i.e., a WRITE BUFFER sequence). The device server should require that the microcode be delivered in a single command. The device server shall perform any required verification of the microcode prior to returning GOOD status for the final WRITE BUFFER command in a sequence (i.e., the WRITE BUFFER command delivering the last part of the microcode).

[e] The application client delivers microcode in one or more WRITE BUFFER commands, specifying a buffer ID and buffer offset in each command. If the device server does not receive all the WRITE BUFFER commands required to deliver the complete microcode before a logical unit reset occurs, an I_T nexus loss occurs, or a WRITE BUFFER command specifying a different download microcode mode is processed, then the device server shall discard the new microcode. If the device server determines that it is processing the final WRITE BUFFER command (i.e., the WRITE BUFFER command delivering the last part of the microcode), then the device server:
   1) shall perform any required verification of the microcode prior to returning GOOD status for the command; and
   2) should return sense data containing a sense key set to COMPLETED, the additional sense code set to DEFERRED MICROCODE IS PENDING, and if the MODE field of the final WRITE BUFFER command is set to 0Dh or 0Eh and the D_SENSE bit (see 7.5.13) is set to one, then a microcode activation sense data descriptor (see 4.4.2.9).

[f] Microcode downloaded with this mode is defined as deferred microcode.

[g] Support for mode 0Fh is mandatory if either mode 0Dh or mode 0Eh is supported.

Table 54 summarizes how the WRITE BUFFER download microcode modes process the BUFFER ID field, the BUFFER OFFSET field, and the PARAMETER LIST LENGTH field in the WRITE BUFFER CDB.

Table 54 – WRITE BUFFER download microcode field processing

Mode	Code	BUFFER ID field, BUFFER OFFSET field, and PARAMETER LIST LENGTH field processing
Download microcode and activate	04h	6.49.4
Download microcode, save, and activate	05h	6.49.5
Download microcode with offsets and activate	06h	6.49.6
Download microcode with offsets, save, and activate	07h	6.49.7
Download microcode with offsets, select activation events, save, and defer activate	0Dh	6.49.9
Download microcode with offsets, save, and defer activate	0Eh	6.49.10
Activate deferred microcode	0Fh	6.49.11

If the device server is unable to process a WRITE BUFFER command with a download microcode mode because of a vendor specific condition (e.g., the device server requires the microcode be delivered in order, and the BUFFER OFFSET field is not equal to the contents of the previous WRITE BUFFER command's BUFFER OFFSET field plus the contents of the previous WRITE BUFFER command's PARAMETER LIST LENGTH field), then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to COMMAND SEQUENCE ERROR.

If the device server detects a digital signature validation failure while processing a WRITE BUFFER command that downloads microcode, it shall terminate the command with CHECK CONDITION status, with the sense key set to ABORTED COMMAND, and the additional sense code set to DIGITAL SIGNATURE VALIDATION FAILURE.

While processing a WRITE BUFFER command that downloads and defers activation of microcode, if a device server that supports microcode digital signature validation is not able to perform validation of the digital signature (e.g., digital signature validation is deferred), then the device server may establish an informational exception condition with the additional sense code set to WARNING - MICROCODE SECURITY AT RISK.

If a WRITE BUFFER command specifies a non-zero value in the BUFFER OFFSET field and the MODE field is:

    a)   07h, 0Dh, or 0Eh; and
    b)   different than the MODE field in the first WRITE BUFFER command of this WRITE BUFFER sequence,

then the device server should terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST. The additional sense code:

    a)   should be set to COMMAND SEQUENCE ERROR; or
    b)   may be set to INVALID FIELD IN CDB.

The MULTI I_T NEXUS MICROCODE DOWNLOAD field (see table 53) in the Extended INQUIRY Data VPD page (see 7.7.7) indicates how the device server handles concurrent attempts to download microcode using the WRITE BUFFER command download microcode modes from multiple I_T nexuses.

Table 55 – MULTI I_T NEXUS MICROCODE DOWNLOAD field (part 1 of 2)

Code	Description
0h	The handling of concurrent WRITE BUFFER download microcode operations from multiple I_T nexus is vendor specific.
1h	For modes that download microcode (see table 53), the device server shall: a) if a WRITE BUFFER command with the BUFFER OFFSET field set to zero is received on any I_T nexus, then the command shall be processed as described elsewhere in this subclause. This shall establish the I_T nexus for the WRITE BUFFER sequence, and cause any microcode downloaded on another I_T nexus to be discarded; b) if a WRITE BUFFER command with the BUFFER OFFSET field set to a non-zero value is received on the established I_T nexus for the WRITE BUFFER sequence, then the command shall be processed as described elsewhere in this subclause; and c) if a WRITE BUFFER command with the BUFFER OFFSET field set to a non-zero value is received on an I_T nexus that is different from the established I_T nexus for the WRITE BUFFER sequence, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to COMMAND SEQUENCE ERROR. The WRITE BUFFER sequence for the established I_T nexus should not be affected. If a WRITE BUFFER command with mode 0Fh (i.e., activate deferred microcode) is received on an I_T nexus that is different from the established I_T nexus for the WRITE BUFFER sequence, then the device server shall terminate the WRITE BUFFER command with mode 0Fh with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to COMMAND SEQUENCE ERROR. Any deferred microcode shall not be invalidated.
2h	For modes that download microcode (see table 53), the device server shall allow concurrent sequences of WRITE BUFFER commands to be processed as described elsewhere in this subclause on more than one I_T nexus. If a WRITE BUFFER command with mode 0Fh (i.e., activate deferred microcode) is received on an I_T nexus that is different from the established I_T nexus for the WRITE BUFFER sequence, then the device server shall process the command as described elsewhere in this subclause.

Table 55 – MULTI I_T NEXUS MICROCODE DOWNLOAD field (part 2 of 2)

Code	Description

3h	For modes that download microcode (see table 53), the device server shall:
	   a) if a WRITE BUFFER command with the BUFFER OFFSET field set to zero is received on any I_T nexus, then the command shall be processed as described elsewhere in this subclause. This shall establish the I_T nexus for the WRITE BUFFER sequence, and cause any microcode downloaded on another I_T nexus to be discarded;
	   b) if a WRITE BUFFER command with the BUFFER OFFSET field set to a non-zero value is received on the established I_T nexus for the WRITE BUFFER sequence, then the command shall be processed as described elsewhere in this subclause; and
	   c) if a WRITE BUFFER command with the BUFFER OFFSET field set to a non-zero value is received on an I_T nexus that is different from the established I_T nexus for the WRITE BUFFER sequence, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to COMMAND SEQUENCE ERROR. The WRITE BUFFER sequence for the established I_T nexus should not be affected.
	
	If a WRITE BUFFER command with mode 0Fh (i.e., activate deferred microcode) is received on an I_T nexus that is different from the established I_T nexus for the WRITE BUFFER sequence, then the device server shall process the command as described elsewhere in this subclause.

4h to Fh	Reserved

For all WRITE BUFFER command modes that download microcode (see table 53), the COMMAND SPECIFIC field (see 6.32.4.2) located in the command timeouts descriptor of the parameter data returned by the REPORT SUPPORTED OPERATION CODES command (see 6.32) indicates the maximum time that access to the SCSI target device is limited or not possible through any SCSI ports associated with a logical unit that processes a WRITE BUFFER command that activates microcode.

5.5.2 Activating microcode

If the SCSI target device contains multiple logical units, the activation of microcode by one logical unit may change the microcode for other logical units in that SCSI target device.

Activating microcode for a logical unit may result in:

   a) a hard reset; or
   b) a logical unit reset for each logical unit affected by the microcode download (i.e., logical units that activated microcode or logical units that processed a logical unit reset due to another logical unit activated microcode).

Deferred microcode that contains a digital signature that was not validated during microcode download (see 5.5.1) shall be validated before that microcode is activated. If:

   a) the device server is not able to validate the digital signature; and
   b) microcode with a digital signature that has not been validated is requested to be activated as a result of:

  A) a power on or a hard reset, then the device server shall establish an informational exception condition with the additional sense code set to WARNING - MICROCODE DIGITAL SIGNATURE VALIDATION FAILURE; or

  B) a command that is:

    a) a WRITE BUFFER command with a mode that activates deferred microcode (i.e., mode 0Fh (see 6.49.11)); or

    b) a command defined as causing deferred microcode to be activated (e.g., the FORMAT UNIT command and the START STOP UNIT command (see SBC-5)),

  then the device server shall terminate the command with CHECK CONDITION status with the sense key set to ABORTED COMMAND, and the additional sense code set to DIGITAL SIGNATURE VALIDATION FAILURE.

If microcode is activated due to processing a WRITE BUFFER command with a mode that requires activation after processing (i.e., modes 04h (see 6.49.4), 06h (see 6.49.6), and 0Fh (see 6.49.11)), then:

  a) if the microcode activation resulted in a hard reset or resulted in a logical unit reset, the device server shall establish a unit attention condition (see SAM-6) for the SCSI initiator port associated with every I_T nexus affected by the microcode activation except the I_T nexus on which the WRITE BUFFER command was received with the additional sense code set to MICROCODE HAS BEEN CHANGED; or

  b) if the microcode activation did not result in a hard reset and did not result in a logical unit reset, the device server shall establish a unit attention condition for the SCSI initiator port associated with every I_T nexus affected by the microcode activation with the additional sense code set to MICROCODE HAS BEEN CHANGED WITHOUT RESET.

If microcode is activated due to processing a WRITE BUFFER command with a mode that may cause activation after processing (i.e., for modes 05h (see 6.49.5) and 07h (see 6.49.7)), then the device server shall establish a unit attention condition (see SAM-6) based on the setting of the ACTIVATE MICROCODE field in the Extended INQUIRY VPD page (see 7.7.7).

If microcode is activated as a result of a power on or as a result of a hard reset, the device server may establish a unit attention condition (see SAM-6) for the SCSI initiator port associated with every I_T nexus with the additional sense code set to MICROCODE HAS BEEN CHANGED in addition to the unit attention condition for the power on or hard reset.

If deferred microcode (see table 53) is activated due to a command defined by its command standard as causing deferred microcode to be activated (e.g., the FORMAT UNIT command and the START STOP UNIT command (see SBC-5)), then the device server:

  a) shall establish a unit attention condition (see SAM-6) for the SCSI initiator port associated with every I_T nexus affected by the microcode activation:

    A) if the microcode activation resulted in a hard reset or resulted in a logical unit reset, the additional sense code for the established unit attention shall be set to MICROCODE HAS BEEN CHANGED; or

    B) if the microcode activation did not result in a hard reset and did not result in a logical unit reset, the additional sense code for the established unit attention shall be set to MICROCODE HAS BEEN CHANGED WITHOUT RESET;

    and

  b) may establish other unit attention condition(s) as defined for the command (e.g., CAPACITY DATA HAS CHANGED for the FORMAT UNIT command).

If new microcode is saved before deferred microcode is activated, then that deferred microcode is not activated.

5.5.3 Download microcode status

SCSI target device implementations may support reporting status information about the microcode and microcode downloads in progress using the READ BUFFER command (see 6.18).

5.6 Error history

5.6.1 Error history overview

Error history is data collected by a logical unit to aid in troubleshooting errors.

The types of error history data are described in table 56.

Table 56 – Error history types

BUFFER FORMAT field [a]	EHS_SOURCE field [b]	Description
00h	00b	Vendor specific data created by the device server
	01b to 10b	Vendor specific data created at the request of an application client using a READ BUFFER command
	11b	Reserved
01h	00b	Reserved
	01b to 11b	Current internal status data (see 6.18.8.3.2) created at the request of an application client using a READ BUFFER command
02h	00b	Saved internal status data (see 6.18.8.3.3) created by the device server
	01b to 10b	Reserved
	11b	Saved internal status data created by the device server
all others	00b to 10b	Reserved
[a] See the error history directory entry definition in table 215.		
[b] See the error history directory definition in table 212.		

The READ BUFFER command (see 6.18) provides a method for retrieving error history (see 5.6.2) from the logical unit.

The WRITE BUFFER command (see 6.49) provides a method for inserting application client error history into the error history (see 5.6.5) and for clearing the error history (see 5.6.6).

The format of the application client error history is defined by the manufacturer of the application client. The format of the error history, including how the application client error history, if any, is incorporated into the error history, is defined by the manufacturer of the logical unit.

If the device server supports saved internal status data (see table 56), the device server shall maintain:

    a) a generation number for the saved internal status parameter data (see 6.18.8.3.3) as an 8-bit wrapping counter that persists across power cycles, hard resets, and logical unit resets; and

b) the NEW SAVED DATA AVAILABLE field in the saved internal status parameter data (see 6.18.8.3.3) that indicates if saved internal status data has changed since it was last retrieved as described in 5.6.2.

If the device server creates saved internal status data, the device server shall perform the following as an uninterrupted series of actions:

a) create internal status data;
b) increment the generation number value of the saved internal status parameter data (see 6.18.8.3.3); and
c) set the NEW SAVED DATA AVAILABLE field to 01h in the saved internal status parameter data.

If any saved internal status data is retrieved as described in 5.6.2, the device server shall set the NEW SAVED DATA AVAILABLE field to 00h in the saved internal status parameter data.

If the device server creates saved internal status data as a result of a condition that is capable of resulting in the establishment of a unit attention with the additional sense code set to DEVICE INTERNAL RESET (see SAM-6), then the device server should establish a unit attention condition for the SCSI initiator port associated with every I_T nexus with the additional sense code set to DEVICE INTERNAL RESET.

5.6.2 Retrieving error history with the READ BUFFER command

Device servers may allow the error history to be retrieved using a sequence of READ BUFFER commands on one I_T nexus.

Error history is returned using error history snapshots. An error history snapshot is the contents of the error history at a specific point in time, created by the device server at vendor specific times or requested by the application client using the READ BUFFER command with certain buffer IDs.

The I_T nexus being used to retrieve an error history snapshot is called the error history I_T nexus. Only one I_T nexus at a time is allowed to be the error history I_T nexus, and only the error history I_T nexus is allowed to retrieve an error history snapshot.

To retrieve the complete error history, an application client uses one I_T nexus to:

1) create an error history snapshot if one does not already exist, establish the I_T nexus as the error history I_T nexus, and retrieve the error history directory by sending a READ BUFFER command (see 6.18.8.2) with:
   A) the MODE field set to 1Ch (i.e., error history);
   B) the BUFFER ID field set to one of the following:
      a) If the error history I_T nexus is expected to be valid:
         A) 00h (i.e., return error history directory); or
         B) 01h (i.e., return error history directory and create new snapshot);
      b) if the application client has knowledge obtained by means outside the scope of this standard that the error history I_T nexus is no longer valid:
         A) 02h (i.e., return error history directory and establish new error history I_T nexus); or
         B) 03h (i.e., return error history directory, establish new error history I_T nexus, and create new snapshot);
   C) the BUFFER OFFSET field set to 000000h; and
   D) the ALLOCATION LENGTH field set to at least 2 088 (i.e., large enough to transfer the complete error history directory);
2) retrieve the error history. The application client uses a Data-In Buffer size that is a multiple of the offset boundary indicated in the READ BUFFER descriptor (see 6.18.4). For each buffer ID indicated in the error history directory in the range of 10h to EFh, the application client sends one or more

READ BUFFER commands (see 6.18.8.3) as follows:
1) send the first READ BUFFER command with:
   a) the MODE field set to 1Ch (i.e., error history);
   b) the BUFFER ID field set to the buffer ID (i.e., an error history data buffer);
   c) the BUFFER OFFSET field set to 000000h; and
   d) the ALLOCATION LENGTH field set to the size of the Data-In Buffer;
   and
2) until the number of bytes returned by the previous READ BUFFER command does not equal the specified allocation length and/or the total number of bytes returned from the buffer ID equals the maximum available length indicated in the error history directory, send zero or more additional READ BUFFER commands with:
   a) the MODE field set to 1Ch (i.e., error history);
   b) the BUFFER ID field set to the buffer ID (i.e., an error history data buffer);
   c) the BUFFER OFFSET field set to the previous buffer offset plus the previous allocation length; and
   d) the ALLOCATION LENGTH field set to the size of the Data-In Buffer;
   and
3) clear the error history I_T nexus and, depending on the buffer ID, release the error history snapshot by sending a READ BUFFER command with:
   A) the MODE field set to 1Ch (i.e., error history);
   B) the BUFFER ID field set to:
      a) FEh (i.e., clear error history I_T nexus) (see 6.18.8.4); or
      b) FFh (i.e., clear error history I_T nexus and release snapshot) (see 6.18.8.5);
   C) the BUFFER OFFSET field set to any value allowed by table 209 (see 6.18.8.1) (e.g., 000000h); and
   D) the ALLOCATION LENGTH field set to any value allowed for the chosen BUFFER ID field value (see 6.18.8.4 or 6.18.8.5) (e.g., 000000h).

While an error history snapshot exists, the device server:

a) shall not modify the error history snapshot to reflect any changes to the error history;
b) may or may not record events that are detected into the error history; and
c) if the device server supports the WRITE BUFFER command download application client error history mode (see 6.49.12), shall record the specified application client error history into the error history.

5.6.3 Error history I_T nexus clearing actions

The device server shall clear the established error history I_T nexus:

a) upon processing of a READ BUFFER command on the error history I_T nexus with:
   A) the MODE field set to 1Ch (i.e., error history); and
   B) the BUFFER ID field set to FEh (i.e., clear error history I_T nexus) (see 6.18.8.4);
b) if an I_T nexus loss occurs on the error history I_T nexus;
c) upon processing of a READ BUFFER command using the same I_T nexus that was used to establish the snapshot with:
   A) the MODE field set to 1Ch (i.e., error history); and
   B) the BUFFER ID field set to FFh (i.e., clear error history I_T nexus and release snapshot) (see 6.18.8.5);
d) if a power on occurs;
e) if a hard reset occurs; or
f) if a logical unit reset occurs.

5.6.4 Error history snapshot releasing actions

The releasing effects for error history snapshots are shown in table 57 based on combinations of the type of error history snapshot as indicated by the contents of BUFFER FORMAT field in the error history directory entry (see table 215), the value of the HSSRELEF bit in the Extended INQUIRY Data VPD page (see 7.7.7), and specified causes.

Table 57 – Error history snapshot releasing effects (part 1 of 3)

Cause	Effect if the HSSRELEF bit [a] is set to	
	one (i.e., alternate reset handling)	**zero** (i.e., normal reset handling)
Buffer format 00h (i.e., vendor specific data)		
The device server processes a READ BUFFER command on the error history I_T nexus with: 　a)　the MODE field set to 1Ch (i.e., error history); and 　b)　the BUFFER ID field set to FEh (i.e., clear error history I_T nexus) (see 6.18.8.4).	The device server shall not release error history snapshots.	
The device server processes a READ BUFFER command using the same I_T nexus that was used to establish the snapshot with: 　a)　the MODE field set to 1Ch (i.e., error history); and 　b)　the BUFFER ID field set to FFh (i.e., clear error history I_T nexus and release snapshot) (see 6.18.8.5).	The device server shall release the error history snapshot.	
An I_T nexus loss occurs on the error history I_T nexus.	The device server shall not release error history snapshots.	
A hard reset occurs.	The device server shall not release an error history snapshot.	The device server shall release the error history snapshot.
A power on occurs.		
A logical unit reset occurs.		
A download microcode activation occurs.	The device server may release the error history snapshot.	
[a] Defined in the Extended INQUIRY Data VPD page (see 7.7.7).		

Table 57 – Error history snapshot releasing effects (part 2 of 3)

Cause	Effect if the HSSRELEF bit [a] is set to	
	one (i.e., alternate reset handling)	**zero** (i.e., normal reset handling)
Buffer format 01h (i.e., current internal status data)		
The device server processes a READ BUFFER command on the error history I_T nexus with: a) the MODE field set to 1Ch (i.e., error history); and b) the BUFFER ID field set to FEh (i.e., clear error history I_T nexus) (see 6.18.8.4).	The device server shall not release error history snapshots.	
The device server processes a READ BUFFER command using the same I_T nexus that was used to establish the snapshot with: a) the MODE field set to 1Ch (i.e., error history); and b) the BUFFER ID field set to FFh (i.e., clear error history I_T nexus and release snapshot) (see 6.18.8.5).	The device server shall release the error history snapshot.	
An I_T nexus loss occurs on the error history I_T nexus.	The device server shall not release error history snapshots.	The device server may release the error history snapshot.
A hard reset occurs.	The device server may release the error history snapshot.	
A power on occurs.		
A logical unit reset occurs.		
The device server creates a new current internal status error history snapshot during the processing of a READ BUFFER command on the error history I_T nexus with: a) the MODE field being set to 1Ch (i.e., error history); b) the BUFFER ID field being set to 01h or 03h; and c) the MODE SPECIFIC field being set to 001b.		
A download microcode activation occurs.		
[a] Defined in the Extended INQUIRY Data VPD page (see 7.7.7).		

Table 57 – Error history snapshot releasing effects (part 3 of 3)

Cause	Effect if the HSSRELEF bit [a] is set to	
	one (i.e., alternate reset handling)	**zero** (i.e., normal reset handling)
Buffer format 02h (i.e., saved internal status data)		

The device server processes a READ BUFFER command on the error history I_T nexus with:
   a) the MODE field set to 1Ch (i.e., error history); and
   b) the BUFFER ID field set to FEh (i.e., clear error history I_T nexus) (see 6.18.8.4).
	The device server shall not release error history snapshots.	

The device server processes a READ BUFFER command using the same I_T nexus that was used to establish the snapshot with:
   a) the MODE field set to 1Ch (i.e., error history); and
   b) the BUFFER ID field set to FFh (i.e., clear error history I_T nexus and release snapshot) (see 6.18.8.5).
	The device server shall release the error history snapshot.	

An I_T nexus loss occurs on the error history I_T nexus.	The device server shall not release error history snapshots.	The device server may release the error history snapshot.
A hard reset occurs.		
A power on occurs.		
A logical unit reset occurs.		
The device server creates a new saved internal status error history snapshot (i.e., an error history snapshot with the BUFFER FORMAT field set to 02h in the error history directory entry (see table 215)).	The device server may release the error history snapshot.	
A download microcode activation occurs.		
[a] Defined in the Extended INQUIRY Data VPD page (see 7.7.7).		

The device server shall not replace or release the error history snapshot while the error history I_T nexus is established unless otherwise specified.

The device server shall implement a vendor specific timer for error history snapshot retrieval. If the vendor specific timer expires, then:

  a) the device server shall:
    A) clear the error history I_T nexus; and
    B) establish a unit attention condition for the error history I_T nexus with the additional sense code set to ERROR HISTORY I_T NEXUS CLEARED;
    or
  b) the device server shall:
    A) clear the error history I_T nexus;
    B) release the error history snapshot; and
    C) establish a unit attention condition for the error history I_T nexus with the additional sense code set to ERROR HISTORY SNAPSHOT RELEASED.

After an error history snapshot is released, the device server shall resume recording error history for events that are detected.

5.6.5 Adding application client error history with the WRITE BUFFER command

An application client adds application client detected error history to the error history collected by a logical unit using a WRITE BUFFER command with the MODE field set to 1Ch (see 6.49.12). The application client error history:

a) may be recovered:
   A) as part of the error history (see 5.6.2); or
   B) by means outside the scope of this standard;
   and
b) is not used for any logical unit related error recovery.

Error history that contains a mix of application client error history and logical unit error history may be used to correlate an application client-detected error with errors detected internally by the logical unit.

Application clients should minimize the amount of error history they store to prevent error history overflows (see 6.49.12).

5.6.6 Clearing error history with the WRITE BUFFER command

An application client clears the portions of the error history that the device server allows to be cleared by sending a WRITE BUFFER command (see 6.49.12) with:

a) the MODE field set to 1Ch (i.e., download error history);
b) the PARAMETER LIST LENGTH field set to 00001Ah;
c) in the parameter list, the CLR bit set to one; and
d) all other fields in the parameter list set as 6.49.12 describes.

Clearing error history shall not:

a) clear the error history I_T nexus, if any; or
b) release the error history snapshot, if any, if it was created with the READ BUFFER command (see 5.6.2).

5.7 Identifying information

The REPORT IDENTIFYING INFORMATION command (see 6.29) and SET IDENTIFYING INFORMATION command (see 6.41) allow an application client to maintain one or more sets of identifying information associated with the logical unit.

Identifying information shall persist through power cycles (i.e., be stored in nonvolatile storage), hard resets, logical unit resets, I_T nexus losses, media format operations, and media replacement.

Table 58 defines the identifying information types.

Table 58 – Identifying information types

Identifying information type	Length	Support [a]
Logical unit identifying information: a value describing the logical unit (e.g., an operating system volume label)	0 to 64 bytes	Mandatory
	65 to 512 bytes	Optional
Logical unit text identifying information: a null-terminated (see 4.3.2) UTF-8 format string providing an informational description of the logical unit (e.g., a descriptive string entered by a system administrator)	0 to 256 bytes	Optional
[a] These support requirements shall apply only if the REPORT IDENTIFYING INFORMATION command and/or SET IDENTIFYING INFORMATION command are implemented.		

Identifying information is changed by:

a) the SET IDENTIFYING INFORMATION command; or
b) a mechanism outside the scope of this standard (e.g., a system administrator may be able to change identifying information through a management interface).

If a mechanism outside the scope of this standard changes the identifying information, then the device server shall establish a unit attention condition for the SCSI initiator port associated with every I_T nexus with the additional sense code set to DEVICE IDENTIFIER CHANGED.

5.8 Logical Unit Bind and Unbind

5.8.1 Binding overview

A binding is:

a) a relationship between:
    A) a subsidiary logical unit;
    B) an administrative logical unit; and
    C) an application client;
b) one or more I_T_L nexuses that allows:
    A) an application client to send requests using one or more SCSI initiator ports;
    B) the logical unit to receive requests using one or more target ports; and
    C) the logical unit's device server to be accessible using one or more LUNs;
    and
c) identified by:

A) the logical unit name (see 7.7.6.2.1) of a subsidiary logical unit;
B) the logical unit name of an administrative logical unit; and
C) the host bind identifier (see 5.8.2) specified by the application client.

A bind operation (see 5.8.9) creates a binding. A bind operation is:

a) an explicit bind operation that is requested by an application client by sending a BIND command (see 6.2) to an administrative logical unit; or
b) an implicit bind operation that is requested by a device server for reasons outside the scope of this standard.

After a successful bind operation:

a) the subsidiary logical unit's device server is accessible to the application client on at least one of the I_T nexuses on which the application client is able to access the administrative logical unit to which that subsidiary logical unit is bound; and
b) the media may or may not be accessible.

An unbind operation (see 5.8.10) removes a binding relationship between a subsidiary logical unit, the administrative logical unit to which that subsidiary logical unit is bound, and the application client. An unbind operation is requested by an application client by sending the UNBIND command (see 6.47) to a subsidiary logical unit.

An implicit bind operation (see 5.8.11) is a bind operation that:

a) adds an additional binding; and
b) is performed by a subsidiary logical unit using a host bind identifier (see 5.8.2) from a previous application client requested bind operation.

If the device server supports bindings, the bind support byte (see 7.7.7) shall not be set to zero.

If the bind support byte is set to zero, the device server:

a) shall not perform any of the operations described in this subclause; and
b) shall terminate the BIND command (see 6.2), the SET AFFILIATION command (see 6.40), and the UNBIND command (see 6.47) with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID COMMAND OPERATION CODE.

5.8.2 Host bind identifier

Host bind identifiers (see SAM-6) identify bindings. A set of saved host bind identifiers shall be maintained for each S_A binding pair. The set of saved host bind identifiers shall consist of one host bind identifier for each binding (i.e., each combination of subsidiary logical unit, administrative logical unit, and unique host bind identifier). An application client uses host bind identifiers to specify the binding on which a function is to be performed as follows:

a) the application client specifies the host bind identifier by which the binding is to be identified in the parameter list of the BIND command (see 6.2) that establishes the binding; and
b) subsequent to completion of the BIND command, the application client specifies the same host bind identifier in:
A) every command that references the binding: and
B) the UNBIND command (see 6.47) that removes the binding.

The application client should specify the host bind identifier as a UUID or a GUID as defined by ISO/IEC 9834-8 and RFC 4122.

If unique identification is not required by the application client, then the application client should specify a host bind identifier that is set to zero.

5.8.3 Binding persistence requirements

Host bind identifiers are specified in a HOST BIND IDENTIFIER field (see 6.2 and 6.47) and shall be preserved from the time a binding is established to the time the binding is removed.

A binding for a subsidiary logical unit shall be preserved until processing of a subsequent UNBIND command unbinds the subsidiary logical unit or the subsidiary logical unit is unbound by means outside the scope of this standard.

5.8.4 Unbound subsidiary logical unit persistence requirements

An unbound subsidiary logical unit shall preserve logical block data (see SBC-5) across all events (see SAM-6).

5.8.5 Binding unit attention conditions related to subsidiary logical unit inventory changes

If a subsidiary logical unit LUN becomes accessible on any I_T nexus as a result of performing a bind operation, then the subsidiary logical unit's device server shall establish a unit attention condition for the SCSI initiator port associated with every I_T nexus on which the subsidiary logical unit becomes accessible, except the I_T nexus on which the BIND command (see 6.2), if any, was received, with the additional sense code set to REPORTED LUNS DATA HAS CHANGED.

If a subsidiary logical unit LUN becomes inaccessible (i.e., the LUN becomes an incorrect logical unit number (see SAM-6)) on any I_T nexus as a result of an UNBIND command, then the subsidiary logical unit's device server shall establish a unit attention condition for the SCSI initiator port associated with every I_T nexus on which the subsidiary logical unit becomes inaccessible, except the I_T nexus on which the UNBIND command was received, with the additional sense code set to REPORTED LUNS DATA HAS CHANGED.

5.8.6 Affiliation

Device servers use affiliation to indicate the condition of relationships that are internal to the SCSI target device (e.g., logical units that share resources). Logical units that share resources may be affiliated. Application clients that send commands to a subsidiary logical unit should use LUNs that are associated with an administrative logical unit with which that subsidiary logical unit is affiliated.

If a subsidiary logical unit is affiliated with the administrative logical unit in a logical unit conglomerate of which the subsidiary is a member, then that subsidiary logical unit shares primary target port asymmetric access states with the administrative logical unit.

This standard defines the following affiliations:

    a) a relationship between a subsidiary logical unit and an administrative logical unit; and
    b) a relationship between a subsidiary logical unit and a logical unit conglomerate.

The device server may terminate a command that requests access to the media with CHECK CONDITION status, with the sense key set to NOT READY, the additional sense code set to LOGICAL UNIT NOT READY, AFFILIATION REQUIRED, the COMMAND-SPECIFIC INFORMATION field set as described in 5.8.8.1, and administrative logical unit identification information set as described in 5.8.8.3, if:

a) that command is addressed to the LUN of a subsidiary logical unit that is associated with an administrative logical unit with which the specified subsidiary logical unit is not affiliated; and
b) the device server is not able to access the media due to that affiliation condition.

Affiliations may be managed explicitly by an application client using the SET AFFILIATION command (see 6.40). Affiliations may be managed implicitly by the SCSI target device based on the type of transactions being routed through each target port and the internal configuration capabilities of the SCSI target device.

5.8.7 Bindings and affiliations

The SET AFFILIATION command (see 6.40) requests that the subsidiary logical unit addressed by the specified LUN have its affiliation to a logical unit collection changed by:

a) changing the subsidiary logical unit's affiliation to be with the specified administrative logical unit; and
b) setting the subsidiary logical unit's logical unit group designator (see 7.7.6.9), if any, to match the logical unit group designator of the specified administrative logical unit (i.e., if the logical unit group designator does not match the logical unit group designator, if any, for the specified administrative logical unit, then change the logical unit group designator returned by the subsidiary logical unit).

During the time when a subsidiary logical unit's device server is changing an affiliation, the device server may terminate commands with CHECK CONDITION status, with the sense key set to NOT READY and the additional sense code set to LOGICAL UNIT NOT READY, CONFIGURATION IN PROGRESS until the process of changing the affiliation completes.

As a result of changing an affiliation, the device server may:

a) change the primary target port group asymmetric access states of the subsidiary logical unit to match the primary target port group asymmetric access states of the specified administrative logical unit;
b) change the logical unit group of which the subsidiary logical unit is a member as described in 5.18.2.2; and
c) change the logical unit group designator (see 7.7.6.9) returned by the subsidiary logical unit as described in 5.18.2.2.6.

If the device server is not able to change the affiliation, then the device server shall terminate the SET AFFIL-IATION command with CHECK CONDITION status, with the sense key set to NOT READY and the additional sense code set to COMMAND REJECTED.

5.8.8 Notifications and sense data

5.8.8.1 Logical unit collection information in sense data

If logical unit collection information is returned in sense data and the subsidiary logical unit:

a) returns a logical unit group designator, then the device server shall set the COMMAND-SPECIFIC INFORMATION field to the logical unit group designator of an administrative logical unit with which the subsidiary logical unit is affiliated; or

b) does not return a logical unit group designator, then the device server shall set the COMMAND-SPECIFIC INFORMATION field to zero.

5.8.8.2 Affiliation condition and LUN information

5.8.8.2.1 Overview

A device server may return the affiliation condition and LUN information in a binding descriptor (see 6.21).

A device server may use the sense data INFORMATION field (see 4.4) to return the affiliation condition of the LUN used to access the logical unit and LUN information based on the formats shown in:

a) 5.8.8.2.4, for descriptor format sense data; and
b) 5.8.8.2.5, for fixed format sense data.

A device server may return:

a) only the affiliation condition as defined in 5.8.8.2.2; or
b) the affiliation condition and LUN information as defined in 5.8.8.2.3.

If LUN information is returned, the LUN information does not indicate the LUN for a specific subsidiary logical unit. The returned LUN information that is sufficient to describe the subsidiary logical unit is copied from only one part of the specific subsidiary logical unit's LUN (see 5.8.8.2.3).

Formatting the INFORMATION field as defined in 5.8.8.2 allows the application client to construct a LUN for the subsidiary logical unit by combining the subsidiary element contained in the SLUN field with an administrative element for the appropriate administrative logical unit.

5.8.8.2.2 Returning affiliation condition only

This subclause describes how to return:

a) in a binding descriptor (see 6.21), the affiliation condition of a LUN described by that binding descriptor; and
b) in descriptor format sense data (see 5.8.8.2.4) and fixed format sense data (see 5.8.8.2.5), the affiliation condition of the LUN used to access the logical unit in the AFFILIATION CONDITION field and not return LUN information in the SLUN field.

If the subsidiary logical unit being accessed:

a) is affiliated with the administrative logical unit associated with the LUN used to access the subsidiary logical unit, then the device server shall set the AFFILIATION CONDITION field to FF01h;
b) is not affiliated with the administrative logical unit associated with the LUN used to access the subsidiary logical unit and is affiliated with a different administrative logical unit, then the device server shall set the AFFILIATION CONDITION field to FF02; and
c) is not affiliated with any administrative logical unit, then the device server shall set the AFFILIATION CONDITION field to FF03h.

If fixed format sense data is being returned, the device server shall set the SLUN field to FFFFh. If descriptor format sense data is being returned, the device server shall set the SLUN field to FFFF FFFF FFFFh.

5.8.8.2.3 Returning affiliation condition and LUN information

This subclause describes how to return:

    a) in a binding descriptor (see 6.21), the LUN information for that binding descriptor; and
    b) in descriptor format sense data (see 5.8.8.2.4) and fixed format sense data (see 5.8.8.2.5), the affiliation condition of the LUN used to access the logical unit in the AFFILIATION CONDITION field and LUN information (see 5.8.8.2.1) in the SLUN field.

The device server shall set the AFFILIATION CONDITION field as described in 5.8.8.2.2.

If fixed format sense data is being returned and the SUBSIDIARY ELEMENT field (see SAM-6) of the LUN to be described is:

    a) two bytes in length, then the device server shall set the SLUN field to the two bytes of the SUBSIDIARY ELEMENT field (see SAM-6) of the LUN being described; or
    b) larger than two bytes in length, then the device server shall set the SLUN field to FFFFh.

If:

    a) a binding descriptor or descriptor format sense data is being returned; and
    b) the SUBSIDIARY ELEMENT field (see SAM-6) of the LUN to be described is:
        A) two bytes in length, then the device server shall set:
            a) the most significant two bytes of the SLUN field to the two bytes of the SUBSIDIARY ELEMENT field (see SAM-6) of the LUN being described; and
            b) the least significant four bytes of the SLUN field to zero;
        B) four bytes in length, then the device server shall set:
            a) the most significant four bytes of the SLUN field to the four bytes of the SUBSIDIARY ELEMENT field (see SAM-6) of the LUN being described; and
            b) the least significant two bytes of the SLUN field to zero;
            or
        C) six bytes in length, then the device server shall set the SLUN field to the six bytes of the SUBSIDIARY ELEMENT field (see SAM-6) of the LUN being described.

5.8.8.2.4 Descriptor format sense data for affiliation condition and LUN information

If affiliation condition and LUN information is being returned in descriptor format sense data, table 59 shows the format of the INFORMATION field.

Table 59 – INFORMATION field contents for descriptor format sense data that contains affiliation condition and LUN information

Bit / Byte	7	6	5	4	3	2	1	0
0	(MSB)							
1			AFFILIATION CONDITION					(LSB)
2	(MSB)							
•••			SLUN					
7								(LSB)

The AFFILIATION CONDITION field indicates the condition of the affiliation between the subsidiary logical unit being accessed and the administrative logical unit associated with the LUN used to address the subsidiary logical unit (i.e., the LUN from which the sense data is being returned) and is set as defined in 5.8.8.2.2.

The SLUN field indicates the subsidiary element portion of a LUN, if any, that is being described (see 5.8.8.2.1) and is set as defined in 5.8.8.2.2 or 5.8.8.2.3.

5.8.8.2.5 Fixed format sense data for affiliation condition and LUN information

If affiliation condition and LUN information is being returned in fixed format sense data, table 60 shows the format of the INFORMATION field.

Table 60 – INFORMATION field contents for fixed format sense data that contains affiliation condition and LUN information

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
1				AFFILIATION CONDITION				(LSB)
2	(MSB)							
3				SLUN				(LSB)

The AFFILIATION CONDITION field and SLUN field are defined in 5.8.8.2.4.

5.8.8.3 Returning administrative logical unit identification information in sense data

If administrative logical unit identification information is returned in sense data and:

a) the subsidiary logical unit is not affiliated with any administrative logical unit, then the INFORMATION field shall be set as described in 5.8.8.2.2;
b) the subsidiary logical unit is affiliated with an administrative logical unit and the D_SENSE bit is set to zero, then the INFORMATION field shall be set as described in 5.8.8.2.2; and
c) the subsidiary logical unit is affiliated with an administrative logical unit and the D_SENSE bit is set to one (see 7.5.13), then descriptor format sense data shall contain:
   A) an information sense data descriptor (see 4.4.2.2) with the INFORMATION field set as described in 5.8.8.2.2 to describe a LUN that is associated with the administrative logical unit indicated in the device designation sense data descriptor; and
   B) a device designation sense data descriptor (see 4.4.2.8) that identifies an administrative logical unit with which the subsidiary logical unit is affiliated, with the DESCRIPTOR USAGE REASON field set to:
      a) 03h (see table 45) if the binding to this administrative logical unit is new (i.e., as a result of an implicit bind operation); or
      b) 04h (see table 45) if the binding to this administrative logical unit is not new.

5.8.8.4 Affiliation change notification

If the subsidiary logical unit's device server detects that it is no longer affiliated with the administrative logical unit associated with the LUN on which a command was received, then the subsidiary logical's device server may establish a unit attention condition (see SAM-6) on the I_T_L nexuses associated with that administrative logical unit with the additional sense code set to SUBSIDIARY BINDING CHANGED, the COMMAND-SPECIFIC INFORMATION field set as described in 5.8.8.1, and administrative logical unit identification information as described in 5.8.8.3.

The subsidiary logical unit's device server may establish a unit attention condition with the additional sense code set to SUBSIDIARY BINDING CHANGED as described in this subclause at a vendor specific time interval. In response to this unit attention condition the application client should send commands to a LUN that is associated with an administrative logical unit with which the subsidiary logical unit is affiliated.

5.8.8.5 Implicit bind notification

To establish an implicit bind notification, the subsidiary logical unit's device server may establish a unit attention condition (see SAM-6) for the SCSI initiator port associated with every I_T nexus that was present prior to the implicit bind operation with the additional sense code set to SUBSIDIARY BINDING CHANGED, the COMMAND-SPECIFIC INFORMATION field set as described in 5.8.8.1, and administrative logical unit identification information as described in 5.8.8.3.

The subsidiary logical unit's device server may establish a unit attention condition with the additional sense code set to SUBSIDIARY BINDING CHANGED as described in this subclause at a vendor specific time interval. In response to this unit attention condition the application client should send commands to a LUN that is associated with an administrative logical unit with which the subsidiary logical unit is affiliated.

5.8.9 Logical unit binding

5.8.9.1 Overview

The BIND command (see 6.2) requests that the administrative logical unit to which the command is sent assign a LUN and perform a bind operation for the specified subsidiary logical unit.

If an administrative logical unit's device server supports the BIND command, then the LU COLLECTION TYPE field (see 7.7.7) shall be set to 001b or 010b.

A BIND command shall not return completion status before the subsidiary logical unit becomes accessible (i.e., while the subsidiary logical unit is an incorrect logical unit (see SAM-6)).

The processing of a BIND command shall not change the affiliation of the subsidiary logical unit.

The administrative logical unit's device server shall return descriptor format sense data (see 4.4.2) upon completion or termination of a BIND command as described in 5.8.9.4 and 5.8.9.5.

A subsidiary logical unit may become bound by means outside the scope of this standard.

5.8.9.2 Subsidiary logical units not already bound to the logical unit processing the BIND command

If the processing of a bind operation results in an unbound subsidiary logical unit (i.e., no LUNs are associated with the subsidiary logical unit) becoming a bound subsidiary logical unit, then that bound subsidiary logical unit shall contain the preserved state of the unbound subsidiary logical unit (see 5.8.4).

If the administrative logical unit's device server determines that the requested bind operation should be performed by a different administrative logical unit, then the BIND command (see 6.2) may return a redirect response as described in 5.8.9.6.

If the specified subsidiary logical unit is not bound to the administrative logical unit processing the BIND command, then processing of the BIND command shall perform the following as an uninterrupted series of actions:

    a) save the specified host bind identifier to the set of saved host bind identifiers for that S_A binding pair; and

    b) associate one or more LUNs with the specified subsidiary logical unit within that logical unit conglomerate as follows:
        1) the specified subsidiary logical unit shall become accessible to application clients through all I_T nexuses that provide access to that administrative logical unit;
        2) the subsidiary logical unit's LUN on each I_T nexus shall be added to the logical unit inventory for that I_T nexus; and
        3) the specified subsidiary logical unit's device server shall establish a unit attention condition for the SCSI initiator port associated with every I_T nexus on which the subsidiary logical unit has become accessible, with the additional sense code set to POWER ON, RESET, OR BUS DEVICE RESET OCCURRED.

The LUN assigned to the subsidiary logical unit on each I_T nexus through which the subsidiary logical unit was made accessible may be different.

If a LUN is assigned to the specified subsidiary logical unit by the administrative logical unit's device server, then each assigned LUN:

    a) has the same non-zero value in the SUBSIDIARY ELEMENT field (see SAM-6); and
    b) designates a subsidiary logical unit in the logical unit conglomerate that contains the administrative logical unit as described in SAM-6.

5.8.9.3 Subsidiary logical units already bound to the logical unit processing the BIND command

If the specified subsidiary logical unit is already bound to the administrative logical unit processing the BIND command and the host bind identifier specified in the BIND command (see 6.2) is:

    a) not in the set of saved host bind identifiers for that S_A binding pair, then the administrative logical unit's device server shall add the host bind identifier specified in the BIND command to the set of the saved host bind identifiers for that S_A binding pair; or
    b) in the set of saved host bind identifiers for that S_A binding pair, then the administrative logical unit's device server shall:
        A) make no change to the set of saved host bind identifiers for that S_A binding pair; and
        B) not consider this to be an error.

The device sever shall complete the command as described in 5.8.9.4 or 5.8.9.5.

5.8.9.4 BIND command completion without error

A BIND command (see 6.2) with the parameter list length set to zero shall be completed with GOOD status with the sense key set to NO SENSE and the additional sense code set to NO ADDITIONAL SENSE INFORMATION.

For successful completion of a BIND command with the parameter list length set to a non-zero value, the administrative logical unit's device server shall complete that BIND command with:

    a) GOOD status with the sense key set to COMPLETED;
    b) the additional sense code set to BIND COMPLETED;
    c) the COMMAND-SPECIFIC INFORMATION field set as described in 5.8.8.1; and

d)   the INFORMATION field set as described in 5.8.8.2.3 to describe the LUN that is used to access the subsidiary logical unit on the I_T nexus that received the BIND command.

5.8.9.5 BIND command completion with error

If the D_SENSE bit is set to zero (see 7.5.13), the BIND command (see 6.2) shall be terminated with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to DESCRIPTOR FORMAT SENSE DATA REQUIRED.

If the logical unit specified by a BIND command is not a subsidiary logical unit, the device server shall terminate the BIND command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST and the additional sense code set to NOT A SUBSIDIARY LOGICAL UNIT.

If the logical unit specified by a BIND command does not exist, the device server shall terminate the BIND command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

If the requested bind operation fails as a result of a temporary lack of internal resources, the administrative logical unit's device server shall terminate the BIND command with CHECK CONDITION status, with the sense key set to ABORTED COMMAND and the additional sense code set to INSUFFICIENT RESOURCES TO BIND. The application client may retry the BIND command.

If the requested bind operation fails as a result of a persistent lack of internal resources, the administrative logical unit's device server shall terminate the BIND command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST and the additional sense code set to INSUFFICIENT RESOURCES TO BIND. The application client should not retry the BIND command.

If the requested bind operation fails as a result of a valid specified subsidiary logical unit not being able to be bound to any administrative logical unit using a BIND command, then the administrative logical unit's device server shall terminate the BIND command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to COMMAND REJECTED.

5.8.9.6 Logical unit binding redirect

The redirect response identifies the administrative logical unit to which a BIND command (see 6.2) should be sent by the application client (e.g., to an administrative logical unit with which the subsidiary logical unit is affiliated).

To return a redirect response, the administrative logical unit's device server shall terminate the BIND command with:

a)   CHECK CONDITION status with the sense key set to ABORTED COMMAND;
b)   the additional sense code set to BIND REDIRECTED;
c)   the COMMAND-SPECIFIC INFORMATION field set to:
   A)   the logical unit group designator of the administrative logical unit to which the BIND command should be sent, if that administrative logical unit returns a logical unit group designator; or
   B)   zero, if the administrative logical unit to which the BIND command should be send does not return a logical unit group designator;
d)   the INFORMATION field set to zero; and
e)   descriptor format sense data that contains a device designation sense data descriptor (see 4.4.2.8) that identifies the administrative logical unit in a logical unit conglomerate to which the subsidiary logical unit should be bound (i.e., the administrative logical unit to which the application client should send the BIND command) with the DESCRIPTOR USAGE REASON field (see table 45) set to:
   A)   01h (i.e., redirection affects this command and subsequent BIND commands); or

B) 02h (i.e., redirection affects only this command).

5.8.9.7 BIND command processing summary

Table 61 summarizes the processing of a BIND command.

Table 61 – BIND command processing summary

Initial state	BIND command results	NRD bit [a]	Action or condition	Status Sense key Reference	Sense data information returned
Subsidiary logical unit is bound [b]	No new binding is created.	zero or one	none	GOOD COMPLETED 5.8.9.4	COMMAND SPECIFIC field (see 5.8.9.1) INFORMATION field (see 5.8.9.2)
Subsidiary logical unit is not bound [c]	If successful, a new binding is created.	zero or one	perform bind operation (see 5.8.9)	GOOD COMPLETED 5.8.9.4 [d]	
		one	perform bind operation (see 5.8.9)	GOOD COMPLETED 5.8.9.4 [d]	
			bind with the NRD bit set to one is not supported	CHECK CONDITION ILLEGAL REQUEST see [e]	none
		zero	redirect recommended (see 5.8.9.6)	CHECK CONDITION ABORTED COMMAND see [f]	Device designation descriptor that indicates the administrative logical unit to which the BIND command should be sent

[a] The NRD bit is in the BIND command (see 6.2)
[b] Subsidiary logical unit is already bound to the administrative logical unit processing the BIND command (see 5.8.9.3).
[c] Subsidiary logical unit is not bound to the administrative logical unit processing the BIND command (see 5.8.9.2).
[d] The subsidiary logical unit's device server establishes a unit attention conditions with the additional sense code set to:
   a) POWER ON, RESET, OR BUS DEVICE RESET OCCURRED (see 5.8.9.2); and
   b) REPORTED LUNS DATA HAS CHANGED (see 5.8.5).
[e] With the additional sense code set to EXPLICIT BIND NOT ALLOWED.
[f] With the additional sense code set to BIND REDIRECTED.

5.8.10 Logical unit unbinding

The UNBIND command (see 6.47) requests that the subsidiary logical unit device server perform an unbind operation of that subsidiary logical unit.

Successful completion of the unbind operation may change the logical unit inventory (see 5.8.5) and may remove the subsidiary logical unit LUN for the I_T_L nexus that was used to route the UNBIND command to the subsidiary logical unit's device server as described in this subclause.

If the application client specifies that access to the subsidiary logical unit is no longer required (i.e., if the ALL CONG bit is set to one in an UNBIND command (see 6.47)), then the subsidiary logical unit's device server:

    a) shall perform an unbind operation that results in the LUN that received that command becoming unbound from the associated conglomerate; and

    b) should perform an additional unbind operation on any different conglomerate to which that subsidiary logical unit is bound with a host bind identifier that matches the host bind identifier specified in the parameter list.

If the command requests that the subsidiary logical unit be unbound from one conglomerate (e.g., the application client may require access to the subsidiary logical unit via a different binding), then the unbind operation shall be performed on only the conglomerate associated with the LUN that received the command.

If the HOST BIND IDENTIFIER field specified by an UNBIND command (see 6.47) does not match a host bind identifier in the set of saved host bind identifiers for the S_A binding pair, then the subsidiary logical unit's device server shall terminate the UNBIND command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

An unbind operation shall result in the following uninterrupted series of actions:

    1) the subsidiary logical unit's device server shall verify that all task management functions, data transfers, and other commands associated with the LUN that is being removed from the logical unit inventory have been completed or terminated;

    2) if the HOST BIND IDENTIFIER field specified by an UNBIND command matches one in the set of saved host bind identifiers (i.e., a host bind identifier saved during the processing of a previous BIND command (see 6.2)) for the S_A binding pair, then the subsidiary logical unit's device server shall remove the host bind identifier from the set of saved host bind identifiers for that S_A binding pair;

    3) the subsidiary logical unit's device server shall return completion status for the UNBIND command;

    4) if processing of an unbind operation results in the number of unique host bind identifiers in the set of saved host bind identifiers (see 5.8.2) for that S_A binding pair becoming zero, then the subsidiary logical unit's device sever shall remove the subsidiary logical unit's LUN from the logical unit inventory (see 5.8.5) for I_T nexuses associated with that S_A binding pair (i.e., the LUN becomes an incorrect logical unit number (see SAM-6)); and

    5) if processing of an unbind operation results in the number of unique host bind identifiers in all sets of saved host bind identifiers (see 5.8.2) for all S_A binding pairs becoming zero, then the subsidiary logical unit's device sever shall perform the actions that:
        A) result in the subsidiary logical unit becoming an unbound subsidiary logical unit; and
        B) preserve the subsidiary logical unit's state as described in 5.8.3.

If the subsidiary logical unit LUN is removed from the logical unit inventory, that LUN may be reused by a subsequent bind operation. After a subsidiary logical unit becomes unbound, the administrative logical unit's device server should not reuse the LUN in a subsequent bind operation for an extended period of time (e.g., at least five minutes).

> NOTE 5 - The processing of an application client SCSI command timeout is capable of causing a SCSI command to be retried long after (e.g., more than one minute) the initial command was sent. If a LUN released by an unbind operation is reused within too short a time, such a retried command is capable of being processed by the device server for a different logical unit than was intended. This undesirable result is avoidable if that LUN is not reused for a significantly longer time period as described in this subclause.

If a subsidiary logical unit's device server processes an UNBIND command that is not completed as a result of the specified subsidiary logical unit not being permitted to be unbound by an UNBIND command, then the device server shall terminate the BIND command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to COMMAND REJECTED.

A subsidiary logical unit may become unbound by means outside the scope of this standard.

5.8.11 Logical unit implicit bind

An implicit bind operation makes a subsidiary logical unit accessible on an additional I_T_L nexus. A subsidiary logical unit's device server may request to establish a binding to a different administrative logical unit than the subsidiary logical unit is bound to (e.g., to an administrative logical unit with which the subsidiary logical unit is affiliated).

To complete an implicit bind, the device server shall initiate an implicit bind operation for each host bind identifier in the set of saved host bind identifiers for every S_A pair known to the subsidiary logical unit's device server.

Upon completion of an implicit bind operation the subsidiary logical unit's device server establishes unit attention conditions as described in 5.8.8.5 and 5.8.5.

5.8.12 Binding status and reports

5.8.12.1 Overview

Binding status may be reported for a single binding of a subsidiary logical unit using the TEST BIND command (see 6.45) or for multiple bindings using the PREPARE BINDING REPORT command (see 6.16) and RECEIVE BINDING REPORT command (see 6.21).

The PREPARE BINDING REPORT command requests that the device server prepare a specified binding report for the application client. The RECEIVE BINDING REPORT command requests that the device server return a specified binding report to the application client.

Each binding report is associated with a binding list identifier as follows:

1) the application client associates a binding report with a specified binding list identifier in a PREPARE BINDING REPORT command as described in 5.8.12.2; and
2) the application client retrieves the resulting binding report using a RECEIVE BINDING REPORT command with the BINDING LIST IDENTIFIER field set to a binding list identifier that was specified by a previous PREPARE BINDING REPORT command as described in 5.8.12.3.

The device server shall prepare the specified binding report before completion of a RECEIVE BINDING REPORT command. The device server shall create each binding descriptor in a binding report using an uninterrupted series of actions.

For a specified binding list identifier, the device server may prepare the binding report:

a) during processing of a PREPARE BINDING REPORT command;
b) between processing of a PREPARE BINDING REPORT command and a RECEIVE BINDING REPORT command; or
c) during processing of a RECEIVE BINDING REPORT command.

5.8.12.2 Preparing a binding report

The PREPARE BINDING REPORT command (see 6.16) requests that the device server prepare a binding report and associates that binding report with a binding list identifier.

If a PREPARE BINDING REPORT command is processed by a device server in a logical unit that is not a member of a logical unit conglomerate, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to NOT A CONGLOMERATE LOGICAL UNIT.

If the PREPARE BINDING REPORT command is processed by a device server in a subsidiary logical unit and the specified SUBSIDIARY LU DESIGNATOR field:

a) does not specify that subsidiary logical unit, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST; or
b) specifies that subsidiary logical unit, then the SUBSIDIARY ELEMENT INFORMATION field of all binding descriptors in the resulting binding report shall be based on the contents of the SUBSIDIARY ELEMENT field (see SAM-6) of the LUN for the I_T_L nexus on which the command was received as described in 5.8.8.2.3.

If the PREPARE BINDING REPORT command is processed by a device server in an administrative logical unit, then:

a) if the value of the SUBSIDIARY LU DESIGNATOR field does not specify a subsidiary logical unit that is bound to that administrative logical unit, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST;
b) if the value of the SUBSIDIARY LU DESIGNATOR field specifies a subsidiary logical unit that is bound to that administrative logical unit, then the SUBSIDIARY ELEMENT INFORMATION field of all binding descriptors in the resulting binding report shall be based on the contents of the SUBSIDIARY ELEMENT field (see SAM-6) of a LUN used to access that subsidiary logical unit in the same logical unit conglomerate as that administrative logical unit as described in 5.8.8.2.3; and
c) the ADMINISTRATIVE LOGICAL UNIT DESIGNATOR field of all binding descriptors (see 6.21) in the resulting binding report shall contain a logical unit designator that designates that administrative logical unit.

If the PREPARE BINDING REPORT command is processed by a device server in an administrative logical unit that does not have a binding relationship with the subsidiary logical unit specified by the SUBSIDIARY LU DESIGNATOR field, then the resulting binding report shall contain zero binding descriptors (see 6.21). This shall not be considered an error.

After successful completion of a PREPARE BINDING REPORT command, the device server shall preserve the information sent by the PREPARE BINDING REPORT COMMAND or the resulting binding report in a way that is consistent with the binding report preservation requirements as described in 5.8.12.3.

If a PREPARE BINDING REPORT command specifies a binding list identifier that was specified by a previous PREPARE BINDING REPORT command received on the same I_T_L nexus, then the device server shall discard the binding report, if any, and associated information, if any, associated with that binding list identifier and I_T_L nexus.

5.8.12.3 Retrieving a binding report

The RECEIVE BINDING REPORT command (see 6.21) returns a binding report whose preparation was requested by a previous PREPARE BINDING REPORT command (see 6.16) as described in 5.8.12.1. The binding report returned by the device server is determined by:

a) the I_T_L nexus on which the RECEIVE BINDING REPORT command was received; and
b) the binding list identifier.

The application client should send the RECEIVE BINDING REPORT command as soon as possible after sending the PREPARE BINDING REPORT command so that the binding report may be retrieved before being discarded by the device server as described in this subclause. An application client delay in sending the RECEIVE BINDING REPORT command may result in the device server discarding the report.

If a RECEIVE BINDING REPORT command is processed by a device server in a logical unit that is not a member of a logical unit conglomerate, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to NOT A CONGLOMERATE LOGICAL UNIT.

If a device server is not preserving a binding report associated with the I_T_L nexus on which the RECEIVE BINDING REPORT command was received and the specified binding list identifier, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

The device server shall discard a binding report:

  a) after all bytes in that binding report have been transferred without error to the application client by a RECEIVE BINDING REPORT command;
  b) if the device server detects a logical unit reset condition or I_T nexus loss condition (see SAM-6); and
  c) if the device server requires the resources used to preserve that binding report.

The device server shall not discard a binding report in response to:

  a) an ABORT TASK task management function (see SAM-6);
  b) an ABORT TASK SET task management function;
  c) a CLEAR TASK SET task management function; or
  d) a PERSISTENT RESERVE OUT command with PREEMPT AND ABORT service action (see 6.15).

5.8.13 Persistent Reservation Effects

If an administrative logical unit's device server processes a BIND command (see 6.2) for a subsidiary logical unit that has a registration (see 5.14.7) or reservation (see 5.14.9) in effect, then any new I_T_L nexus that results from processing that BIND command shall not be registered.

BIND commands, SET AFFILIATION commands (see 6.40), and UNBIND commands (see 6.47) are subject to the restrictions imposed by persistent reservations. However, an UNBIND command that completes without error releases persistent reservations and removes registrations (see 5.14.11) that were established on any I_T_L nexus that is removed by the unbind operation.

Persistent reservations do not restrict processing of commands that are rerouted to an administrative logical unit due to an incorrect logical unit number. Any command that is rerouted to an administrative logical unit due to an incorrect logical unit number is completed with CHECK CONDITION status as defined in SAM-6.

5.9 Medium auxiliary memory

Some types of media, especially removable media, include a nonvolatile memory referred to as MAM. Medium auxiliary memory is used to store data describing the media and its contents. This standard supports medium auxiliary memory with the READ ATTRIBUTE command (see 6.17) and the WRITE ATTRIBUTE command (see 6.48). These commands are used to retrieve and store information in the medium auxiliary memory in the form of MAM attributes.

A MAM attribute is represented in a format described in 7.4.

There are three types of MAM attributes (see table 62).

Table 62 – Types of MAM attributes

Attribute Type	Attribute Source	Example	Readable with READ ATTRIBUTE	Writable with WRITE ATTRIBUTE
Medium	Permanently stored in the medium auxiliary memory during manufacture.	Media Serial Number	Yes	No
Device	Maintained by the device server.	Load Count	Yes	No
Host	Maintained by the application client.	Backup Date	Yes	Yes

Depending on the attribute type, MAM attributes have the states shown in table 63.

Table 63 – MAM attribute states

Attribute Type	Attribute State	Description
Medium or Device	Read Only	An application client may read the contents of the MAM attribute with the READ ATTRIBUTE command, but an attempt to clear or change the MAM attribute using the WRITE ATTRIBUTE command shall result in the device server terminating the command with CHECK CONDITION status. If the READ ONLY bit (see 7.4.1) is set to one, the MAM attribute is in the read only state.
	Unsupported	The device server does not support the MAM attribute and shall not return this MAM attribute in response to a READ ATTRIBUTE command.
	Unavailable	The MAM attribute exists but is not available at this time. The device server shall not return this MAM attribute in response to a READ ATTRIBUTE command.
Host	Nonexistent	A host attribute does not exist in the medium auxiliary memory until a WRITE ATTRIBUTE command creates it.
	Read/Write	The MAM attribute has been created using the WRITE ATTRIBUTE command. After the MAM attribute has been created, the contents may be altered using subsequent WRITE ATTRIBUTE commands. A read/write MAM attribute may be placed in the nonexistent state using a WRITE ATTRIBUTE command with the attribute length set to zero. If the READ ONLY bit (see 7.4.1) is set to zero, the MAM attribute is in the read/write state.
	Unsupported	The device server does not support the MAM attribute and shall not return this MAM attribute in response to a READ ATTRIBUTE command.

5.10 Parameter rounding

For certain commands, one or more specified parameters may be constrained to a range of values. Device servers may choose to implement only selected values from this range. If the device server receives a value that it does not support, the device server shall:

    a) terminate the command (e.g., by returning CHECK CONDITION status with ILLEGAL REQUEST sense key); or
    b) round the value received to a supported value.

If parameter rounding is implemented, a device server that receives a parameter value that is not an exact supported value shall adjust the value to one that it supports and shall return CHECK CONDITION status, with the sense key set to RECOVERED ERROR, and the additional sense code set to ROUNDED PARAMETER. The application client should send an appropriate command to learn what value the device server has selected.

The device server shall reject unsupported values unless rounding is permitted in the description of the parameter. When the description of a parameter states that rounding is permitted, the device server should adjust maximum value fields down to the next lower supported value than the one specified by the application client. Minimum value fields should be rounded up to the next higher supported value than the one specified by the application client. In some cases, the type of rounding (i.e., up or down) is described in the definition of the parameter.

5.11 Parsing variable length parameter lists and parameter data

Parameter lists and parameter data (e.g., diagnostic pages, mode pages, log pages, and VPD pages) often include length fields indicating the size of the parameter list or parameter data (e.g., the MODE DATA LENGTH field in the mode parameter header (see 7.5.6)). Parameter lists and parameter data often include descriptor lists and descriptor length fields containing the length of the descriptors in the descriptor lists (e.g., the DESIG- NATOR LENGTH field in the designation descriptor used in the Device Identification VPD page (see 7.7.6.1)).

An application client or device server shall not assume that any length field contains the value defined in a SCSI standard.

If a device server receives a parameter list containing a length field (e.g., a PAGE LENGTH field) and containing more bytes than are defined in the standard to which it was designed (e.g., the device server complies with a version of a SCSI standard defining that a parameter list has 24 bytes, but receives a parameter list containing 36 bytes), then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

For parameter lists containing a descriptor length field and a descriptor list, if a device server receives more bytes in a descriptor than are defined in the standard to which the device server was designed (e.g., the device server complies with a version of a SCSI standard defining that a descriptor is 12 bytes, but receives a parameter list containing a 16 byte form of that descriptor), then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

An application client should ignore any bytes of parameter data beyond those defined in the standard to which the application client was designed (e.g., if the application client complies with a version of a SCSI standard defining 24 bytes of parameter data, but receives 36 bytes of parameter data, then the application client should ignore the last 12 bytes or the parameter data).

For additional response bytes containing a descriptor length field and a descriptor list, an application client should ignore any bytes in each descriptor beyond those defined in the standard to which the application client was designed (e.g., if the application client complies with a version of a SCSI standard defining that a descriptor has 24 bytes, but receives parameter data containing a descriptor list with a 36 byte form of that descriptor, then the application client should ignore the last 12 bytes of the descriptor).

5.12 Pollable condition information

5.12.1 Information that does not represent an exception condition

A device server may have information about a condition that does not represent an exception condition. This information is not reported with a CHECK CONDITION status. Instead, this information is reported:

   a) as sense data format parameter data in response to a REQUEST SENSE command as described in 5.12.2; or
   b) as log parameter data as described in 5.12.3.

5.12.2 REQUEST SENSE pollable sense data

5.12.2.1 Making information available for the REQUEST SENSE command

SCSI target devices are required to make specified information used in the parameter data returned by the REQUEST SENSE command (see 6.36) available whenever that information is applicable. Which sense data is returned in the REQUEST SENSE parameter data is determined at the time the REQUEST SENSE command is processed.

Application clients have no way to control which pollable sense data is returned by a REQUEST SENSE command. Mechanisms that are specialized to a particular function (e.g., log pages, mode pages) should be used to obtain information about that function.

5.12.2.2 Selecting pollable sense data to return

Conditions that are not related to the availability of pollable sense data (e.g., a pending unit attention condition) may cause the device server to ignore all available pollable sense data.

If pollable sense data is available to be returned by a REQUEST SENSE command (see 6.36), the choice of which sense key and additional sense code to return shall be made as follows:

   1) sense data with the sense key set to NOT READY and the additional sense code set to:
       1) LOGICAL UNIT NOT READY, INITIALIZING COMMAND REQUIRED (see 5.13.8); and
       2) any other additional sense code that is associated with pollable sense data when combined with a sense key set to NOT READY;
       and
   2) sense data with the sense key set to NO SENSE and the additional sense code set:
       1) as defined for the informational exceptions sense data described in the Informational Exceptions Control mode page (see applicable command standard);
       2) to LOGICAL UNIT TRANSITIONING TO ANOTHER POWER CONDITION (see 5.13.9 and SBC-5);
       3) as defined for any power condition related sense data described in 5.13.8; and
       4) any other additional sense code that is associated with pollable sense data when combined with a sense key set to NO SENSE.

5.12.2.3 Returning one or more progress indications

If the sense key is set to NOT READY or NO SENSE in the header of the sense data being returned by a REQUEST SENSE command (see 6.36) and progress indication information is associated with the pollable sense data, if any, in the sense data (see 5.12.2.1), then:

  a) if the DESC bit is set to zero in the REQUEST SENSE command, the device server shall set the SKSV bit in the fixed-format sense data to one only if progress indication information is available for the additional sense code associated with the ADDITIONAL SENSE CODE field and ADDITIONAL SENSE CODE QUALIFIER field; or
  b) if the DESC bit is set to one in the REQUEST SENSE command, the device server places progress indications in the sense data as follows:
     A) if progress indication information is available for the additional sense code associated with the ADDITIONAL SENSE CODE field and ADDITIONAL SENSE CODE QUALIFIER field in the sense data header, then the device server shall include one sense key specific sense data descriptor (see 4.4.2.4) that contains the available progress indication information; and
     B) if progress indication information is available for one or more additional sense codes that are not associated with the ADDITIONAL SENSE CODE field and ADDITIONAL SENSE CODE QUALIFIER field in the sense data header, then for each instance of available progress indication information, the device server should include one another progress indication sense data descriptor (see 4.4.2.6) that contains the available progress indication information.

5.12.3 Log parameter pollable device condition information

The following background testing functions report their condition information using log page parameters:

  a) self-test operations report whether a test is in progress, but not how far it has progressed using the Self-Test Results log page (see 7.3.22); and
  b) direct access block devices report progress for background pre-scan operations and background medium scan operations using the Background Scan Results log page (see SBC-5).

5.13 Power management

5.13.1 Overview

The Power Condition mode page (see 7.5.18) and Power Consumption mode page (see 7.5.19) allow an application client to manage the power utilization of a logical unit in a manner that may reduce power consumption of the SCSI target device.

Power consumption management is described in 5.13.2, including its interactions with power condition management. Power condition management is described in 5.13.3.

A change in the power consumption setting or power condition of any logical unit in a SCSI target device may result in a change in the SCSI target device's power utilization. If a SCSI target device contains multiple logical units, then the SCSI target device's power utilization may not change until a group of the logical units have changed their power consumption in the active power condition (see 5.13.2) or changed to a lower power condition (see 5.13.3). Any grouping or groupings of logical units for power management is outside the scope of this standard.

5.13.2 Power consumption management

5.13.2.1 Overview

Power consumption management allows control of the power consumption (e.g., the maximum power consumption (see USB-3)) of a logical unit that is in the active power condition (see 5.13.5). A device server may support relative power consumption management (see 5.13.2.2), maximum power consumption management (see 5.13.2.3), or both.

Power consumption management:

a) may be used to limit the power consumption while in the active power condition;
b) shall not affect the power consumed during a change between power conditions; and
c) shall not affect the power consumed while in a power condition other than the active power condition.

5.13.2.2 Relative power consumption management

If relative power consumption management is supported, the device server shall support the ACTIVE LEVEL field in the Power Consumption mode page (see 7.5.19).

An application client may specify use of one of the relative power consumption levels by setting a non-zero value in the ACTIVE LEVEL field in the Power Consumption mode page.

5.13.2.3 Maximum power consumption management

If maximum power consumption management is supported, the device server shall support:

a) the Power Consumption mode page (see 7.5.19); and
b) the Power Consumption VPD page (see 7.7.11).

The Power Consumption VPD page contains one or more power consumption descriptors that indicate the maximum power consumption levels supported by the device server using:

a) a power consumption identifier; and
b) information about the maximum power consumption associated with that power consumption identifier.

An application client may specify use of one of the maximum power consumption levels indicated by the Power Consumption VPD page by setting:

a) the POWER CONSUMPTION IDENTIFIER field in the Power Consumption mode page to the contents of the POWER CONSUMPTION IDENTIFIER field in one power consumption descriptor in the Power Consumption VPD page; and
b) the ACTIVE LEVEL field to zero in the Power Consumption mode page.

The SCSI target device shall limit the maximum power consumption while the logical unit is in the active power condition to the value indicated in the power consumption descriptor in the Power Consumption VPD page that is associated with the POWER CONSUMPTION IDENTIFIER field in the Power Consumption mode page.

5.13.3 Power conditions management

Fields in the Power Condition mode page (see 7.5.18) manage power conditions by enabling and specifying timing values for one or more power condition timers (see 5.13.4).

Command standards may define the following additional power management features:

    a) power conditions (e.g., the stopped power condition in SBC-5);
    b) changes to the power condition state machine (e.g., the SSU_PC8:Stopped state in SBC-5);
    c) commands that manage power conditions (e.g., a START STOP UNIT command in SBC-5 or MMC-6);
    d) changes to commands defined in this standard; or
    e) mode pages, log pages, or VPD pages that are associated with managing power conditions.

SCSI transport protocol standards (e.g., SPL-5) may define additional requirements on the states in the power condition state machine defined in this standard or a command standard.

There shall be no notification to the application client that a logical unit has changed from one power condition to another. The response to a REQUEST SENSE command (see 6.36) may indicate whether a logical unit is in a low power condition and which low power condition.

The current power condition of a logical unit may be decreased by:

    a) the expiration of a power condition timer;
    b) the completion of background functions; or
    c) power condition activities described in a command standard.

The current power condition of a logical unit is increased by:

    a) the processing of a command that the device server is unable to continue processing while in the current power condition;
    b) the processing of a background function that the device server is unable to process while in the current power condition; or
    c) power condition activities described in a command standard.

If a device server processes a command that the device server is capable of completing while the logical unit is in a low power condition, then the device server shall not stop any enabled power condition timers, regardless of which power condition the logical unit was in when the device server began processing the command.

If a device server processes a command that the device server is not capable of completing while the logical unit is in a low power condition, then the device server shall stop any running power condition timers. On completion of the command, the device server shall reinitialize all enabled power condition timers based on their values in the Power Condition mode page (see 7.5.18) and start the timers, regardless of which power condition the logical unit was in when the device server began processing the command.

The device server shall process any task management function (see SAM-6), except LOGICAL UNIT RESET, regardless of current power condition, without changing to a different power condition. The power condition timers shall not be affected by task management functions, except LOGICAL UNIT RESET.

The device server may change power conditions or power condition timers while processing a Logical Unit Reset event (see SAM-6).

No power condition defined in this standard shall affect the supply of any power required for proper operation of a service delivery subsystem.

Logical units that contain cache memory shall write all volatile cache data to the medium for the logical unit (e.g., as a logical unit would do in response to a SYNCHRONIZE CACHE command as described in SBC-5) prior to entering into any power condition that prevents accessing the media (e.g., before a SCSI target device stops its spindle motor during a change to the standby power condition).

5.13.4 Power condition timers

A device server supports one or more power condition timers (i.e., idle condition timers and/or standby condition timers). An application client enables one or more power condition timers and specifies a timing value for each enabled power condition timer using the Power Condition mode page (see 7.5.18).

A device servers determines whether each enabled power condition timer is:

    a) running (i.e., capable of expiring);
    b) expired (i.e., having run until the specified timing value was reached);
    c) stopped (i.e., incapable of expiring, until a change is initiated by the device server, the application client, or SCSI events (e.g., Logical Unit Reset events and Power On events (see SAM-6))); or
    d) halted (i.e., incapable of expiring, until a change is initiated by the application client or SCSI events).

A power condition timer that is enabled and not halted is operational.

Actions that device servers may perform on enabled power condition timers include:

    a) detecting the expiration of a power condition timer;
    b) initializing a power condition timer to the timing value specified in the Power Condition mode page, and starting that power condition timer so that it is running;
    c) stopping a power condition timer to prevent it from expiring;
    d) starting a power condition timer to allow it to expire; and
    e) halting a power condition timer to prevent it from expiring until a command from an application client or a SCSI event results in that timer being initialized and started.

If a device server processes a command that the device server is capable of completing while the logical unit is in a low power condition, then the device server shall not stop any enabled power condition timers, regardless of which power condition the logical unit was in when the device server began processing the command.

If a device server processes a command that the device server is not capable of completing while the logical unit is in a low power condition, then the device server shall stop any running power condition timers. On completion of the command, the device server shall initialize and start all operational power condition timers based on their values in the Power Condition mode page, regardless of which power condition the logical unit was in when the device server began processing the command.

A command standard (e.g., the SBC-5 definition of the START STOP UNIT command) may allow the application client to specify that the power condition timers be:

    a) halted; and
    b) initialized and started.

If application clients do not provide sufficient synchronization for the changes made to power condition timers (e.g., with Reservations (see 5.14)), the results are outside the scope of this standard.

5.13.5 Active power condition

While in the active power condition:

a) the device server is capable of completing the processing of its supported commands, including those that require media access, without the logical unit changing power condition;
b) the device server completes processing of a command in the shortest time when compared to the time required for completion of that command if command processing began while the logical unit was in any of the idle power conditions or standby power conditions; and
c) the SCSI target device may consume more power than while the logical unit is in any of the idle power conditions or standby power conditions (e.g., a disk drive's spindle motor may be active).

A logical unit that is in the active power condition may be affected by power consumption management (see 5.13.2).

5.13.6 Idle power conditions

A device server may support more than one idle power condition (i.e., idle_a, idle_b, and idle_c) to provide progressively lower power consumption (i.e., the following power consumption relationship: idle_a $\geq$ idle_b $\geq$ idle_c).

> NOTE 6 - The idle_a power condition was referenced as the idle power condition in SPC-3.

While in one of the idle power conditions:

a) the device server is capable of completing the processing of its supported commands, except those that require the logical unit to be in the active power condition to be capable of completing the command with GOOD status (e.g., commands that require media access to complete processing);
b) the device server may take longer to complete processing a command than while the logical unit is in the active power condition (e.g., the device may have to activate some circuitry before completing processing of a command);
c) the power consumed by the SCSI target device while in an idle power condition should be less than the power consumed while the logical unit is in the active power condition and may be greater than the power consumed while the logical unit is in a standby power condition; and
d) the peak power consumption during a change from an idle power condition to the active power condition shall be no more than the typical peak power consumption in the active power condition.

5.13.7 Standby power conditions

A device server may support more than one standby power condition (i.e., standby_y and standby_z) to provide progressively lower power consumption (i.e., the following power consumption relationship: standby_y $\geq$ standby_z).

> NOTE 7 - The standby_z power condition was referenced as the standby power condition in SPC-3.

While in one of the standby power conditions:

a) the device server is not capable of completing the processing of commands that require media access without the logical unit changing to the active power condition. SCSI transport protocol standards may impose additional requirements on command processing while changing to a higher power condition (e.g., the response may be CHECK CONDITION status with sense key set to NOT READY and

additional sense bytes set to LOGICAL UNIT NOT READY, NOTIFY (ENABLE SPINUP) REQUIRED instead of GOOD status (see SPL-5));

b) the device server may take longer to complete processing a command than while the logical unit is in the active power condition or one of the idle power conditions (e.g., a disk drive's spindle motor may need to be started);

c) the power consumed by the SCSI target device while in one of the standby power conditions should be less than the power consumed while the logical unit is in the active power condition or any of the idle power conditions; and

d) the peak power consumption during a change from a standby power condition to the active power condition or an idle power condition is not limited by this standard.

5.13.8 Power condition pollable sense data

If the logical unit is in any power condition other than active, the following data shall be available for use by the REQUEST SENSE command while returning pollable sense data (see 5.12.2) and:

a) if the logical unit is in an idle power condition (see 5.13.6), then the sense key shall be set to NO SENSE and the additional sense code set to one of the following:
    A) LOW POWER CONDITION ON if the reason for entry into the idle power condition is unknown;
    B) IDLE CONDITION ACTIVATED BY TIMER if the logical unit entered the idle_a power condition due to the idle_a condition timer (see 5.13.9.4);
    C) IDLE CONDITION ACTIVATED BY COMMAND if the logical unit entered the idle_a power condition due to processing of a command;
    D) IDLE_B CONDITION ACTIVATED BY TIMER if the logical unit entered the idle_b power condition due to the idle_b condition timer (see 5.13.9.4);
    E) IDLE_B CONDITION ACTIVATED BY COMMAND if the logical unit entered the idle_b power condition due to processing of a command;
    F) IDLE_C CONDITION ACTIVATED BY TIMER if the logical unit entered the idle_c power condition due to the idle_c condition timer (see 5.13.9.4); or
    G) IDLE_C CONDITION ACTIVATED BY COMMAND if the logical unit entered the idle_c power condition due to processing of a command;

b) if the logical unit is in a standby power condition (see 5.13.7), then the sense key shall be set to NO SENSE and the additional sense code set to one of the following:
    A) LOW POWER CONDITION ON if the reason for entry into the standby power condition is unknown;
    B) STANDBY_Y CONDITION ACTIVATED BY TIMER if the logical unit entered the standby_y power condition due to the standby_y condition timer (see 5.13.9.5);
    C) STANDBY_Y CONDITION ACTIVATED BY COMMAND if the logical unit entered the standby_y power condition due to processing of a command;
    D) STANDBY CONDITION ACTIVATED BY TIMER if the logical unit entered the standby_z power condition due to the standby_z condition timer (see 5.13.9.5); or
    E) STANDBY CONDITION ACTIVATED BY COMMAND if the logical unit entered the standby_z power condition due to processing of a command;
    or

c) if the logical unit is in the stopped power condition (see SBC-5), then the sense key shall be set to NOT READY and the additional sense code shall be set to LOGICAL UNIT NOT READY, INITIALIZING COMMAND REQUIRED.

> NOTE 8 - Device servers that conform to SBC-2 may not provide the pollable sense data described in c).

5.13.9 Power condition state machine

5.13.9.1 Power condition state machine overview

The power condition state machine describes the logical unit power states and transitions resulting from command processing and Power Condition mode page values (see 7.5.18).

The power condition state machine states are shown in table 64.

Table 64 – Power condition state machine states

State	Reference
PC0:Powered_On [a]	5.13.9.2
PC1:Active	5.13.9.3
PC2:Idle	5.13.9.4
PC3:Standby	5.13.9.5
PC4:Active_Wait	5.13.9.6
PC5:Wait_Idle	5.13.9.7
PC6:Wait_Standby	5.13.9.8
[a] PC0:Powered_On is the initial state.	

While in the following power condition state machine states the logical unit may be increasing power usage to enter a higher power condition:

    a)   PC4:Active_Wait.

While in the following power condition state machine states the logical unit may be decreasing power usage to enter a lower power condition:

    a)   PC5:Wait_Idle; and
    b)   PC6:Wait_Standby.

The power condition state machine maintains the timers listed in table 65.

Table 65 – Power condition state machine timers

Timer	Initial value [a]	Enable bit [a, b]
idle_a condition	IDLE_A CONDITION TIMER field	IDLE_A bit
idle_b condition	IDLE_B CONDITION TIMER field	IDLE_B bit
idle_c condition	IDLE_C CONDITION TIMER field	IDLE_C bit
standby_y condition	STANDBY_Y CONDITION TIMER field	STANDBY_Y bit
standby_z condition	STANDBY_Z CONDITION TIMER field	STANDBY_Z bit
[a] These fields and bits are in the Power Condition mode page (see 7.5.18).		
[b] In a direct access block device, the enabled state of these bits may be overridden by a START STOP UNIT command (see SBC-5).		

If more than one of the timers listed in table 65 expire at the same time, then only one timer is processed. The processing priority order shall be as follows:

  1) standby_z condition timer;
  2) standby_y condition timer;
  3) idle_c condition timer;
  4) idle_b condition timer; and
  5) idle_a condition timer.

The power condition state machine shall start in the PC0:Powered_On state after power on.

Figure 4 describes the power condition state machine.
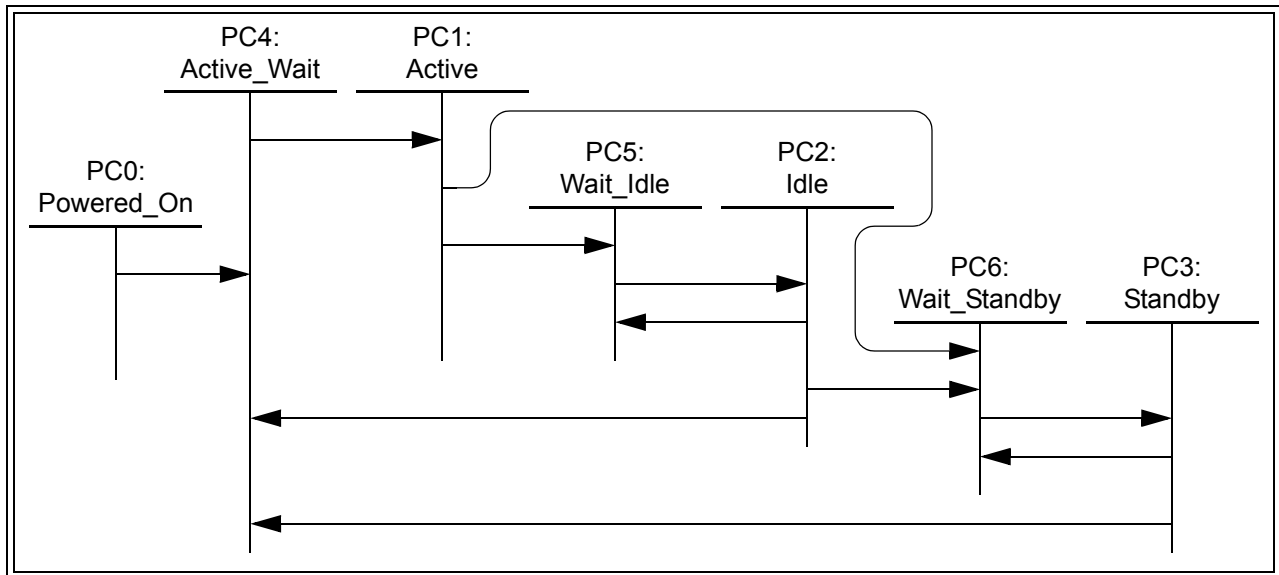
Figure 4 – Power condition state machine

5.13.9.2 PC0:Powered_On state

5.13.9.2.1 PC0:Powered_On state description

The logical unit shall enter this state upon power on.

5.13.9.2.2 Transition PC0:Powered_On to PC4:Active_Wait

This transition shall occur after:

  a) the logical unit is ready to begin power on initialization.

The transition shall include a Transitioning From Powered On argument.

5.13.9.3 PC1:Active state

5.13.9.3.1 PC1:Active state description

While in this state, if power on initialization is not complete, then the logical unit shall complete its power on initialization.

While in this state, if power on initialization is complete, then:

a) the logical unit is in the active power condition (see 5.13.5);
b) each idle condition timer that is operational (see 5.13.4) is running; and
c) each standby condition timer that is operational is running.

5.13.9.3.2 Transition PC1:Active to PC5:Wait_Idle

This transition shall occur if:

a) an idle condition timer is enabled; and
b) that idle condition timer has expired.

The transition shall include a:

a) Transitioning To Idle_a argument, if the highest priority timer (see 5.13.9.1) that expired is the idle_a condition timer;
b) Transitioning To Idle_b argument, if the highest priority timer that expired is the idle_b condition timer; or
c) Transitioning To Idle_c argument, if the highest priority timer that expired is the idle_c condition timer.

5.13.9.3.3 Transition PC1:Active to PC6:Wait_Standby

This transition shall occur if:

a) a standby condition timer is enabled; and
b) that standby condition timer has expired.

The transition shall include a:

a) Transitioning To Standby_z argument, if the highest priority timer (see 5.13.9.1) that expired is the standby_z condition timer; or
b) Transitioning To Standby_y argument, if the highest priority timer that expired is the standby_y condition timer.

5.13.9.4 PC2:Idle state

5.13.9.4.1 PC2:Idle state description

While in this state:

a) the logical unit is in an idle power condition (see 5.13.6);
b) the device server shall provide power condition pollable sense data (see 5.13.8);
c) each idle condition timer that is operational (see 5.13.4) and not expired is running; and
d) each standby condition timer that is operational and not expired is running.

If a lower priority (see 5.13.9.1) idle condition timer is enabled and expires, then that timer is ignored.

5.13.9.4.2 Transition PC2:Idle to PC4:Active_Wait

This transition shall occur if:

a) the device server processes a command that requires the logical unit to be in the PC1:Active state to continue processing that command.

The transition shall include a:

    a)   Transitioning From Idle argument; and
    b)   Transitioning From Idle_c argument, if the current power condition is the idle_c power condition.

5.13.9.4.3 Transition PC2:Idle to PC5:Wait_Idle

This transition shall occur if:

    a)   an idle condition timer is enabled;
    b)   that idle condition timer has expired; and
    c)   the priority (see 5.13.9.1) of that idle condition timer is greater than the priority of the idle condition timer associated with the current idle power condition.

The transition shall include a:

    a)   Transitioning To Idle_b argument, if the highest priority timer that expired is the idle_b condition timer; or
    b)   Transitioning To Idle_c argument, if the highest priority timer that expired is the idle_c condition timer.

5.13.9.4.4 Transition PC2:Idle to PC6:Wait_Standby

This transition shall occur if:

    a)   a standby condition timer is enabled; and
    b)   that standby condition timer has expired.

The transition shall include a:

    a)   Transitioning To Standby_z argument, if the highest priority timer (see 5.13.9.1) that expired is the standby_z condition timer; or
    b)   Transitioning To Standby_y argument, if the highest priority timer that expired is the standby_y condition timer.

5.13.9.5 PC3:Standby state

5.13.9.5.1 PC3:Standby state description

While in this state:

    a)   the logical unit is in a standby power condition (see 5.13.7);
    b)   the device server shall provide power condition pollable sense data (see 5.13.8);
    c)   each idle condition timer that is operational (see 5.13.4) and not expired is running; and
    d)   each standby condition timer that is operational and not expired is running.

If an idle condition timer or a lower priority (see 5.13.9.1) standby condition timer is enabled and expires, then that timer is ignored.

5.13.9.5.2 Transition PC3:Standby to PC4:Active_Wait

This transition shall occur if:

    a)   the device server processes a command that requires the logical unit to be in the PC1:Active state to continue processing that command.

The transition shall include a Transitioning From Standby argument.

5.13.9.5.3 Transition PC3:Standby to PC6:Wait_Standby

This transition shall occur if:

a) the standby_z condition timer is enabled;
b) the standby_z condition timer expired; and
c) the current power condition is the standby_y power condition.

The transition shall include a Transitioning To Standby_z argument.

5.13.9.6 PC4:Active_Wait state

5.13.9.6.1 PC4:Active_Wait state description

While in this state:

a) each idle condition timer that is operational (see 5.13.4) and not expired is running;
b) each standby condition timer that is operational and not expired is running;
c) the device server shall provide power condition pollable sense data (see 5.13.8) with the sense key set to NO SENSE and the additional sense code set to LOGICAL UNIT TRANSITIONING TO ANOTHER POWER CONDITION; and
d) the logical unit is performing the operations required for it to be in the PC1:Active state (e.g., a disk drive spins up its media).

If this state was entered with a Transitioning From Idle argument, then:

a) the device server is capable of processing and completing the same commands that the device server is able to process and complete while in the PC2:Idle state;
b) the peak power consumed in this state shall be no more than the typical peak power consumed in the PC1: Active state; and
c) the device server shall terminate any command that requires the logical unit be in the PC1:Active state to continue processing, with CHECK CONDITION status, with the sense key set to NOT READY and the additional sense code set to LOGICAL UNIT IS IN PROCESS OF BECOMING READY if all of the following are true:
   A) this state was entered with a Transitioning From Idle_c argument; and
   B) the CCF IDLE field in the Power Condition mode page (see 7.5.18) is set to 10b (i.e., enabled).

If this state was entered with a Transitioning From Standby argument, then:

a) the device server is capable of processing and completing the same commands that the device server is able to process and complete while in the PC3:Standby state;
b) the peak power consumption in this state is not limited by this standard; and
c) if the CCF STANDBY field in the Power Condition mode page (see 7.5.18) is set to 10b (i.e., enabled), then the device server shall terminate any command that requires the logical unit be in the PC1:Active state or PC2:Idle state to continue processing, with CHECK CONDITION status, with the sense key set to NOT READY and the additional sense code set to LOGICAL UNIT IS IN PROCESS OF BECOMING READY.

If this state was entered with a Transitioning From Powered On argument, then:

a) the device server is capable of processing and completing the same commands (except a TEST UNIT READY command) that the device server is able to process and complete while in the PC3:Standby state; and

b) the device server shall terminate with CHECK CONDITION status, with the sense key set to NOT READY and the additional sense code set to LOGICAL UNIT IS IN PROCESS OF BECOMING READY any of the following commands:
   A) any command that requires the logical unit be in the PC1:Active state or PC2:Idle state to continue processing; and
   B) all TEST UNIT READY commands (see 6.46).

If an idle condition timer or a standby condition timer is enabled and expires, then that timer is ignored in this state.

5.13.9.6.2 Transition PC4:Active_Wait to PC1:Active

This transition shall occur if:

a) the logical unit meets the requirements for being in the PC1:Active state.

5.13.9.7 PC5:Wait_Idle state

5.13.9.7.1 PC5:Wait_Idle state description

While in this state:

a) each idle condition timer that is operational (see 5.13.4) and not expired is running;
b) each standby condition timer that is operational and not expired is running;
c) the device server shall provide power condition pollable sense data (see 5.13.8) with the sense key set to NO SENSE and the additional sense code set to LOGICAL UNIT TRANSITIONING TO ANOTHER POWER CONDITION;
d) the logical unit is performing the operations required for it to be in the PC2:Idle state (e.g., reducing power usage); and
e) the device server is capable of processing and completing the same commands, except a START STOP UNIT command with the IMMED bit set to zero (see SBC-5), that the device server is able to process and complete in the PC2:Idle state.

If an idle condition timer or a standby condition timer is enabled and expires, then that timer is ignored in this state.

5.13.9.7.2 Transition PC5:Wait_Idle to PC2:Idle

This transition shall occur if:

a) the logical unit meets the requirements for being in:
   A) the idle_a power condition, if this state was entered with a Transitioning To Idle_a argument;
   B) the idle_b power condition, if this state was entered with a Transitioning To Idle_b argument; or
   C) the idle_c power condition, if this state was entered with a Transitioning To Idle_c argument.

5.13.9.8 PC6:Wait_Standby state

5.13.9.8.1 PC6:Wait_Standby state description

While in this state:

a) each idle condition timer that is operational (see 5.13.4) and not expired is running;
b) each standby condition timer that is operational and not expired is running;
c) the device server shall provide power condition pollable sense data (see 5.13.8) with the sense key set to NO SENSE and the additional sense code set to LOGICAL UNIT TRANSITIONING TO ANOTHER POWER CONDITION;
d) the logical unit is performing the operations required for it to be in the PC3:Standby state (e.g., reducing power usage); and
e) the device server is capable of processing and completing the same commands, except a START STOP UNIT command with the IMMED bit set to zero (see SBC-5), that the device server is able to process and complete in the PC3:Standby state.

If an idle condition timer or a standby condition timer is enabled and expires, then that timer is ignored in the state.

5.13.9.8.2 Transition PC6:Wait_Standby to PC3:Standby

This transition shall occur if:

a) the logical unit meets the requirements for being in:
   A) the standby_y power condition, if this state was entered with a Transitioning To Standby_y argument; or
   B) the standby_z power condition, if this state was entered with a Transitioning To Standby_z argument.

5.14 Reservations

5.14.1 Persistent Reservations overview

Reservations may be used to allow a device server to process commands from a selected set of I_T nexuses (i.e., combinations of SCSI initiator ports accessing target ports) and reject commands from I_T nexuses outside the selected set. The device server uniquely identifies I_T nexuses using protocol specific mechanisms.

Application clients may add or remove I_T nexuses from the selected set using reservation commands. If the application clients do not cooperate in the reservation protocol, data may be unexpectedly modified and deadlock conditions may occur.

The persistent reservations mechanism allows multiple application clients communicating through multiple I_T nexuses to preserve reservation operations across SCSI initiator device failures, which usually involve logical unit resets and involve I_T nexus losses. Persistent reservations persist across recovery actions. Persistent reservations are not reset by hard reset, logical unit reset, or I_T nexus loss.

The persistent reservation held by a failing I_T nexus may be preempted by another I_T nexus as part of its recovery process. Persistent reservations shall be retained by the device server until released, preempted, or cleared by mechanisms defined in this standard. Persistent reservations may be retained if power to the SCSI target device is removed.

The PERSISTENT RESERVE OUT command and PERSISTENT RESERVE IN command provide the basic mechanism for dynamic contention resolution in systems with multiple SCSI initiator ports accessing a logical unit.

Before a persistent reservation may be established, the application client shall register a reservation key for each I_T nexus with the device server. Reservation keys allow:

    a) authentication of subsequent PERSISTENT RESERVE OUT commands;
    b) identification of other I_T nexuses that are registered;
    c) identification of the reservation key(s) that have an associated persistent reservation;
    d) preemption of a persistent reservation from a failing or uncooperative I_T nexus; and
    e) multiple I_T nexuses to participate in a persistent reservation.

The reservation key provides a method for the application client to associate a protocol-independent identifier with a registered I_T nexus. The reservation key is used in the PERSISTENT RESERVE IN command to identify which I_T nexuses are registered and which I_T nexus, if any, holds the persistent reservation. The reservation key is used in the PERSISTENT RESERVE OUT command to register an I_T nexus, to verify the I_T nexus being used for the PERSISTENT RESERVE OUT command is registered, and to specify which registrations or persistent reservation to preempt.

Reservation key values may be used by application clients to identify registered I_T nexuses, using application specific methods that are outside the scope of this standard. This standard provides the ability to register no more than one reservation key per I_T nexus. Multiple SCSI initiator ports may use the same reservation key value for a logical unit accessed through the same target ports. A SCSI initiator port may use the same reservation key value for a logical unit accessed through different target ports. The logical unit shall maintain a separate reservation key for each I_T nexus, regardless of the reservation key's value.

An application client may register an I_T nexus with multiple logical units in a SCSI target device using any combination of unique or duplicate reservation keys. These rules provide the ability for an application client to preempt multiple I_T nexuses with a single PERSISTENT RESERVE OUT command, but they do not provide the ability for the application client to uniquely identify the I_T nexuses using the PERSISTENT RESERVE commands.

See table 184 in 6.15.2 for a list of PERSISTENT RESERVE OUT service actions. See table 172 in 6.14.1 for a list of PERSISTENT RESERVE IN service actions.

The scope (see 6.14.3.2) of a persistent reservation shall be the entire logical unit.

The type (see 6.14.3.3) of a persistent reservation defines the selected set of I_T nexuses for which the persistent reservation places restrictions on commands.

The details of which commands are allowed under what types of reservations are described in table 66.

In table 66 and table 67 the following keywords are used:

    a) **allowed:** Commands received from I_T nexuses not holding the reservation or from I_T nexuses not registered if a registrants only or all registrants type persistent reservation is present should complete normally; and
    b) **conflict:** Commands received from I_T nexuses not holding the reservation or from I_T nexuses not registered if a registrants only or all registrants type persistent reservation is present shall not be performed and the device server shall complete the command with RESERVATION CONFLICT status.

Commands from I_T nexuses holding a reservation should complete normally. The behavior of commands from registered I_T nexuses if a registrants only or all registrants type persistent reservation is present is defined in table 66 and table 67.

A command shall be checked for reservation conflicts when the device server begins processing of the command. After that check succeeds, the device server shall not complete the command with RESERVATION CONFLICT status due to a subsequent reservation.

The time at which a reservation is established with respect to other commands being managed by the device server is vendor specific. Successful completion of a reservation command indicates that the new reservation is established. A reservation may apply to some or all of the commands in the task set before the completion of the reservation command. The reservation shall apply to all commands received by the device server after successful completion of the reservation command. Any persistent reserve service action shall be performed as a single indivisible event.

Multiple persistent reserve service actions may be present in the task set at the same time. The order of processing of such service actions is defined by the task set management requirements defined in SAM-6, but each is processed as a single indivisible command without any interleaving of actions that may be required by other reservation commands.

For each command, this standard or a command standard defines the conditions that result in the command being completed with RESERVATION CONFLICT. Command standards define the conditions either in the device model or in the descriptions of each specific command.

Table 66 – SPC-6 commands that are allowed in the presence of various reservations (part 1 of 3)

	Addressed logical unit has this type of persistent reservation held by another I_T nexus				
	From any I_T nexus		From registered I_T nexus (RR all types)	From not registered I_T nexus	
Command	**Write Excl**	**Excl Access**		**Write Excl RR**	**Excl Access – RR**
BIND	Conflict	Conflict	Allowed	Conflict	Conflict
CHANGE ALIASES	Conflict	Conflict	Allowed	Conflict	Conflict
COPY OPERATION ABORT	Conflict	Conflict	Allowed	Conflict	Conflict
COPY OPERATION CLOSE	Conflict	Conflict	Allowed	Conflict	Conflict
EXTENDED COPY	Conflict	Conflict	Allowed	Conflict	Conflict
EXTENDED COPY(LID1)	see SPC-4				
INQUIRY	Allowed	Allowed	Allowed	Allowed	Allowed
LOG SELECT	Conflict	Conflict	Allowed	Conflict	Conflict
Key: **Excl**=Exclusive, **RR**=Registrants Only or All Registrants					
[a] Exceptions to the behavior of the RESERVE and RELEASE commands described in SPC-2 are defined in 5.14.3.					
[b] Logical units claiming compliance with SPC-2 or SPC-3 may return RESERVATION CONFLICT status in this case. Logical units may report whether certain commands are allowed in the ALLOW COMMANDS field of the parameter data returned by the PERSISTENT RESERVE IN command with REPORT CAPABILITIES service action (see 6.14.4).					

Table 66 – SPC-6 commands that are allowed in the presence of various reservations (part 2 of 3)

Command	Addressed logical unit has this type of persistent reservation held by another I_T nexus				
	From any I_T nexus		From registered I_T nexus (RR all types)	From not registered I_T nexus	
	Write Excl	Excl Access		Write Excl RR	Excl Access – RR
LOG SENSE	Allowed	Allowed	Allowed	Allowed	Allowed
MANAGEMENT PROTOCOL IN	Allowed	Conflict	Allowed	Allowed	Conflict
MANAGEMENT PROTOCOL OUT	Conflict	Conflict	Allowed	Conflict	Conflict
MODE SELECT(10)	Conflict	Conflict	Allowed	Conflict	Conflict
MODE SENSE(10)	Allowed [b]	Conflict	Allowed	Allowed [b]	Conflict
PERSISTENT RESERVE IN	Allowed	Allowed	Allowed	Allowed	Allowed
PERSISTENT RESERVE OUT	see table 67				
PREPARE BINDING REPORT	Allowed	Allowed	Allowed	Allowed	Allowed
READ ATTRIBUTE	Allowed [b]	Conflict	Allowed	Allowed [b]	Conflict
READ BUFFER(10)	Allowed [b]	Conflict	Allowed	Allowed [b]	Conflict
READ BUFFER(16)	Allowed	Conflict	Allowed	Allowed	Conflict
READ MEDIA SERIAL NUMBER	Allowed	Allowed	Allowed	Allowed	Allowed
RECEIVE BINDING REPORT	Allowed	Allowed	Allowed	Allowed	Allowed
RECEIVE COPY DATA	Allowed	Allowed	Allowed	Allowed	Allowed
RECEIVE COPY DATA(LID1)	see SPC-4				
RECEIVE COPY OPERATING PARAMETERS	see SPC-4				
RECEIVE COPY FAILURE DETAILS(LID1)	see SPC-4				
RECEIVE COPY STATUS	Allowed	Allowed	Allowed	Allowed	Allowed
RECEIVE COPY STATUS(LID1)	see SPC-4				
RECEIVE ROD TOKEN INFORMATION	Allowed	Allowed	Allowed	Allowed	Allowed
RECEIVE DIAGNOSTIC RESULTS	Allowed [b]	Conflict	Allowed	Allowed [b]	Conflict
RELEASE(6) / RELEASE(10)	As defined in SPC-2 [a]				
REMOVE I_T NEXUS	Conflict	Conflict	Allowed	Conflict	Conflict

Key: **Excl**=Exclusive, **RR**=Registrants Only or All Registrants

[a] Exceptions to the behavior of the RESERVE and RELEASE commands described in SPC-2 are defined in 5.14.3.

[b] Logical units claiming compliance with SPC-2 or SPC-3 may return RESERVATION CONFLICT status in this case. Logical units may report whether certain commands are allowed in the ALLOW COMMANDS field of the parameter data returned by the PERSISTENT RESERVE IN command with REPORT CAPABILITIES service action (see 6.14.4).

Table 66 – SPC-6 commands that are allowed in the presence of various reservations (part 3 of 3)

Command	Addressed logical unit has this type of persistent reservation held by another I_T nexus				
	From any I_T nexus		From registered I_T nexus (RR all types)	From not registered I_T nexus	
	Write Excl	Excl Access		Write Excl RR	Excl Access – RR
REPORT ALIASES	Allowed	Allowed	Allowed	Allowed	Allowed
REPORT ALL ROD TOKENS	Allowed	Allowed	Allowed	Allowed	Allowed
REPORT IDENTIFYING INFORMATION	Allowed	Allowed	Allowed	Allowed	Allowed
REPORT LUNS	Allowed	Allowed	Allowed	Allowed	Allowed
REPORT PRIORITY	Allowed	Allowed	Allowed	Allowed	Allowed
REPORT SUPPORTED OPERATION CODES	Allowed[b]	Allowed[b]	Allowed	Allowed[b]	Allowed[b]
REPORT SUPPORTED TASK MANAGEMENT FUNCTIONS	Allowed[b]	Allowed[b]	Allowed	Allowed[b]	Allowed[b]
REPORT TARGET PORT GROUPS	Allowed	Allowed	Allowed	Allowed	Allowed
REPORT TIMESTAMP	Allowed	Allowed	Allowed	Allowed	Allowed
REQUEST SENSE	Allowed	Allowed	Allowed	Allowed	Allowed
RESERVE(6) / RESERVE(10)	As defined in SPC-2 [a]				
SECURITY PROTOCOL IN	Allowed	Conflict	Allowed	Allowed	Conflict
SECURITY PROTOCOL OUT	Conflict	Conflict	Allowed	Conflict	Conflict
SEND DIAGNOSTIC	Conflict	Conflict	Allowed	Conflict	Conflict
SET IDENTIFYING INFORMATION	Conflict	Conflict	Allowed	Conflict	Conflict
SET AFFILIATION	Conflict	Conflict	Allowed	Conflict	Conflict
SET PRIORITY	Conflict	Conflict	Allowed	Conflict	Conflict
SET TARGET PORT GROUPS	Conflict	Conflict	Allowed	Conflict	Conflict
SET TIMESTAMP	Conflict	Conflict	Allowed	Conflict	Conflict
TEST UNIT READY	Allowed[b]	Allowed[b]	Allowed	Allowed [b]	Allowed [b]
UNBIND	Conflict	Conflict	Allowed	Conflict	Conflict
WRITE ATTRIBUTE	Conflict	Conflict	Allowed	Conflict	Conflict
WRITE BUFFER	Conflict	Conflict	Allowed	Conflict	Conflict

Key: **Excl**=Exclusive, **RR**=Registrants Only or All Registrants

[a] Exceptions to the behavior of the RESERVE and RELEASE commands described in SPC-2 are defined in 5.14.3.

[b] Logical units claiming compliance with SPC-2 or SPC-3 may return RESERVATION CONFLICT status in this case. Logical units may report whether certain commands are allowed in the ALLOW COMMANDS field of the parameter data returned by the PERSISTENT RESERVE IN command with REPORT CAPABILITIES service action (see 6.14.4).

Table 67 – PERSISTENT RESERVE OUT service actions that are allowed in the presence of various reservations

Service action	Addressed logical unit has a persistent reservation held by another I_T nexus	
	Command is from a registered I_T nexus	Command is from a not registered I_T nexus
CLEAR	Allowed	Conflict
PREEMPT	Allowed	Conflict
PREEMPT AND ABORT	Allowed	Conflict
REGISTER	Allowed	Allowed
REGISTER AND IGNORE EXISTING KEY	Allowed	Allowed
REGISTER AND MOVE	Conflict	Conflict
RELEASE	Allowed [a]	Conflict
REPLACE LOST RESERVATION [b]	Allowed	Conflict
RESERVE	Conflict	Conflict

[a] The reservation is not released (see 5.14.11.2.2).
[b] If the device server has not detected that persistent reservation information has been lost, then the command shall be processed as shown in this table. If the device server has detected that persistent reservation information has been lost, then the command shall be processed as described in 5.14.5.4.

5.14.2 Third party persistent reservations

Except for all registrants type reservations, a reservation holder (see 5.14.10) may move the persistent reservation to a third party (e.g., a copy manager supporting the EXTENDED COPY command) using the REGISTER AND MOVE service action (see 5.14.8). A copy manager supporting the EXTENDED COPY command may be instructed to move the persistent reservation to a specified I_T nexus using the third party persistent reservations source I_T nexus segment descriptor (see 6.6.6.18).

5.14.3 Exceptions to SPC-2 RESERVE and RELEASE behavior

This subclause defines exceptions to the behavior of the RESERVE command and RELEASE command defined in SPC-2. The RESERVE command and RELEASE command are obsolete in this standard, except for the behavior defined in this subclause. Device servers that operate using the exceptions described in this subclause shall set the CRH bit to one in the parameter data returned by the REPORT CAPABILITIES service action of the PERSISTENT RESERVE IN command (see 6.14.4).

A RELEASE(6) command or RELEASE(10) command shall complete with GOOD status, but the persistent reservation shall not be released, if the command is received from:

   a) an I_T nexus that is a persistent reservation holder (see 5.14.10); or
   b) an I_T nexus that is registered if a registrants only or all registrants type persistent reservation is present.

A RESERVE(6) command or RESERVE(10) command shall complete with GOOD status, but no reservation shall be established and the persistent reservation shall not be changed, if the command is received from:

    a) an I_T nexus that is a persistent reservation holder; or

    b) an I_T nexus that is registered if a registrants only or all registrants type persistent reservation is present.

In all other cases, the device server shall process a RESERVE(6) command, RESERVE(10) command, RELEASE(6) command, or RELEASE(10) command as defined in SPC-2.

5.14.4 Persistent reservations interactions with IKEv2-SCSI SA creation

If a PERSISTENT RESERVE OUT command is received while an IKEv2-SCSI CCS is in progress (see SFSC), the device server shall terminate the command with CHECK CONDITION status, with the sense key NOT READY, and the additional sense code set to LOGICAL UNIT NOT READY, SA CREATION IN PROGRESS. The sense key specific additional sense data may be set as described in SFSC.

5.14.5 Preserving persistent reservations and registrations

5.14.5.1 Requirements for preserving persistent reservations and registrations

The device server shall preserve the following information for each existing registration across any hard reset, logical unit reset, or I_T nexus loss, and if the persist through power loss capability is enabled (see 5.14.5.2), across any power cycle:

    a) for SCSI transport protocols where initiator port names are required, the initiator port name; otherwise, the initiator port identifier;

    b) reservation key; and

    c) indication of the target port to which the registration was applied.

The device server shall preserve the following information about the existing persistent reservation across any hard reset, logical unit reset, or I_T nexus loss, and if the persist through power loss capability is enabled (see 5.14.5.2), across any power cycle:

    a) for SCSI transport protocols where initiator port names are required, the initiator port name; otherwise, the initiator port identifier;

    b) reservation key;

    c) scope;

    d) type; and

    e) indication of the target port through which the reservation was established.

> NOTE 9 - The scope of a persistent reservation is always LU_SCOPE (see 6.14.3.2). For an all registrants type persistent reservation, preserving the scope and type is sufficient.

5.14.5.2 Preserving persistent reservations and registrations through power loss

The application client may request activation of the persist through power loss device server capability to preserve the persistent reservation and registrations across power cycles by setting the APTPL bit to one in the PERSISTENT RESERVE OUT parameter data associated with a REGISTER service action, REGISTER AND IGNORE EXISTING KEY service action, or REGISTER AND MOVE service action.

After the application client enables the persist through power loss capability the device server shall preserve the persistent reservation, if any, and all current and future registrations associated with the logical unit to which the REGISTER service action, the REGISTER AND IGNORE EXISTING KEY service action, or the REGISTER AND MOVE service action was addressed until an application client disables the persist through power loss capability. The APTPL value from the most recent successfully completed REGISTER service action, REGISTER AND IGNORE EXISTING KEY service action, or REGISTER AND MOVE service action from any application client shall determine the logical unit's behavior in the event of a power loss.

5.14.5.3 Nonvolatile memory considerations for preserving persistent reservations and registrations

The capability of preserving persistent reservations and registrations across power cycles requires logical units to use nonvolatile memory within the SCSI target device. Any logical unit that supports the persist through power loss capability of persistent reservation and has nonvolatile memory that is not ready shall allow the following commands into the task set:

a) INQUIRY;
b) LOG SENSE;
c) READ BUFFER;
d) REPORT LUNS;
e) REPORT TARGET PORT GROUPS;
f) REQUEST SENSE;
g) START STOP UNIT with the START bit set to one and the POWER CONDITION field set to 0h (see SBC-5); and
h) WRITE BUFFER.

Until nonvolatile memory has become ready after a power cycle, commands other than those listed in this subclause shall be terminated with CHECK CONDITION status, with the sense key set to NOT READY, and the additional sense code set as described in table 304 (see 6.46).

5.14.5.4 Loss of persistent reservation information

5.14.5.4.1 Loss of persistent reservation information overview

While the persist through power loss capability is enabled (see 5.14.5.2), the device server may detect a failure (e.g., a hardware failure in nonvolatile memory) that causes the loss of the preserved persistent reservation information.

The failure detected by the device server may be:

a) recoverable through the combined actions of the device server and application client (e.g., sufficient nonvolatile memory is available to recreate the lost persistent reservation and registrations information) using the processes described in 5.14.5.4.2 (i.e., a recoverable lost persistent reservation); or
b) unrecoverable, except by operator intervention (i.e., an unrecoverable lost persistent reservation).

5.14.5.4.2 Recoverable loss of persistent reservation information

If the device server detects a recoverable lost persistent reservation, the device server shall establish a recoverable lost persistent reservation condition. A recoverable lost persistent reservation condition is a condition in which the device server shall:

a) not terminate a PERSISTENT RESERVE OUT command with the REPLACE LOST RESERVATION service action with RESERVATION CONFLICT status; and

b) terminate with CHECK CONDITION status, with the sense key set to DATA PROTECT and the additional sense code set to PERSISTENT RESERVATION INFORMATION LOST all commands other than:
   A) a PERSISTENT RESERVE OUT command with a REPLACE LOST RESERVATION service action; and
   B) those commands listed in 5.14.5.3.

The device server shall clear a recoverable lost persistent reservation condition in response to:

a) the successful processing of a PERSISTENT RESERVE OUT command with the REPLACE LOST RESERVATION service action (see 5.14.11.3); or
b) the recoverable lost persistent reservation becoming an unrecoverable lost persistent reservation.

The device server shall not clear a recoverable lost persistent reservation condition for any reason other than the reasons described in this subclause.

5.14.5.4.3 Unrecoverable loss of persistent reservation information overview

If the device server detects an unrecoverable lost persistent reservation, then the device server:

a) should operate as if it has non volatile memory that is not ready (see 5.14.5.3); or
b) may terminate commands other than those commands listed in 5.14.5.3 with CHECK CONDITION status with the sense key set to HARDWARE ERROR with the additional sense code set to an appropriate value.

5.14.6 Finding persistent reservations and reservation keys

5.14.6.1 Summary of commands for finding persistent reservations and reservation keys

The application client may obtain information about the persistent reservation and the reservation keys (i.e., registrations) that are present within a device server by issuing a PERSISTENT RESERVE IN command with a READ RESERVATION service action, a READ KEYS service action, or a READ FULL STATUS service action.

5.14.6.2 Reporting reservation keys

An application client may send a PERSISTENT RESERVE IN command with READ KEYS service action to determine if any I_T nexuses have been registered with a logical unit through any target port.

In response to a PERSISTENT RESERVE IN with READ KEYS service action the device server shall report the following:

a) the current PRgeneration value (see 6.14.2); and
b) the reservation key for every I_T nexus that is currently registered regardless of the target port through which the registration occurred.

The PRgeneration value allows the application client to verify that the configuration of the I_T nexuses registered with a logical unit has not been modified (i.e., if the PRgeneration value is not changed, the configuration of the I_T nexus registered with a logical unit has not been modified).

Duplicate reservation keys shall be reported if multiple I_T nexuses are registered using the same reservation key.

If an application client uses a different reservation key for each I_T nexus, the application client may use the reservation key to uniquely identify an I_T nexus.

5.14.6.3 Reporting the persistent reservation

An application client may send a PERSISTENT RESERVE IN command with READ RESERVATION service action to receive the persistent reservation information.

In response to a PERSISTENT RESERVE IN command with READ RESERVATION service action the device server shall report the following information for the persistent reservation, if any:

   a) the current PRgeneration value (see 6.14.2);
   b) the registered reservation key, if any, associated with the I_T nexus that holds the persistent reservation (see 5.14.10). If the persistent reservation is an all registrants type, the registered reservation key reported shall be zero; and
   c) the scope and type of the persistent reservation, if any.

If an application client uses a different reservation key for each I_T nexus, the application client may use the reservation key to associate the persistent reservation with the I_T nexus that holds the persistent reservation. This association is done using techniques that are outside the scope of this standard.

5.14.6.4 Reporting full status

An application client may send a PERSISTENT RESERVE IN command with READ FULL STATUS service action to receive all information about registrations and the persistent reservation, if any.

In response to a PERSISTENT RESERVE IN command with READ FULL STATUS service action the device server shall report the current PRgeneration value (see 6.14.2) and, for every I_T nexus that is currently registered, the following information:

   a) the registered reservation key;
   b) whether the I_T nexus is a persistent reservation holder;
   c) if the I_T nexus is a persistent reservation holder, the scope and type of the persistent reservation;
   d) the relative target port identifier identifying the target port of the I_T nexus; and
   e) a TransportID identifying the SCSI initiator port of the I_T nexus.

5.14.7 Registering

To establish a persistent reservation the application client shall first register an I_T nexus with the device server. An application client registers with a logical unit by issuing a PERSISTENT RESERVE OUT command with REGISTER service action or REGISTER AND IGNORE EXISTING KEY service action.

If the I_T nexus has an established registration, an application client may remove the reservation key (see 5.14.11.2.3). This is accomplished by issuing a PERSISTENT RESERVE OUT command with a REGISTER service action or a REGISTER AND IGNORE EXISTING KEY service action as shown in table 68 and table 69, respectively.

If an I_T nexus has not yet established a reservation key or the reservation key and registration have been removed, then an application client may register that I_T nexus and zero or more specified unregistered I_T nexuses by issuing a PERSISTENT RESERVE OUT command with REGISTER service action as defined in table 68.

If the I_T nexus has an established registration, the application client may change the reservation key by issuing a PERSISTENT RESERVE OUT command with REGISTER service action as defined in table 68.

Table 68 – Register behaviors for a REGISTER service action

Command I_T nexus status	Parameter list fields [a]			Device server action
	RESERVATION KEY	SERVICE ACTION RESERVATION KEY	SPEC_I_PT	
received on an unregistered I_T nexus	zero	zero	ignore	Do nothing except return GOOD status.
		non-zero	zero	Register the I_T nexus on which the command was received with the value specified in the SERVICE ACTION RESERVATION KEY field.
			one	Register the I_T nexus on which the command was received and each unregistered I_T nexus specified in the parameter list with the value specified in the SERVICE ACTION RESERVATION KEY field. [b]
	non-zero	ignore	ignore	Return RESERVATION CONFLICT status.
received on a registered I_T nexus	Not equal to I_T nexus reservation key	ignore	ignore	Return RESERVATION CONFLICT status.
	Equal to I_T nexus reservation key	zero	zero	Unregister the I_T nexus on which the command was received (see 5.14.11.2.3).
			one	Return CHECK CONDITION status. [c]
		non-zero	zero	Change the reservation key of the I_T nexus on which the command was received to the value specified in the SERVICE ACTION RESERVATION KEY field.
			one	Return CHECK CONDITION status. [c]

[a] For requirements regarding the parameter list fields not shown in this table, see 6.15.3.

[b] If any I_T nexus specified in the parameter list is registered, the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST. Devices compliant with SPC-3 may return an additional sense code set to INVALID FIELD IN CDB.

[c] The sense key shall be set to ILLEGAL REQUEST, and the additional sense code shall be set to INVALID FIELD IN PARAMETER LIST. Devices compliant with SPC-3 may return an additional sense code set to INVALID FIELD IN CDB.

Alternatively, an application client may establish a reservation key for an I_T nexus without regard for whether one has previously been established by issuing a PERSISTENT RESERVE OUT command with REGISTER AND IGNORE EXISTING KEY service action as defined in table 69.

Table 69 – Register behaviors for a REGISTER AND IGNORE EXISTING KEY service action

Command I_T nexus status	Parameter list fields [a] SERVICE ACTION RESERVATION KEY	Results
received on an unregistered I_T nexus	zero	Do nothing except return GOOD status.
	non-zero	Register the I_T nexus on which the command was received with the value specified in the SERVICE ACTION RESERVATION KEY field.
received on a registered I_T nexus	zero	Unregister the I_T nexus on which the command was received (see 5.14.11.2.3).
	non-zero	Change the reservation key of the I_T nexus on which the command was received to the value specified in the SERVICE ACTION RESERVATION KEY field.
[a] The RESERVATION KEY field is ignored when processing a REGISTER AND IGNORE EXISTING KEY service action. For requirements regarding other parameter list fields not shown in this table, see 6.15.3.		

If a PERSISTENT RESERVE OUT command with a REGISTER service action or a REGISTER AND IGNORE EXISTING KEY service action is attempted, but there are insufficient device server resources to complete the operation, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INSUFFICIENT REGIS-TRATION RESOURCES.

In response to a PERSISTENT RESERVE OUT command with a REGISTER service action or a REGISTER AND IGNORE EXISTING KEY service action the device server shall perform a registration for each specified I_T nexus by doing the following as an uninterrupted series of actions:

- a) process the registration request regardless of any persistent reservations;
- b) process the APTPL bit;
- c) ignore the contents of the SCOPE and TYPE fields;
- d) associate the reservation key specified in the SERVICE ACTION RESERVATION KEY field with the I_T nexus being registered, where:
    - A) the I_T nexus(es) being registered are shown in table 70; and
    - B) regardless of how the I_T nexus SCSI initiator port is specified, the association for the SCSI initiator port is based on either the initiator port name on SCSI transport protocols where initiator port names are required or the initiator port identifier on SCSI transport protocols where initiator port names are not required;
- e) register the reservation key specified in the SERVICE ACTION RESERVATION KEY field without changing any persistent reservation that may exist; and
- f) retain the reservation key specified in the SERVICE ACTION RESERVATION KEY field and associated information.

Table 70 – I_T Nexuses being registered

SPEC_I_PT [a]	ALL_TG_PT	I_T nexus(es) being registered	
		Initiator port	**Target port**
0	0	The port's names or identifiers to be registered are determined from the I_T nexus on which the PERSISTENT RESERVE OUT command was received.	
0	1	The port's name or identifier to be registered is determined from the I_T nexus on which the PERSISTENT RESERVE OUT command was received.	Register all of the target ports in the SCSI target device.
1	0	Each port's name or identifier to be registered is: a) determined from the I_T nexus on which the PERSISTENT RESERVE OUT command was received; and b) specified by each TransportID in the TransportID list (see 6.15.3).	The port's name or identifier to be registered is determined from the I_T nexus on which the PERSISTENT RESERVE OUT command was received.
1	1	Each port's name or identifier to be registered is: a) determined from the I_T nexus on which the PERSISTENT RESERVE OUT command was received; and b) specified by each TransportID in the additional parameter data.	Register all of the target ports in the SCSI target device.
[a] If the SPEC_I_PT bit is set to one and the service action is REGISTER AND IGNORE EXISTING KEY, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.			

After the registration request has been processed, the device server shall then allow other PERSISTENT RESERVE OUT commands from the registered I_T nexus to be processed. The device server shall retain the reservation key until the key is changed as described in this subclause or removed as described in 5.14.11.

Any PERSISTENT RESERVE OUT command service action received from an unregistered I_T nexus, other than the REGISTER or the REGISTER AND IGNORE EXISTING KEY service action, shall be completed with RESERVATION CONFLICT status.

It is not an error for an I_T nexus that is registered to be registered again with the same reservation key or a new reservation key. A registration shall have no effect on any other registrations (e.g., if more than one I_T nexus is registered with the same reservation key and one of those I_T nexuses registers again it has no effect on the other I_T nexus' registrations). A registration that contains a non-zero value in the SERVICE ACTION RESERVATION KEY field shall have no effect on any persistent reservations (i.e., the reservation key for an I_T nexus may be changed without affecting any previously created persistent reservation).

Multiple I_T nexuses may be registered with the same reservation key. An application client may use the same reservation key for other I_T nexuses and logical units.

5.14.8 Registering and moving the reservation

The PERSISTENT RESERVE OUT command REGISTER AND MOVE service action is used to register a specified I_T nexus (see table 71) and move the reservation to establish that I_T nexus as the reservation holder.

Table 71 – Register behaviors for a REGISTER AND MOVE service action

Command I_T nexus status	Parameter list fields [a]			Device server action
	RESERVATION KEY	SERVICE ACTION RESERVATION KEY	UNREG	
received on an unregistered I_T nexus	ignore	ignore	ignore	Return RESERVATION CONFLICT status. [d]
received on the registered I_T nexus of reservation holder	Not equal to I_T nexus reservation key	ignore	ignore	Return RESERVATION CONFLICT status.
	Equal to I_T nexus reservation key	zero	ignore	Return CHECK CONDITION status. [b]
		non-zero [c]	zero	The I_T nexus on which PERSISTENT RESERVE OUT command was received shall remain registered. See this subclause for the registration and the move specifications.
			one	The I_T nexus on which PERSISTENT RESERVE OUT command was received shall be unregistered (see 5.14.11.2.3) upon completion of command processing. See this subclause for the registration and the move specifications.
received on a registered I_T nexus that is not the reservation holder	ignore	ignore	ignore	Return RESERVATION CONFLICT status.

[a] For requirements regarding other parameter list fields not shown in this table see 6.15.4.
[b] The sense key shall be set to ILLEGAL REQUEST, and the additional sense code shall be set to INVALID FIELD IN PARAMETER LIST. Devices compliant with SPC-3 may return an additional sense code set to INVALID FIELD IN CDB.
[c] The application client and backup application should use the same reservation key.
[d] Devices compliant with SPC-3 may return CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.

If a PERSISTENT RESERVE OUT command with a REGISTER AND MOVE service action is attempted, but there are insufficient device server resources to complete the operation, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INSUFFICIENT REGISTRATION RESOURCES.

If a PERSISTENT RESERVE OUT command with a REGISTER AND MOVE service action is received and the established persistent reservation is a Write Exclusive - All Registrants type reservation or Exclusive Access - All Registrants type reservation, then the device server shall complete the command with RESERVATION CONFLICT status.

If a PERSISTENT RESERVE OUT command with a REGISTER AND MOVE service action is received and there is no persistent reservation established, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

If a PERSISTENT RESERVE OUT command with a REGISTER AND MOVE service action specifies a TransportID that is the same as the SCSI initiator port of the I_T nexus on which the command received, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

In response to a PERSISTENT RESERVE OUT command with a REGISTER AND MOVE service action the device server shall perform a register and move by doing the following as an uninterrupted series of actions:

a) process the APTPL bit;
b) ignore the contents of the SCOPE and TYPE fields;
c) associate the reservation key specified in the SERVICE ACTION RESERVATION KEY field with the I_T nexus specified as the destination of the register and move, where:
  A) the I_T nexus is specified by the TransportID and the RELATIVE TARGET PORT IDENTIFIER field (see 6.15.4); and
  B) regardless of the TransportID format used, the association for the SCSI initiator port is based on either the initiator port name on SCSI transport protocols where initiator port names are required or the initiator port identifier on SCSI transport protocols where initiator port names are not required;
d) register the reservation key specified in the SERVICE ACTION RESERVATION KEY field;
e) retain the reservation key specified in the SERVICE ACTION RESERVATION KEY field and associated information;
f) release the persistent reservation for the persistent reservation holder (i.e., the I_T nexus on which the command was received);
g) move the persistent reservation to the specified I_T nexus using the same scope and type as the persistent reservation released in item f); and
h) if the UNREG bit is set to one, unregister (see 5.14.11.2.3) the I_T nexus on which PERSISTENT RESERVE OUT command was received.

It is not an error for a REGISTER AND MOVE service action to register an I_T nexus that is already registered with the same reservation key or a different reservation key.

5.14.9 Reserving

An application client creates a persistent reservation by issuing a PERSISTENT RESERVE OUT command with RESERVE service action through a registered I_T nexus with:

a) the RESERVATION KEY field set to the value of the reservation key that is registered with the logical unit for the I_T nexus; and
b) the TYPE field and the SCOPE field set to the persistent reservation being created.

Only one persistent reservation is allowed at a time per logical unit and that persistent reservation has a scope of LU_SCOPE.

If the device server receives a PERSISTENT RESERVE OUT command from an I_T nexus other than a persistent reservation holder (see 5.14.10) that attempts to create a persistent reservation when a persistent reservation already exists for the logical unit, then the device server shall complete the command with RESERVATION CONFLICT status.

If a persistent reservation holder attempts to modify the type or scope of an existing persistent reservation, the device server shall complete the command with RESERVATION CONFLICT status.

If the device server receives a PERSISTENT RESERVE OUT command with RESERVE service action where the TYPE field and the SCOPE field contain the same values as the existing type and scope from a persistent reservation holder, then the device server shall not make any change to the existing persistent reservation and shall complete the command with GOOD status.

See 5.14.1 for information on when a persistent reservation takes effect.

5.14.10 Persistent reservation holder

The persistent reservation holder is determined by the type of the persistent reservation as follows:

 a) for a persistent reservation of the type Write Exclusive – All Registrants or Exclusive Access – All Registrants, the persistent reservation holder is any registered I_T nexus; or
 b) for all other persistent reservation types, the persistent reservation holder is the I_T nexus:
  A) for which the reservation was established with a PERSISTENT RESERVE OUT command with the RESERVE service action, the PREEMPT service action, the PREEMPT AND ABORT service action, or the REPLACE LOST RESERVATION service action; or
  B) to which the reservation was moved by a PERSISTENT RESERVE OUT command with REGISTER AND MOVE service action.

A persistent reservation holder has its reservation key returned in the parameter data from a PERSISTENT RESERVE IN command with READ RESERVATION service action as follows:

 a) for a persistent reservation of the type Write Exclusive – All Registrants or Exclusive Access – All Registrants, the reservation key shall be set to zero; or
 b) for all other persistent reservation types, the reservation key shall be set to the registered reservation key for the I_T nexus that holds the persistent reservation.

It is not an error for a persistent reservation holder to send a PERSISTENT RESERVE OUT command with RESERVE service action to the reserved logical unit with TYPE and SCOPE fields that match those of the persistent reservation (see 5.14.9).

A persistent reservation holder is allowed to release the persistent reservation using the PERSISTENT RESERVE OUT command with RELEASE service action (see 5.14.11.2.2).

If the registration of the persistent reservation holder is removed (see 5.14.11.2), the reservation shall be released. If the persistent reservation holder is more than one I_T nexus, the reservation shall not be released until the registrations for all persistent reservation holder I_T nexuses are removed.

5.14.11 Releasing persistent reservations and removing registrations

5.14.11.1 Releasing persistent reservations, removing registrations, and lost reservation information

The application client may use PERSISTENT RESERVE OUT command service actions to:

a) release persistent reservations and remove registrations (see 5.14.11.2); and
b) begin the process of recovering from lost reservation information, if any (see 5.14.5.4 and 5.14.11.3).

If a logical unit becomes inaccessible to application clients on an I_T nexus as a result of processing an UNBIND command (see 6.47 and 5.8.13), then:

a) persistent reservations, if any, associated with that I_T_L nexus are released (see 5.14.11.2.2); and
b) registrations, if any, associated with that I_T_L nexus are removed (see 5.14.11.2.3).

5.14.11.2 Service actions that release persistent reservations and remove registrations

5.14.11.2.1 Service actions that release persistent reservations and remove registrations overview

An application client may release or preempt the persistent reservation by issuing one of the following commands through a registered I_T nexus with the RESERVATION KEY field set to the reservation key value that is registered with the logical unit for that I_T nexus:

a) a PERSISTENT RESERVE OUT command with RELEASE service action from a persistent reservation holder (see 5.14.11.2.2);
b) a PERSISTENT RESERVE OUT command with PREEMPT service action specifying the reservation key of the persistent reservation holder or holders (see 5.14.11.2.4);
c) a PERSISTENT RESERVE OUT command with PREEMPT AND ABORT service action specifying the reservation key of the persistent reservation holder or holders (see 5.14.11.2.6);
d) a PERSISTENT RESERVE OUT command with CLEAR service action (see 5.14.11.2.7); or
e) if the I_T nexus is the persistent reservation holder and the persistent reservation is not an all registrants type, then a PERSISTENT RESERVE OUT command with REGISTER service action or REGISTER AND IGNORE EXISTING KEY service action with the SERVICE ACTION RESERVATION KEY field set to zero (see 5.14.11.2.3).

Table 72 defines processing for a persistent reservation released or preempted by an application client based on the reservation type.

Table 72 – Processing for a released or preempted persistent reservation

Reservation Type	Processing
Write Exclusive – Registrants Only or Exclusive Access – Registrants Only	This persistent reservation shall be released if the persistent reservation holder (see 5.14.10) of this reservation type becomes unregistered.
Write Exclusive – All Registrants or Exclusive Access – All Registrants	This persistent reservation shall be released if: a) the registration for the last registered I_T nexus is removed; or b) the type or scope is changed.
Write Exclusive or Exclusive Access	This persistent reservation shall be released if the persistent reservation holder (see 5.14.10) of this reservation type becomes unregistered.

An application client may remove registrations by issuing one of the following commands through a registered I_T nexus with the RESERVATION KEY field set to the reservation key value that is registered with the logical unit for that I_T nexus:

a) a PERSISTENT RESERVE OUT command with PREEMPT service action with the SERVICE ACTION RESERVATION KEY field set to the reservation key (see 5.14.11.2.4) to be removed;
b) a PERSISTENT RESERVE OUT command with PREEMPT AND ABORT service action with the SERVICE ACTION RESERVATION KEY field set to the reservation key (see 5.14.11.2.6) to be removed;
c) a PERSISTENT RESERVE OUT command with CLEAR service action (see 5.14.11.2.7); or
d) a PERSISTENT RESERVE OUT command with REGISTER service action or REGISTER AND IGNORE EXISTING KEY service action with the SERVICE ACTION RESERVATION KEY field set to zero (see 5.14.11.2.3).

After a reservation key (i.e., registration) has been removed, no information shall be reported for that unregistered I_T nexus in subsequent READ KEYS service actions until the I_T nexus is registered again (see 5.14.7).

If the persist through power loss capability is not enabled, loss of power also causes persistent reservations to be released and registrations to be removed. If the most recent APTPL value received by the device server is zero (see 6.15.3), the processing of a power on condition:

a) releases all persistent reservations; and
b) removes all registered reservation keys (see 5.14.7).

5.14.11.2.2 Releasing

Only the persistent reservation holder (see 5.14.10) is allowed to release a persistent reservation.

An application client releases the persistent reservation by issuing a PERSISTENT RESERVE OUT command with RELEASE service action through an I_T nexus that is a persistent reservation holder with:

a) the RESERVATION KEY field set to the value of the reservation key that is registered with the logical unit for the I_T nexus; and
b) the TYPE field and the SCOPE field set to match the persistent reservation being released.

If a logical unit becomes inaccessible to application clients on an I_T nexus as a result of processing an UNBIND command (see 6.47 and 5.8.13), then the persistent reservation, if any, associated with that I_T_L nexus shall be released.

In response to a persistent reservation release request from the persistent reservation holder the device server shall perform a release by doing the following as an uninterrupted series of actions:

a) release the persistent reservation;
b) not remove any registration(s);
c) if the NUAR bit (see 7.5.13) is set to zero and the released persistent reservation is either a registrants only type or an all registrants type persistent reservation, then the device server shall establish a unit attention condition for the SCSI initiator port associated with every registered I_T nexus other than I_T nexus on which the PERSISTENT RESERVE OUT command with RELEASE service action was received, with the additional sense code set to RESERVATIONS RELEASED;
d) if the NUAR bit is set to one and the released persistent reservation is either a registrants only type or an all registrants type persistent reservation, then the device server shall not establish a unit attention condition; and
e) if the persistent reservation is of any other type, the device server shall not establish a unit attention condition.

The device server shall not alter the established persistent reservation and shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID RELEASE OF PERSISTENT RESERVATION, for a PERSISTENT RESERVE OUT command that specifies the release of a persistent reservation if:

    a)   the requesting I_T nexus is a persistent reservation holder (see 5.14.10); and
    b)   the SCOPE and TYPE fields do not match the scope and type of the established persistent reservation.

If there is no persistent reservation or in response to a persistent reservation release request from a registered I_T nexus that is not a persistent reservation holder (see 5.14.10), then the device server shall do the following:

    a)   not release the persistent reservation, if any;
    b)   not remove any registrations; and
    c)   complete the command with GOOD status.

5.14.11.2.3 Unregistering

An application client may remove a registration for an I_T nexus by issuing a PERSISTENT RESERVE OUT command with REGISTER service action or a REGISTER AND IGNORE EXISTING KEY service action with the SERVICE ACTION RESERVATION KEY field set to zero through that I_T nexus.

If a logical unit becomes inaccessible to application clients on an I_T nexus as a result of processing an UNBIND command (see 6.47 and 5.8.13), then the registrations, if any, associated with that I_T_L nexus shall be removed.

If the I_T nexus is a reservation holder, the persistent reservation is of an all registrants type, and the I_T nexus is the last remaining registered I_T nexus, then the device server shall also release the persistent reservation.

If the I_T nexus is the reservation holder and the persistent reservation is of a type other than all registrants, then the device server shall also release the persistent reservation. If the persistent reservation is a registrants only type, then the device server shall establish a unit attention condition for the SCSI initiator port associated with every registered I_T nexus except for the I_T nexus on which the PERSISTENT RESERVE OUT command was received, with the additional sense code set to RESERVATIONS RELEASED.

5.14.11.2.4 Preempting

5.14.11.2.4.1 Commands that preempt reservations

A PERSISTENT RESERVE OUT command with PREEMPT service action or PREEMPT AND ABORT service action is used to:

   a)   preempt (i.e., replace) the persistent reservation and remove registrations (see 5.14.11.2.4.3); or
   b)   remove registrations (see 5.14.11.2.5).

Table 73 lists the actions taken by the device server based on the current persistent reservation type and the SERVICE ACTION RESERVATION KEY field in the PERSISTENT RESERVE OUT command.

Table 73 – Preempting actions

Reservation Type	Service Action Reservation Key	Device server action	Reference
All Registrants	Zero	Preempt the persistent reservation and remove registrations.	5.14.11.2.4.3
	Not Zero	Remove registrations.	5.14.11.2.5
All other types	Zero	Terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.	
	Reservation holder's reservation key	Preempt the persistent reservation and remove registrations.	5.14.11.2.4.3
	Any other, non-zero reservation key	Remove registrations.	5.14.11.2.5

See figure 5 for a description of how a device server interprets a PREEMPT service action to determine its actions (e.g., preempt the persistent reservation, remove registration, or both preempt the persistent reservation and remove registration).
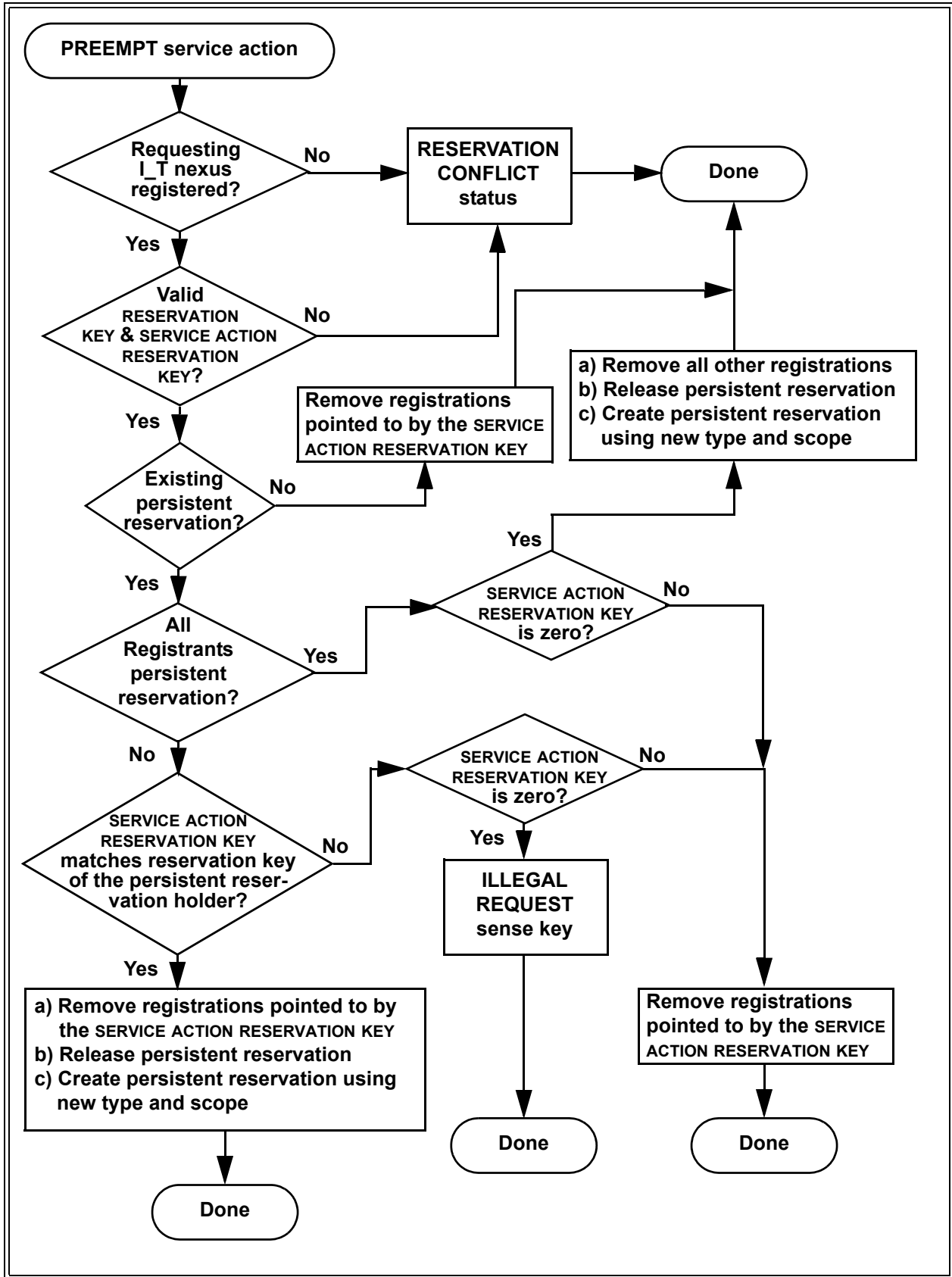
Figure 5 – Device server interpretation of PREEMPT service action

5.14.11.2.4.2 Failed persistent reservation preempt

If the preempting I_T nexus' PREEMPT service action or PREEMPT AND ABORT service action fails (e.g., repeated TASK SET FULL status, repeated BUSY status, SCSI transport protocol time-out, or time-out due to the task set being blocked due to failed SCSI initiator port or failed SCSI initiator device), then the application client may send a LOGICAL UNIT RESET task management function to the failing logical unit to remove blocking commands and then resend the preempting service action.

5.14.11.2.4.3 Preempting persistent reservations and registration handling

An application client may preempt the persistent reservation with another persistent reservation by issuing a PERSISTENT RESERVE OUT command with PREEMPT service action or PREEMPT AND ABORT service action through a registered I_T nexus with:

   a) the RESERVATION KEY field set to the value of the reservation key that is registered with the logical unit for the I_T nexus;
   b) the SERVICE ACTION RESERVATION KEY field set to the value of the reservation key of the persistent reservation to be preempted; and
   c) the TYPE field and the SCOPE field set to define a new persistent reservation. The scope and type of the persistent reservation created by the preempting I_T nexus may be different than those of the persistent reservation being preempted.

If the SERVICE ACTION RESERVATION KEY field identifies a persistent reservation holder (see 5.14.10), the device server shall perform a preempt by doing the following as an uninterrupted series of actions:

   a) release the persistent reservation for the holder identified by the SERVICE ACTION RESERVATION KEY field;
   b) remove the registrations for all I_T nexuses identified by the SERVICE ACTION RESERVATION KEY field, except the I_T nexus that is being used for the PERSISTENT RESERVE OUT command. If an all registrants persistent reservation is present and the SERVICE ACTION RESERVATION KEY field is set to zero, then all registrations shall be removed except for that of the I_T nexus that is being used for the PERSISTENT RESERVE OUT command;
   c) establish a persistent reservation for the preempting I_T nexus using the contents of the SCOPE field and the TYPE field;
   d) process commands as defined in 5.14.1;
   e) establish a unit attention condition for the SCSI initiator port associated with every I_T nexus that lost its persistent reservation and/or registration, with the additional sense code set to REGISTRATIONS PREEMPTED; and
   f) if the type or scope has changed, then for every I_T nexus whose reservation key was not removed, except for the I_T nexus on which the PERSISTENT RESERVE OUT command was received, the device server shall establish a unit attention condition for the SCSI initiator port associated with that I_T nexus, with the additional sense code set to RESERVATIONS RELEASED. If the type or scope have not changed, then no unit attention condition(s) shall be established for this reason.

After the PERSISTENT RESERVE OUT command has been completed with GOOD status, new commands are subject to the persistent reservation restrictions established by the preempting I_T nexus.

The following commands shall be affected in a vendor specific manner either by the restrictions established by the persistent reservation being preempted or by the restrictions established by the preempting I_T nexus:

a) a command received after the arrival, but before the completion of the PERSISTENT RESERVE OUT command with the PREEMPT service action or the PREEMPT AND ABORT service action; or

b) a command that has been placed into a task set by the task manager (see SAM-6) at the time the PERSISTENT RESERVE OUT command with the PREEMPT service action or the PREEMPT AND ABORT service action is received.

Completion status shall be returned for each command unless it was aborted by a PERSISTENT RESERVE OUT command with the PREEMPT AND ABORT service action and TAS bit is set to zero in the Control mode page (see 7.5.13).

If an all registrants persistent reservation is not present, it is not an error for the persistent reservation holder to preempt itself (i.e., a PERSISTENT RESERVE OUT with a PREEMPT service action or a PREEMPT AND ABORT service action with the RESERVATION KEY field value and the SERVICE ACTION RESERVATION KEY field value equal to the persistent reservation holder's reservation key that is received from the persistent reservation holder). In that case, the device server shall establish the new persistent reservation and maintain the registration.

5.14.11.2.5 Removing registrations

If a registered reservation key does not identify a persistent reservation holder (see 5.14.10), an application client may remove the registration(s) without affecting any persistent reservations by issuing a PERSISTENT RESERVE OUT command with PREEMPT service action through a registered I_T nexus with:

a) the RESERVATION KEY field set to the value of the reservation key that is registered for the I_T nexus; and

b) the SERVICE ACTION RESERVATION KEY field set to match the reservation key of the registration or registrations being removed.

If the SERVICE ACTION RESERVATION KEY field does not identify a persistent reservation holder or there is no persistent reservation holder (i.e., there is no persistent reservation), then the device server shall perform a preempt by doing the following in an uninterrupted series of actions:

a) remove the registrations for all I_T nexuses specified by the SERVICE ACTION RESERVATION KEY field;

b) ignore the contents of the SCOPE field and the TYPE field;

c) process commands as defined in 5.14.1; and

d) establish a unit attention condition for the SCSI initiator port associated with every I_T nexus that lost its registration other than the I_T nexus on which the PERSISTENT RESERVE OUT command was received, with the additional sense code set to REGISTRATIONS PREEMPTED.

If a PERSISTENT RESERVE OUT with a PREEMPT service action or a PREEMPT AND ABORT service action sets the SERVICE ACTION RESERVATION KEY field to a value that does not match any registered reservation key, then the device server shall complete the command with RESERVATION CONFLICT status.

It is not an error for a PERSISTENT RESERVE OUT with a PREEMPT service action or a PREEMPT AND ABORT service action to set the RESERVATION KEY field and the SERVICE ACTION RESERVATION KEY field to the same value. However, no unit attention condition is established for the I_T nexus on which the PERSISTENT RESERVE OUT command was received. The registration is removed.

5.14.11.2.6 Preempting and aborting

The application client's request for and the device server's responses to a PERSISTENT RESERVE OUT command with PREEMPT AND ABORT service action are identical to the responses to a PREEMPT service action (see 5.14.11.2.4) except for the additions described in this subclause. If no reservation conflict occurred, the device server shall perform the following uninterrupted series of actions:

a) if the persistent reservation is not an all registrants type then:
   A) if the TST field is set to 000b (see 7.5.13) and the faulted I_T nexus, if any, is not the I_T nexus associated with the persistent reservation or registration being preempted, then the task set ACA condition shall be processed as defined in SAM-6;
   B) if the TST field is set to 000b and the faulted I_T nexus, if any, is the I_T nexus associated with the persistent reservation or registration being preempted, then the PERSISTENT RESERVE OUT command shall be processed without regard for the task set ACA condition; or
   C) if the TST field is set to 001b, then the ACA condition shall be processed as defined in SAM-6;
b) perform the uninterrupted series of actions described for the PREEMPT service action (see 5.14.11.2.4);
c) all commands from the I_T nexus(es) associated with the persistent reservations or registrations being preempted (i.e., preempted commands) except the PERSISTENT RESERVE OUT command itself shall be aborted as defined in SAM-6;
d) for each copy operation (see 5.19.4.3) being processed:
   A) the third-party copy command (see 5.19.3), if any, that is associated with that copy operation shall be aborted as described in c); and
   B) that copy operation shall be processed as a background copy operation and aborted as if a COPY OPERATION ABORT command (see 6.4) has been received;
e) after the PERSISTENT RESERVE OUT command with PREEMPT AND ABORT service action has completed, all new commands are subject to the persistent reservation restrictions established by the preempting I_T nexus;
f) if the persistent reservation is not an all registrants type, then the device server shall clear any ACA condition associated with an I_T nexus being preempted and shall abort any commands with an ACA attribute received on that I_T nexus;
g) if the persistent reservation is an all registrants type, then:
   A) if the service action reservation key is set to zero, the device server shall clear any ACA condition and shall abort any commands with an ACA attribute; or
   B) if the service action reservation key is not set to zero, the device server shall do the following for any I_T nexus registered using the specified reservation key:
      a) clear any ACA condition; and
      b) abort any commands with an ACA attribute;
   and
h) for logical units that implement the PREVENT ALLOW MEDIUM REMOVAL command (see SBC-5, SSC-5, and SMC-3), the device server shall perform an action equivalent to the processing of a PREVENT ALLOW MEDIUM REMOVAL command with the PREVENT field equal to zero received on the I_T nexuses associated with the persistent reservation being preempted.

The actions described in this subclause shall be performed for all I_T nexuses that are registered with a non-zero value in the SERVICE ACTION RESERVATION KEY field, without regard for whether the preempted I_T nexuses hold the persistent reservation. If the SERVICE ACTION RESERVATION KEY field is set to zero and an all registrants persistent reservation is present, the device server shall abort all commands for all registered I_T nexuses.

5.14.11.2.7 Clearing

Any application client may release the persistent reservation and remove all registrations from a device server by issuing a PERSISTENT RESERVE OUT command with CLEAR service action through a registered I_T nexus with the following parameter:

  a) RESERVATION KEY field set to the value of the reservation key that is registered with the logical unit for the I_T nexus.

In response to this request the device server shall perform a clear by doing the following as part of an uninterrupted series of actions:

  a) release the persistent reservation, if any;
  b) remove all registration(s);
  c) ignore the contents of the SCOPE field and the TYPE field;
  d) for logical units that implement the PREVENT ALLOW MEDIUM REMOVAL command (see SBC-5, SSC-5, and SMC-3), the device server shall perform an action equivalent to the processing of a PREVENT ALLOW MEDIUM REMOVAL command with the PREVENT field equal to zero received on the I_T nexuses associated with the persistent reservation being cleared;
  e) continue normal processing of any commands from any I_T nexus that have been accepted by the device server as allowed (i.e., nonconflicting); and
  f) establish a unit attention condition for the SCSI initiator port associated with every registered I_T nexus other than the I_T nexus on which the PERSISTENT RESERVE OUT command with CLEAR service action was received, with the additional sense code set to RESERVATIONS PREEMPTED.

  NOTE 10 - Application clients should not use the CLEAR service action except during recovery operations that are associated with a specific SCSI initiator port, since the effect of the CLEAR service action defeats the persistent reservation features that protect data integrity.

5.14.11.3 Replacing lost reservations

A PERSISTENT RESERVE OUT command with the REPLACE LOST RESERVATION service action is used to:

  a) begin a recovery process for the lost persistent reservation that is managed by application clients; and
  b) cause the device server to stop terminating commands due to a lost persistent reservation (see 5.14.5.4).

If the device server has not detected that persistent reservation information has been lost (see 5.14.5.4), then the device server shall terminate a PERSISTENT RESERVE OUT command with the REPLACE LOST RESERVATION service action with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID RELEASE OF PERSISTENT RESERVATION.

An application client may replace lost reservation information by issuing a PERSISTENT RESERVE OUT command with the REPLACE LOST RESERVATION service action with:

  a) the RESERVATION KEY field set to zero;
  b) the SERVICE ACTION RESERVATION KEY field set to the value of the new reservation key (i.e., the value used to replace the lost reservation key value); and
  c) the TYPE field and the SCOPE field set to define a new persistent reservation. The scope and type of the new persistent reservation may be different than those of the lost persistent reservation.

To process a valid PERSISTENT RESERVE OUT command with the REPLACE LOST RESERVATION service action the device server shall perform the following as an uninterrupted series of actions:

a) remove the prior registrations for all I_T nexuses, if any, without establishing unit attention conditions;
b) establish a registration for the I_T nexus that is being used for the PERSISTENT RESERVE OUT command using the service action reservation key;
c) release any persistent reservations known to the device server;
d) establish a new persistent reservation for the I_T nexus that is being used for the PERSISTENT RESERVE OUT command using the contents of the SCOPE field and the TYPE field;
e) set the PRgeneration value to zero; and
f) stop terminating commands due to a lost persistent reservation (see 5.14.5.4).

After the PERSISTENT RESERVE OUT command with the REPLACE LOST RESERVATION service action has been completed with GOOD status:

a) new commands are subject to the new persistent reservation restrictions established by the command; and
b) until the APTPL bit is set to one in a PERSISTENT RESERVE OUT command with a REGISTER service action or a REGISTER AND IGNORE EXISTING KEY service action that completes with GOOD status, the persist through power loss capability is not enabled (see 5.14.5.2).

5.15 Self-test operations

5.15.1 Self-test types

The SEND DIAGNOSTIC command (see 6.39) provides methods for an application client to request that a SCSI target device perform self test operations. This standard defines the following self-tests:

a) the default self-test (see 5.15.2);
b) the short self-test (see 5.15.3); and
c) the extended self-test (see 5.15.3).

5.15.2 Default self-test

The default self-test is mandatory for all SCSI target device types that support the SEND DIAGNOSTIC command. The operations performed for the default self-test are outside the scope of this standard (e.g., performing no diagnostics and returning GOOD status is a valid default self-test). An application client requests that a SCSI target device perform a default self-test by setting the SELFTEST bit to one in the SEND DIAGNOSTIC command (see 6.39).

An application client may use the DEVOFFL bit and the UNITOFFL bit in the SEND DIAGNOSTIC command to allow the device server to perform operations during a default self-test that affect conditions for one or more logical units in the SCSI target device (e.g., if the DEVOFFL bit is set to one, then the device server may clear established reservations while performing the test, and if the UNITOFFL bit is set to one, then the logical unit may alter its medium while performing the test).

While a SCSI target device is performing a default self-test, the device server shall terminate all commands, except INQUIRY commands, REPORT LUNS commands, and REQUEST SENSE commands, with CHECK CONDITION status with the sense key set to NOT READY and the additional sense code set to LOGICAL UNIT NOT READY, SELF-TEST IN PROGRESS. If the device server receives an INQUIRY command, a

REPORT LUNS command, or a REQUEST SENSE command while performing a default self-test, then the device server shall process the command.

If the SCSI target device detects no errors during a default self-test, then the device server shall complete the command with GOOD status. If the SCSI target device detects an error during the test, then the device server shall terminate the command with CHECK CONDITION status with the sense key set to HARDWARE ERROR and the additional sense code set to indicate the cause of the error.

5.15.3 The short self-test and extended self-test

An application client may request that a SCSI target device perform a short self-test or the extended self-test by setting the SELFTEST bit to zero and specifying an appropriate value in the SELF-TEST CODE field in the SEND DIAGNOSTIC command (see 6.39).

The criteria for the short self-test are that the test has one or more segments and completes in two minutes or less. The criteria for the extended self-test are that the test has one or more segments and that the completion time required by the SCSI target device to complete the extended self-test is reported in the EXTENDED SELF-TEST COMPLETION MINUTES field in the Extended INQUIRY Data VPD page (see 7.7.7), the EXTENDED SELF-TEST COMPLETION TIME field in the Control mode page (see 7.5.13), or both.

The tests performed in the segments are vendor specific and may be the same for the short self-test and the extended self-test.

The following are examples of segments:

    a) an electrical segment wherein the logical unit tests its own electronics. The tests in this segment are vendor specific, but some examples of tests that may be included are:
       A) a buffer RAM test;
       B) a read/write circuitry test; and
       C) a test of the read/write heads;
    b) a seek/servo segment wherein a SCSI target device tests the seek capability and the servo capability; and
    c) a read/verify scan segment wherein a SCSI target device performs read scanning of some or all of the medium surface.

5.15.4 Self-test modes

5.15.4.1 Self-test modes overview

A foreground mode (see 5.15.4.2) and a background mode (see 5.15.4.3) are defined for the short self-test and the extended self-test. An application client specifies the self-test mode by the value in the SELF-TEST CODE field in the SEND DIAGNOSTIC command (see 6.39).

5.15.4.2 Foreground mode

If an application client specifies a self-test to be performed in the foreground mode, the device server shall return status for the command after the self-test has been completed.

While a SCSI target device is performing a self-test in the foreground mode, the device server shall terminate all commands, except INQUIRY commands, REPORT LUNS commands, and REQUEST SENSE commands, with CHECK CONDITION status, with the sense key set to NOT READY, and the additional sense code set to LOGICAL UNIT NOT READY, SELF-TEST IN PROGRESS. If the device server receives an INQUIRY

command, a REPORT LUNS command, or a REQUEST SENSE command while performing a self-test in the foreground mode, then the device server shall process the command.

If a SCSI target device is performing a self-test in the foreground mode and an error occurs during the test, then:

   a) the SCSI target device shall abort the self-test; and
   b) if the device server is:
      A) able to update the Self-Test Results log page (see 7.3.22), then the device server shall update the Self-Test Results log page and terminate the SEND DIAGNOSTIC command with CHECK CONDITION status, with the sense key set to HARDWARE ERROR, and the additional sense code set to LOGICAL UNIT FAILED SELF-TEST. The application client may obtain additional information about the failure by reading the Self-Test Results log page; or
      B) unable to update the Self-Test Results log page, then the device server shall terminate the SEND DIAGNOSTIC command with CHECK CONDITION status, with the sense key set to HARDWARE ERROR, and the additional sense code set to LOGICAL UNIT UNABLE TO UPDATE SELF-TEST LOG.

An application client may request a SCSI target device to abort a self-test that is being performed in the foreground mode by using:

   a) a task management function that causes the SEND DIAGNOSTIC command to be aborted (see SAM-6) (e.g., an ABORT TASK task management function, a CLEAR TASK SET task management function); or
   b) a SCSI transport protocol specific event that causes the SEND DIAGNOSTIC command to be aborted (e.g., a hard reset event) (see SAM-6).

A self-test being performed in the foreground mode shall be aborted by:

   a) an I_T nexus loss event; or
   b) a power loss expected event (see SAM-6).

If a SCSI target device aborts a self-test that is being performed in the foreground mode based on the SCSI target device receiving a task management function or a SCSI transport specific protocol event, then the device server shall update the Self-Test Results log page (see 7.3.22).

5.15.4.3 Background mode

If a device server receives a SEND DIAGNOSTIC command specifying a self-test to be performed in the background mode, then:

   a) the device server shall terminate the command if the CDB is invalid; or
   b) the device server shall:
      1) complete the command with GOOD status;
      2) initialize the next self-test results log parameter in the Self-Test Results log page (see 7.3.22) by setting:
         a) the SELF-TEST CODE field to the self-test code from the SEND DIAGNOSTIC command; and
         b) the SELF-TEST RESULTS field to Fh;
         and
      3) begin the self-test.

An application client may request that a device server abort a self-test that is being performed in the background mode by sending a SEND DIAGNOSTIC command with the SELF-TEST CODE field set to 100b (i.e., abort background self-test function). A SCSI target device shall not abort a self-test being performed in the

background mode as the result of an I_T nexus loss event (see SAM-6). A SCSI target device shall abort a self-test being performed in the background mode as the result of a power loss expected event (see SAM-6).

While the SCSI target device is performing a self-test in the background mode, the device server shall terminate with CHECK CONDITION status, with the sense key set to NOT READY and the additional sense code to LOGICAL UNIT NOT READY, SELF-TEST IN PROGRESS any received SEND DIAGNOSTIC command that meets any of the following criteria:

a) the SELFTEST bit is set to one; or
b) the SELF-TEST CODE field is set to a value other than 000b or 100b.

If the SCSI target device is performing a self-test in the background mode, and the device server receives any command that requires suspension of the self-test to process, except those listed in table 74, then:

a) the device server shall suspend the self-test;
b) the device server shall begin processing the command within two seconds after the CDB has been validated; and
c) after the command completes, the device server shall resume the self-test.

If the device server receives one of the commands listed in table 74, then the device server shall:

a) abort the self-test;
b) update the self-test log; and
c) begin processing the command within two seconds after the CDB has been validated.

Table 74 – Exception commands for background self-tests

Device type	Command	Reference
All device types	SEND DIAGNOSTIC (with SELF-TEST CODE field set to 100b) WRITE BUFFER (with the MODE field set to any download microcode mode (see table 53 in 5.5))	6.39 6.49
Direct access block	FORMAT UNIT FORMAT WITH PRESET SANITIZE START STOP UNIT REMOVE ELEMENT AND TRUNCATE RESTORE ELEMENTS AND REBUILD	SBC-5
Sequential access	ERASE FORMAT MEDIUM LOAD UNLOAD	SSC-5
Object-based storage	Any command with operation code 7Fh (i.e., all commands defined by the OSD standard)	OSD
NOTE – Device types not listed in this table do not have commands that are exceptions for background self-tests, other than those listed above for all device types.		

5.15.4.4 Features common to foreground and background self-test modes

An application client may use a REQUEST SENSE command (see 6.36) to poll for progress indication at any time during a self-test. The device server shall provide pollable REQUEST SENSE data (see 5.12.2) with the sense key set to NOT READY, the additional sense code set to LOGICAL UNIT NOT READY, SELF-TEST IN PROGRESS, and the PROGRESS INDICATION field set to indicate the progress of the self-test.

An application client may use the EBACKERR bit and the MRIE field in the Informational Exceptions Control mode page (see applicable command standard) to control the reporting of errors that occur during a background self-test operation.

An application client may obtain information about the 20 most recent self-tests, including the self-test in progress, if any, by reading the Self-Test Results log page (see 7.3.22). With the exception of progress indication, this is the only method for an application client to obtain information about self-tests performed in the background mode unless an error occurs during the self-test.

Table 75 summarizes:

   a) when a device server returns status after receipt of a self-test command;
   b) how an application client may abort a self-test;
   c) how a device server processes commands that are entered into the task set while a self-test is in progress; and
   d) how a self-test failure is reported.

Table 75 – Self-test mode summary

Self-test mode	When status is returned	How to abort the self-test	Processing of commands while a self-test is in progress	Self-test failure reporting
Fore-ground	After the self-test is complete	A task management function or reset event that causes a self-test to be aborted (see 5.15.4.2)	If the command is INQUIRY, REPORT LUNS or REQUEST SENSE, then process normally; otherwise, terminate with CHECK CONDITION status, with the sense key set to NOT READY, and the additional sense code set to LOGICAL UNIT NOT READY, SELF-TEST IN PROGRESS.	The device server terminates the SEND DIAGNOSTIC command with CHECK CONDITION status, with the sense key set to HARDWARE ERROR, and the additional sense code set to LOGICAL UNIT FAILED SELF-TEST or LOGICAL UNIT UNABLE TO UPDATE SELF-TEST LOG (see 5.15.4.2). [a]
Back-ground	After the CDB is validated	A SEND DIAGNOSTIC command with the SELF-TEST CODE field set to 100b	Process the command, except as described in 5.15.4.3.	An application client: a) checks the Self-Test Results log page (see 7.3.22) after the PROGRESS INDICATION field returned in response to a REQUEST SENSE command indicates that the self-test is complete; or b) uses the EBACKERR bit and the MRIE field (see applicable command standard) to specify a method of indicating that a failure occurred. If a failure occurs, then an additional sense code of WARNING - BACKGROUND SELF-TEST FAILED shall be returned using the method defined in the MRIE field.
[a] The device server shall not report an error until after the Self-Test Results log page is updated.				

5.16 Sequestered commands

5.16.1 Sequestered commands overview

A sequestered command is a read command or a write command (see the applicable command standard) for which processing has the potential to be delayed (see 5.16.2). Non-sequestered commands are commands that are not sequestered (e.g., INQUIRY commands are non-sequestered commands).

The non-zero value specified by the NON-SEQUESTERED COMMANDS COUNT field (see 7.5.14) specifies one of the conditions under which a sequestered command is able to become a non-sequestered command as described in this subclause (i.e., 5.16.1).

If the NON-SEQUESTERED COMMANDS COUNT field is set to zero, then the device server shall process all commands as non-sequestered commands.

Upon the initial entry to the Enabled state (see SAM-6) of a read command or a write command, if:

    a) that command is:
        A) associated with a T2 command duration limit descriptor (see 7.5.11.2) in which the BYP_SEQ bit is set to zero; or
        B) not associated with any T2 command duration limit descriptor;
        and
    b) the number of non-sequestered commands is:
        A) less than the value in the NON-SEQUESTERED COMMANDS COUNT field, then the device server shall process that command as a non-sequestered command; and
        B) greater than or equal to the value in the NON-SEQUESTERED COMMANDS COUNT field, then the device server shall process that command as a sequestered command.

If the BYP_SEQ bit is set to one in the T2 duration limit descriptor associated with a read command or a write command, then:

    a) the device server shall process that command as a non-sequestered command; and
    b) this processing may result in the number of non-sequestered commands being processed increasing to a value that is greater than the value in the NON-SEQUESTERED COMMANDS COUNT field.

If the completion of processing a non-sequestered command results in the number of non-sequestered commands becoming less than the value in the NON-SEQUESTERED COMMANDS COUNT field, then the device server shall use the method specified by the SEQUESTERED COMMANDS ORDERING field (see 7.5.14) to select a command, if any, from sequestered commands to become a non-sequestered command.

5.16.2 Sequestered commands processing

The device server shall not process a sequestered command if the processing of that command has a significant probability of causing the time required to complete a non-sequestered command to become greater than the limit set by the PERF VERSUS COMMAND DURATION GUIDELINES field (see 7.5.11). The device server may process a sequestered command if the processing of that command is able to be accomplished without causing the time required to complete a non-sequestered command to become greater than the limit set by the PERF VERSUS COMMAND DURATION GUIDELINES field.

If the device server discovers that the successful processing of a sequestered command requires retries, the device server should not continue processing that command until that command becomes a non-sequestered command.

5.17 SCSI feature sets

SCSI feature sets are sets of mandatory and optional features that are used together. SCSI feature sets are specified in normative annexes in the applicable command standard. Device servers that claim compliance with a SCSI feature set:

    a) shall support both the mandatory and the optional SCSI features that are required by the SCSI feature set; and

    b) shall not support the optional SCSI features that are prohibited from being supported by the SCSI feature set.

Application clients may use detection of feature set compliance as an indication that all features required by that feature set are supported by the device server.

Application clients should be capable of basic interoperability with the feature described by the feature set using only the features required by the feature set.

Device servers may provide additional functionality not required by a feature set and application clients may detect support of additional functionality using detection methods defined in the applicable command standard.

Device servers report compliance with the requirements specified by a SCSI feature set using the SCSI Feature Sets VPD page (see 7.7.14).

5.18 Target port group asymmetric access states

5.18.1 Target port group access overview

Logical units may be connected to one or more service delivery subsystems via multiple target ports (see SAM-6). The access to logical units through the multiple target ports may be symmetrical (see 5.18.3) or asymmetrical (see 5.18.2).

If referrals are supported (see SBC-5), then a logical unit accessed through a target port group may have different target port group asymmetric access states based on the user data segments being accessed.

5.18.2 Asymmetric logical unit access

5.18.2.1 Introduction to asymmetric logical unit access

Asymmetric logical unit access occurs when the access characteristics of one port may differ from those of another port. SCSI target devices with target ports implemented in separate physical units may designate differing levels of access for the target ports associated with each logical unit. While commands and task management functions (see SAM-6) may be routed to a logical unit through any target port, the performance may not be optimal, and the allowable command set may be less complete than when the same commands and task management functions are routed through a different target port. In addition, some target ports may be in a state (e.g., offline) that is unique to that target port. If a failure on the path to one target port is detected, the SCSI target device may perform automatic internal reconfiguration to make a logical unit accessible from a different set of target ports or may be instructed by the application client to make a logical unit accessible from a different set of target ports.

A target port characteristic called primary target port asymmetric access state (see 5.18.2.5) defines properties of a target port and the allowable command set for a logical unit when commands and task management functions are routed through the target port maintaining that state.

A primary target port group is defined as a set of target ports that are in the same primary target port asymmetric access state at all times (i.e., a change in one target port's primary target port asymmetric access state implies an equivalent change in the primary target port asymmetric access state of all target ports in the same primary target port group). A primary target port group asymmetric access state is defined as the primary target port asymmetric access state common to the set of target ports in a primary target port group. One target port is a member of at most one primary target port group for a logical unit group (see 5.18.2.2). The grouping of target ports in a primary target port group is vendor specific.

A logical unit may have commands and task management functions routed through multiple primary target port groups. Logical units support asymmetric logical unit access if different primary target port groups may be in different primary target port group asymmetric access states. Support for asymmetric logical unit access should not affect how the device server responds to unsupported commands or how the task manager responds to unsupported task management functions.

An example of asymmetric logical unit access is a SCSI controller device with two separated controllers where all target ports on one controller are in the same primary target port asymmetric access state with respect to a logical unit and are members of the same primary target port group. Target ports on the other controller are members of another primary target port group. The behavior of each primary target port group may be different with respect to a logical unit, but all members of a single primary target port group are always in the same primary target port group asymmetric access state with respect to a logical unit.

An example of primary target port groups is shown in figure 6.
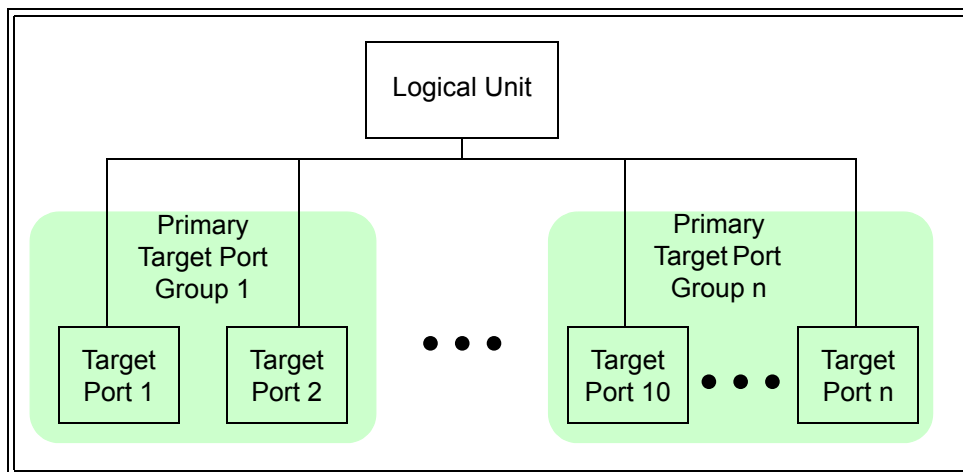
Figure 6 – Primary target port group example

Another target port characteristic called secondary target port asymmetric access state (see 5.18.2.5) indicates a condition that affects the way in which an individual target port participates in its assigned primary target port group. All target ports, if any, in one secondary target port asymmetric access state are grouped into a secondary target port group. Secondary target port groups have the following properties:

    a)   a target port in any secondary target port group also shall be in one primary target port group;
    b)   a change of secondary target port asymmetric access state for one target port shall not cause changes in the secondary target port asymmetric access state of other target ports, if any, in the same secondary target port group; and
    c)   a target port may be a member of zero or more secondary target port groups.

The term, target port asymmetric access state, represents both primary target port asymmetric access states and secondary target port asymmetric access states. The term, target port group, represents both primary target port groups and secondary target port groups.

5.18.2.2 Collections of logical units

5.18.2.2.1 Overview

Logical units that share the same primary target port group definitions may be members of a logical unit collection for the purposes of reporting primary target port asymmetric access states. A logical unit collection is identified by:

a) a logical unit group designator (see 7.7.6.9) (i.e., for members of a logical unit group); or
b) an administrative logical unit (i.e., for members of a logical unit conglomerate) (see SAM-6).

A logical unit group collection contains logical units that share the same primary target port group definitions. The primary target port groups maintain the same primary target port group asymmetric access states for all logical units that are members of a logical unit collection (i.e., a change in one logical unit's primary target port asymmetric access state implies an equivalent change in the primary target port asymmetric access state of all other logical units that are members of the same logical unit collection).

5.18.2.2.2 Non-conglomerate logical units with no logical unit group designator

If a logical unit is not a member of a logical unit conglomerate and does not return a logical unit group designator, then:

a) the device server may return independent primary target port group asymmetric access states (e.g., REPORT TARGET PORTS GROUP commands (see 6.34) sent to different logical units may return information that is specific to the logical unit that processed the command); and
b) the logical unit is not a member of a logical unit collection.

5.18.2.2.3 Non-conglomerate logical units with a logical unit group designator

A logical unit that is not a member of a logical unit conglomerate and returns a logical unit group designator (see 7.7.6.9) is a member of a logical unit collection. All logical units that indicate the same logical unit group in the logical unit group designator:

a) shall maintain the same primary target port group asymmetric access states (i.e., a change in one logical units primary target port asymmetric access state implies an equivalent change in the primary target port asymmetric access state of all other logical units that return the same logical unit group designator) (e.g., a REPORT TARGET PORTS GROUP command (see 6.34) sent to any logical unit that returns the same logical unit group designator returns the same information); and
b) are members of the logical unit collection identified by that logical unit group designator.

5.18.2.2.4 Conglomerate logical units with no logical unit group designator

If the LU COLLECTION TYPE field (see 7.7.7) for an administrative logical unit is set to 001b (i.e., conglomerate collection) then:

a) that administrative logical unit shall not return a logical unit group designator (see 7.7.6.9);
b) all subsidiary logical units associated with that administrative logical unit shall not return a logical unit group designator; and
c) if the primary target port asymmetric access states of a subsidiary logical unit associated with that administrative logical unit differ from the primary target port group asymmetric access states of that

administrative logical unit then a REPORT TARGET PORT GROUPS command (see 6.34) or a SET TARGET PORT GROUPS command (see 6.43) processed by a subsidiary logical unit using a LUN that is associated with that administrative logical unit shall be terminated with CHECK CONDITION status, with the sense key set to NOT READY, the additional sense code set to LOGICAL UNIT NOT READY, AFFILIATION REQUIRED, the COMMAND-SPECIFIC INFORMATION field set as described in 5.8.8.1, and administrative logical unit identification information set as described in 5.8.8.3.

5.18.2.2.5 Conglomerate logical units with a logical unit group designator

If the LU COLLECTION TYPE field (see 7.7.7) for an administrative logical unit is set to 010b (i.e., logical unit group collection) then:

a) that administrative logical unit shall return a non-zero logical unit group designator (see 7.7.6.9);
b) all subsidiary logical units associated with that administrative logical unit shall return a non-zero logical unit group designator;
c) all device servers that are members of the same logical unit group (i.e., return the same logical unit group designator) shall maintain the same primary target port group asymmetric access states (i.e., a change in one logical units primary target port asymmetric access state implies an equivalent change in the primary target port asymmetric access state of all other logical units that are members of the same logical unit group) (e.g., a REPORT TARGET PORTS GROUP command (see 6.34) sent to any logical unit that is a member of the same logical unit group returns the same information); and
d) if a subsidiary logical unit is associated with more than one logical unit conglomerate, then all logical units associated with each of those logical unit conglomerates shall return a non-zero logical unit group designator.

5.18.2.2.6 Logical unit group designator changes

If the primary target port group asymmetric access states for a logical unit change to be different than the primary target port group asymmetric access states for all other logical units that are members of the same logical unit group, then the device server shall:

a) change the logical unit group designator associated with that logical unit to the logical unit group designator of a logical unit group that shares the same primary target port group asymmetric access states; and
b) establish a unit attention condition (see SAM-6) for the SCSI initiator port associated with every I_T nexus, with the additional sense code set to INQUIRY DATA HAS CHANGED.

5.18.2.3 Explicit and implicit asymmetric logical unit access

Asymmetric logical unit access may be managed explicitly by an application client using the REPORT TARGET PORT GROUPS (see 6.34) command and SET TARGET PORT GROUPS (see 6.43) command.

Alternatively, asymmetric logical unit access may be managed implicitly by the SCSI target device based on the type of transactions being routed through each target port and the internal configuration capabilities of the primary target port group(s) through which the logical unit may be accessed. The logical units may attempt to maintain full performance across the primary target port groups that are busiest and that show the most reliable performance, allowing other primary target port groups to select a lower performance primary target port asymmetric access state.

Implicit management of secondary target port asymmetric access states is based on the condition of an individual target port and how such conditions affect that target port's ability to participate in its assigned primary target port group.

If both explicit and implicit asymmetric logical unit access management methods are implemented, the precedence of one over the other is vendor specific.

5.18.2.4 Discovery of asymmetric logical unit access behavior

SCSI logical units with asymmetric logical unit access may be identified using the INQUIRY command. The value in the target port group support (TPGS) field (see 6.7.2) indicates whether or not the logical unit supports asymmetric logical unit access and if so whether implicit or explicit management is supported. The target port asymmetric access states supported by a logical unit may be determined by the REPORT TARGET PORT GROUPS command parameter data (see 6.34).

5.18.2.5 Target port asymmetric access states

5.18.2.5.1 Target port asymmetric access states overview

For all SCSI target devices that report in the INQUIRY data that they support asymmetric logical unit access, all of the target ports in a primary target port group (see 5.18.2.1) shall be in the same primary target port asymmetric access state with respect to the ability to route information to a logical unit. The primary target port asymmetric access states are:

   a) active/optimized;
   b) active/non-optimized;
   c) standby;
   d) unavailable; and
   e) logical block dependent.

Individual target ports may be in secondary target port groups (see 5.18.2.1) that have the following secondary target port asymmetric access states:

   a) offline.

5.18.2.5.2 Active/optimized state

The active/optimized state is a primary target port asymmetric access state. While commands and task management functions are being routed through a target port in the active/optimized primary target port asymmetric access state, the device server shall function (e.g., respond to commands) as specified in the appropriate command standards. All target ports within a primary target port group should be capable of immediately accessing the logical unit.

The SCSI target device shall participate in all task management functions as defined in SAM-6 and modified by the applicable SCSI transport protocol standards.

5.18.2.5.3 Active/non-optimized state

The active/non-optimized state is a primary target port asymmetric access state. While commands and task management functions are being routed through a target port in the active/non-optimized primary target port asymmetric access state, the device server shall function as specified in the appropriate command standards.

The processing of some task management functions and commands, especially those involving data transfer or caching, may operate with lower performance than they would if the target port were in the active/optimized primary target port asymmetric access state.

The SCSI target device shall participate in all task management functions as defined in SAM-6 and modified by the applicable SCSI transport protocol standards.

5.18.2.5.4 Standby state

The standby state is a primary target port asymmetric access state. While being accessed through a target port in the standby primary target port asymmetric access state, the device server shall support those of the following commands that it supports while in the active/optimized primary target port asymmetric access state:

a) INQUIRY;
b) LOG SELECT;
c) LOG SENSE;
d) MODE SELECT;
e) MODE SENSE;
f) REPORT LUNS;
g) RECEIVE DIAGNOSTIC RESULTS;
h) SEND DIAGNOSTIC;
i) REPORT TARGET PORT GROUPS;
j) SET AFFILIATION;
k) SET TARGET PORT GROUPS;
l) REQUEST SENSE;
m) PERSISTENT RESERVE IN;
n) PERSISTENT RESERVE OUT;
o) TEST UNIT READY;
p) UNBIND;
q) echo buffer modes of READ BUFFER; and
r) echo buffer modes of WRITE BUFFER.

The device server may support other commands while in the standby state.

While in the standby state, the device server shall terminate commands that are not supported in the standby state and should terminate TEST UNIT READY commands with CHECK CONDITION status, with the sense key set to NOT READY, and the additional sense code set to LOGICAL UNIT NOT ACCESSIBLE, TARGET PORT IN STANDBY STATE.

The SCSI target device shall participate in all task management functions as defined in SAM-6 and modified by the applicable SCSI transport protocol standards.

5.18.2.5.5 Unavailable state

The unavailable state is a primary target port asymmetric access state. While being accessed through a target port in the unavailable primary target port asymmetric access state, the device server shall accept only a limited set of commands. The unavailable primary target port asymmetric access state is intended for situations where the target port accessibility to a logical unit may be severely constrained due to SCSI target device limitations (e.g., hardware errors). Therefore it may not be possible to transition from the unavailable state to the active/optimized state, the active/non-optimized state, or the standby state. The unavailable primary target port asymmetric access state is also intended for minimizing any disruption when using the downloading microcode modes of the WRITE BUFFER command (see 5.5).

While in the unavailable primary target port asymmetric access state, the device server shall support those of the following commands that it supports while in the active/optimized state:

a) INQUIRY (the peripheral qualifier (see 6.7.2) shall be set to 001b);
b) REPORT LUNS;
c) REPORT TARGET PORT GROUPS;
d) SET AFFILIATION;
e) SET TARGET PORT GROUPS;

    f)   REQUEST SENSE;
    g)   TEST UNIT READY;
    h)   UNBIND;
    i)   echo buffer modes of READ BUFFER;
    j)   echo buffer modes of WRITE BUFFER; and
    k)   download microcode mode of WRITE BUFFER.

The device server may support other commands while in the unavailable state.

While in the unavailable state, the device server shall terminate commands that are not supported in the unavailable state and should terminate TEST UNIT READY commands with CHECK CONDITION status, with the sense key set to NOT READY, and the additional sense code set to LOGICAL UNIT NOT ACCESSIBLE, TARGET PORT IN UNAVAILABLE STATE.

The SCSI target device should participate in all task management functions (see SAM-6 and the applicable SCSI transport protocol standards).

5.18.2.5.6 Offline state

The offline state is a secondary target port asymmetric access state. Target ports in the offline secondary target port asymmetric access state are not accessible via the service delivery subsystem (e.g., during maintenance, port replacement, port disabled, hot swap, or power failures that affect only a subset of target ports). While in the offline secondary target port asymmetric state, the target port is not capable of receiving or responding to any commands or task management functions.

The offline secondary target port asymmetric access state allows a device server to report that some target ports are not capable of being accessed.

After access to the service delivery subsystem is enabled, the target port shall transition out of the offline secondary target port asymmetric access state.

5.18.2.5.7 Logical block dependent state

The logical block dependent state is a primary target port asymmetric access state. The logical block dependent state only occurs if the device server supports referrals (see 7.7.7).

The target port asymmetric access state for a user data segment shall be one of the following target port asymmetric access states:

    a)   active/optimized;
    b)   active/non-optimized;
    c)   transitioning; or
    d)   unavailable.

An application client may determine the target port asymmetric access state for user data segments by issuing a REPORT REFERRALS command (see SBC-5).

5.18.2.6 Transitions between target port asymmetric access states

The movement from one target port asymmetric access state to another is called a transition.

During a transition between target port asymmetric access states the device server shall respond to a command in one of the following ways:

a) if during the transition the logical unit is inaccessible, then the transition is performed as a single indivisible event and the device server shall respond by either returning BUSY status, or returning CHECK CONDITION status, with the sense key set to NOT READY, and the sense code set to LOGICAL UNIT NOT ACCESSIBLE, ASYMMETRIC ACCESS STATE TRANSITION; or

b) if during the transition the target ports in a primary target port group are able to access the requested logical unit, then:
   A) the device server shall support those of the following commands that it supports in the active/optimized primary target port asymmetric access state:
      a) INQUIRY;
      b) REPORT LUNS;
      c) REPORT TARGET PORT GROUPS;
      d) REQUEST SENSE;
      e) TEST UNIT READY;
      f) echo buffer modes of READ BUFFER; and
      g) echo buffer modes of WRITE BUFFER;
   B) the device server may support other commands when those commands are routed through a target port that is transitioning between primary target port asymmetric access states;
   C) during a transition, the device server shall terminate commands that are not supported during a transition and should terminate TEST UNIT READY commands with CHECK CONDITION status, with the sense key set to NOT READY, and the additional sense code set to LOGICAL UNIT NOT ACCESSIBLE, ASYMMETRIC ACCESS STATE TRANSITION; and
   D) the SCSI target device should participate in all task management functions (see SAM-6 and the applicable SCSI transport protocol standard).

If the transition was explicit to a supported target port asymmetric access state and it failed, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to HARDWARE ERROR, and the additional sense code set to SET TARGET PORT GROUPS COMMAND FAILED. If the transition was to a primary target port asymmetric access state, the primary target port group that encountered the error should complete a transition to the unavailable primary target port asymmetric access state.

If a target port asymmetric access state change occurred as a result of the failed transition, then the device server shall establish a unit attention condition for the SCSI initiator port associated with every I_T nexus other than the I_T nexus on which the SET TARGET PORT GROUPS command was received with the additional sense code set to ASYMMETRIC ACCESS STATE CHANGED.

If the transition was implicit and it failed, then the device server shall establish a unit attention condition for the SCSI initiator port associated with every I_T nexus with the additional sense code set to IMPLICIT ASYMMETRIC ACCESS STATE TRANSITION FAILED.

An implicit CLEAR TASK SET task management function may be performed following a transition failure.

Once a transition is completed, the new target port asymmetric access state may apply to some or all commands entered into the task set before the completion of the transition. The new target port asymmetric access state shall apply to all commands received by the device server after completion of a transition.

If a transition is to the offline secondary target port asymmetric access state, communication with the service delivery subsystem shall be terminated. This may result in commands being terminated and may cause command timeouts to occur on the initiator.

After an implicit target port asymmetric access state change, a device server shall establish a unit attention condition for the SCSI initiator port associated with every I_T nexus with the additional sense code set to ASYMMETRIC ACCESS STATE CHANGED.

After an explicit target port asymmetric access state change, a device server shall establish a unit attention condition with the additional sense code set to ASYMMETRIC ACCESS STATE CHANGED for the SCSI initiator port associated with every I_T nexus other than the I_T nexus on which the SET TARGET PORT GROUPS command was received.

5.18.2.7 Preference indicator

A device server may indicate one or more primary target port groups is a preferred primary target port group for accessing a logical unit by setting the PREF bit to one in the target port group descriptor (see 6.34). The preference indication is independent of the primary target port asymmetric access state.

An application client may use the PREF bit value in the target port group descriptor to influence the path selected for a logical unit (e.g., a primary target port group in the standby primary target port asymmetric access state with the PREF bit set to one may be chosen over a primary target port group in the active/optimized primary target port asymmetric access state with the PREF bit set to zero).

The value of the PREF bit for a primary target port group may change whenever a primary target port asymmetric access state changes.

5.18.2.8 Target port asymmetric access state reporting

Target port asymmetric access state information is reported in a target port group descriptor (see table 272) in the parameter data returned by the REPORT TARGET PORT GROUPS command (see 6.34). Each target port group descriptor indicates the asymmetric access state for all target ports contained in the indicated target port group (i.e., all target ports described in the target port descriptors contained in the target port group descriptor). A primary asymmetric access state (see table 273) applies to all logical units in the same logical unit group (see 5.18.2.2).

The parameter data returned by each REPORT TARGET PORT GROUPS command is independent (e.g., the device server may return different values in the ASYMMETRIC ACCESS STATE field (see table 272) for the same target port group in the parameter data returned by REPORT TARGET PORT GROUPS commands received through different target ports).

The information returned in the target port group descriptor that contains a target port descriptor with a relative target port identifier that matches the relative target port identifier of the target port through which the REPORT TARGET PORTS GROUP command is received shall be the current information.

EXAMPLE – An application client sends two REPORT TARGET PORT GROUPS commands to the logical unit shown in figure 6. The commands are received via different target ports with target port identifiers 2 and 10. Although the command that is received via the target port with relative target port identifier 2 returns the current information for the target port group that contains the target port with relative target port identifier 2, the command may not return the current information for the target port group that contains the target port with relative target port identifier 10. The converse is true for the command that is received via the target port with relative target port identifier 10. Although the command that is received via the target port with relative target port identifier 10 returns the current information for the target port group that contains the target port with relative target port identifier 10, the command may not return the current information for the target port group that contains the target port with relative target port identifier 2.

If an application client detects different parameter data returned by REPORT TARGET PORT GROUPS commands for the same target port group (i.e., both current information and information that may not be current), then the application client should use the current information.

5.18.2.9 Implicit asymmetric logical units access management

SCSI target devices with implicit asymmetric logical units access management are capable of using mechanisms other than the SET TARGET PORT GROUPS command to set:

a) the primary target port asymmetric access state of a primary target port group; or
b) the secondary target port asymmetric access state of a target port that is a member of a primary target port group.

All logical units that report in the standard INQUIRY data (see 6.7.2) that they support asymmetric logical unit access and support implicit asymmetric logical unit access (i.e., the TPGS field is set to 01b or 11b):

a) shall implement the INQUIRY command Device Identification VPD page designator type 4h (see 7.7.6.7) and designator type 5h (see 7.7.6.8);
b) shall support the REPORT TARGET PORT GROUPS command as described in 6.34; and
c) may implement the INQUIRY command Device Identification VPD page designator type 6h (see 7.7.6.9).

Implicit logical unit access state changes between primary target port asymmetric access states may be disabled with the IALUAE bit in the Control Extension mode page (see 7.5.14).

5.18.2.10 Explicit asymmetric logical units access management

All logical units that report in the standard INQUIRY data (see 6.7.2) that they support asymmetric logical units access and support explicit asymmetric logical unit access (i.e., the TPGS field is set to 10b or 11b):

a) shall implement the INQUIRY command Device Identification VPD page designator type 4h (see 7.7.6.7) and designator type 5h (see 7.7.6.8);
b) shall support the REPORT TARGET PORT GROUPS command as described in 6.34;
c) shall support the SET TARGET PORT GROUPS command as described in 6.43; and
d) may implement the INQUIRY command Device Identification VPD page designator type 6h (see 7.7.6.9).

5.18.2.11 Behavior after power on, hard reset, logical unit reset, and I_T nexus loss

For all SCSI target devices that report in the standard INQUIRY data (see 6.7.2) that they support only explicit asymmetric logical unit access (i.e., the TPGS field is set to 10b), the target port shall preserve the primary target port asymmetric access state during any power on, hard reset, logical unit reset, and I_T nexus loss.

5.18.2.12 Behavior of target ports that are not accessible from the service delivery subsystem

If the offline secondary target port asymmetric access state is supported and a subset of the target ports in a primary target port group are not accessible via the service delivery subsystem (e.g., power failure), then those ports may be reported in a primary target port group consistent with their primary target port asymmetric access state and in the secondary target port group with the offline secondary target port asymmetric access state.

5.18.3 Symmetric logical unit access

A device server that provides symmetrical access to a logical unit may use a subset of the asymmetrical logical access features (see 5.18.2) to indicate this ability to an application client, providing an application client a common set of commands to determine how to manage target port access to a logical unit.

Symmetrical logical unit access should be represented as follows:

    a) the TPGS field in the standard INQUIRY data (see 6.7.2) indicates that implicit asymmetric access is
       supported;
    b) the REPORT TARGET PORT GROUPS command is supported; and
    c) the REPORT TARGET PORT GROUPS parameter data indicates that the same state (e.g.,
       active/optimized state) is in effect for all primary target port groups.

5.19 Third-party copies

5.19.1 General considerations for third-party copies

Third-party copy commands (see 5.19.3) cause a copy manager to perform copy operations (see 5.19.4.3)
that transfer data as follows:

    a) from specified areas of the medium within a logical unit to different areas within the same logical unit;
    b) from one logical unit to another within a SCSI target device; or
    c) from one SCSI target device to another SCSI target device.

The transfers requested by a third-party copy command are managed by a copy manager (see 5.19.2) that is
contained in a logical unit (see SAM-6). The copy manager is responsible for transferring data from copy
sources to copy destinations (e.g., reading from the copy sources, buffering as needed, and writing to the
copy destinations).

Application clients and other copy managers request third-party copy operations by sending commands (see
5.19.3) to a copy manager for processing by that copy manager. Copy managers provide information about
their capabilities to application clients in the Third-party Copy VPD page (see 7.7.18).

A Copy Group is a set of logical units that have a high probability of using high performance methods (e.g.,
copy on write snapshot) for third-party copy operations involving logical units that are in the same Copy
Group. Each logical unit may be a member of zero or one Copy Group. A logical unit indicates membership in
a Copy Group using the Copy Group Identifier third-party copy descriptor (see 7.7.18.13).

If a third-party copy operation involves logical units that are in different Copy Groups, then that third-party copy
operation has a high probability of using low performance methods (e.g., copy manager read operations from
the source CSCD or copy manager write operations to the destination CSCD).

A copy manager is not required to support all the third-party copy features described in 5.19, but if a copy
manager supports copies from one SCSI target device to another SCSI target device, then the copy manager
shall support copies from one logical unit to another logical unit within the same SCSI target device.

If a logical unit contains a copy manager that supports any of the commands described in 5.19.3, then the 3PC
bit shall be set to one in the standard INQUIRY data (see 6.7.2).

5.19.2 Copy manager model

A copy manager is:

a) a kind of device server that processes the commands described in 5.19.3 using foreground or background copy operations (see 5.19.4.3); and
b) a kind of application client that sends commands to other device servers and copy managers, possibly in other SCSI target devices, as necessary to perform the copy operation originated by a third-party copy command (see 5.19.4.3).

If a copy manager interacts with a copy manger in another SCSI target device, these interactions may occur over a SCSI transport protocol or over a non-SCSI transport.

Upon the successful completion of a copy operation (see 5.19.4.3), the copy manager shall have produced the results specified by the command that originated the copy operation in accordance with this standard or the applicable command standard (e.g., SBC-5 for the WRITE USING TOKEN command). For interoperability, this standard or the applicable command standard may place requirements on the copy manager using terminology based on specific commands and parameter data (e.g., specific instances of the EXTENDED COPY command). These are only functional descriptions of the required copy manager behavior. Any copy manager implementation that produces the specified results and does not violate interoperability may be used.

A copy manager may be contained in:

a) the same logical unit as the device server for a data storage device (e.g., a direct access block device (see SBC-5) or sequential access device (see SSC-5)); or
b) a standalone SCSI target device whose only purpose is to contain one or more logical units that contain copy managers.

If the copy manager is contained in the same logical unit as the device server for a data storage device, then the following requirements shall apply:

a) the PERIPHERAL DEVICE TYPE field in the standard INQUIRY data (see 6.7.2) shall indicate the device type associated with the device server;
b) the copy manager shall have the same access to the data storage media associated with the logical unit that contains the copy manager as any other application client for the purposes of processing third-party copy commands and operations (see 5.19.3);
c) the copy manager shall be able to access all other device servers and copy managers located in the same SCSI target device as the copy manager; and
d) the copy manager may or may not be able to access device servers and copy managers located in other SCSI target devices.

If the copy manager is contained in a standalone SCSI target device whose only purpose is to contain logical units that contain copy managers, then the following requirements shall apply:

a) the PERIPHERAL DEVICE TYPE field in the standard INQUIRY data (see 6.7.2) shall indicate that the device is a processor type device (see SPC-2);
b) the device server may or may not implement any of the specialized processor device type commands (e.g., SEND); and
c) the copy manager shall be able to access device servers and copy managers in at least one other SCSI target device for the purposes of processing third-party copy commands and operations.

Within a SCSI target device, a copy manager shall not have access to SCSI ports that are not accessible to the device server in the same logical unit (e.g., due to restrictions imposed by asymmetric logical unit access features (see 5.18.2)), but a copy manager may have access to non-SCSI data transports. As a result:

   a) if a copy manager has access to only one SCSI port, then the copy operations performed by the copy manager are limited to a single SCSI domain;
   b) if a copy manager has access to multiple SCSI ports some of which are in different SCSI domains, then the copy operations performed by the copy manager are limited to the accessible SCSI domains, but may transfer data from one SCSI domain to another; or
   c) if a copy manager has access to non-SCSI data transports, then the copy operations performed by the copy manager may transfer data from one SCSI domain to another SCSI domain that is not accessible to the device server associated with the copy manager.

In response to interactions with other copy managers, a copy manager may process requests for copy operations even if the copy manager does not implement an equivalent third-party copy command (see 5.19.3).

EXAMPLE – Suppose a copy manager has access to a non-SCSI transport that transfers data in message IUs instead of SCSI reads and writes. Even though no SCSI commands are performed, the copy manager is allowed to process a write command as an EXTENDED COPY command (see 6.6) with the data to be written contained in the inline data portion of the parameter data. The copy manager is also allowed to process a read command as an EXTENDED COPY command that generates held data (see 5.19.4.5) followed by a RECEIVE COPY DATA command (see 6.22) to retrieve the held data. The same copy manager may indicate that it supports only the POPULATE TOKEN command (see SBC-5), WRITE USING TOKEN command (see SBC-5), and RECEIVE ROD TOKEN INFORMATION command (see 6.25 and SBC-5).

Figure 7 shows examples copy manager configurations and third-party copies they may perform.
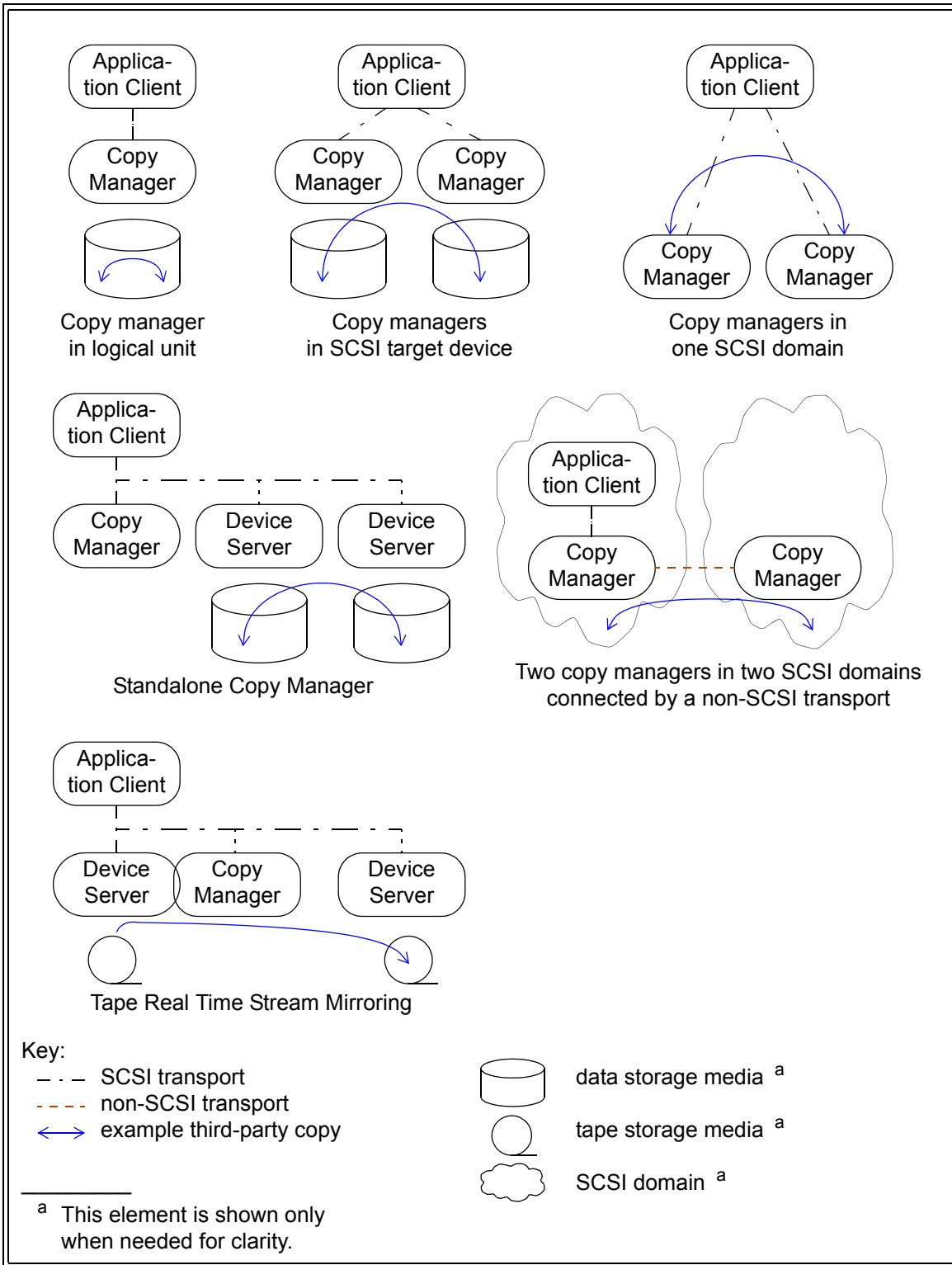
Figure 7 – Examples of copy manager configurations

5.19.3 Third-party copy commands

The commands processed by copy managers (i.e., third-party copy commands) are shown in table 76.

Table 76 – Third-party copy commands

Command	Operation code [a]	Command type	Reference
COPY OPERATION ABORT	83h/1Ch	abort	6.4
COPY OPERATION CLOSE	83h/1Dh	close	6.5
EXTENDED COPY	83h/01h	originate	6.6
EXTENDED COPY(LID1)			SPC-4
POPULATE TOKEN	83h/10h	originate	SBC-5
RECEIVE COPY DATA	84h/06h	retrieve	6.22
RECEIVE COPY DATA(LID1)			SPC-4
RECEIVE COPY OPERATING PARAMETERS			SPC-4
RECEIVE COPY FAILURE DETAILS(LID1)			SPC-4
RECEIVE COPY STATUS	84h/05h	retrieve	6.23
RECEIVE COPY STATUS(LID1)			SPC-4
RECEIVE ROD TOKEN INFORMATION	84h/07h	retrieve	6.25
REPORT ALL ROD TOKENS	84h/08h	retrieve	6.28
REPORT TAPE STREAM MIRRORING	84h/16h	retrieve	SSC-5
SET TAPE STREAM MIRRORING	83h/16h	originate	ADC-4 and SSC-5
WRITE USING TOKEN	83h/11h	originate	SBC-5
Reserved	all others [b]		

Key:
  abort   third-party copy command that aborts a specified copy operation
  close   third-party copy command that ends a specified copy operation
  originate   third-party copy command that requests the processing of a copy operation
  retrieve   third-party copy command that retrieves the results (e.g., status data or held data) for a
                previously originated copy operation

[a] All copy manager commands are defined by a combination of operation code and service action. The operation code value is shown preceding the slash and the service action value is shown after the slash.
[b] All service actions of operation code 83h and operation code 84h not shown in this table are reserved.

Copy manager support for third-party copy commands is optional, but support for some third-party copy commands and features may require support for other third-party copy commands as shown in table 77.

Table 77 – Mandatory copy manager command support requirements

Supported command	Optional command features supported		Copy manager support for the following commands is mandatory
	Held data ^a	R_TOKEN bit ^b	
COPY OPERATION ABORT	n/a	n/a	RECEIVE COPY STATUS
COPY OPERATION CLOSE	n/a	n/a	RECEIVE COPY STATUS
EXTENDED COPY	n/a	n/a	RECEIVE COPY STATUS
EXTENDED COPY	yes	n/a	RECEIVE COPY DATA
EXTENDED COPY	n/a	yes	RECEIVE ROD TOKEN INFORMATION
POPULATE TOKEN	n/a	n/a	See SBC-5
SET TAPE STREAM MIRRORING	n/a	n/a	See SSC-5
WRITE USING TOKEN	n/a	n/a	See SBC-5
^a Held data (see 5.19.4.5) refers to support for the ability to hold some or all of the data processed by a copy operation for later transfer to the application client (e.g., support for the stream →discard& application client segment descriptor (see 6.6.6.8)).			
^b R_TOKEN bit refers to support for the ability to create ROD tokens that are later returned to the application client (i.e., support for the R_TOKEN bit being set to one in the ROD CSCD descriptor (see 6.6.5.10)).			

If a copy manager supports a third-party copy command in which the IMMED bit, if any, is allowed to be set to one, then the copy manager shall support the COPY OPERATION ABORT command (see 6.4).

5.19.4 Third-party copy command usage

5.19.4.1 Prior to sending a third-party copy command

The application client may use the information provided in the Third-Party Copy VPD page (see 7.7.18) for the source CSCD and the Third-Party Copy VPD page for the destination CSCD to determine if those logical units are appropriate candidates for third-party copy operations as described in 5.19.1.

Before the copy manager is instructed to transfer data, the application client requesting the data transfers shall take any necessary actions required to prepare the copy sources and copy destinations (see 5.19.1). Such preparatory actions include but are not limited to:

a) loading tapes;
b) sending media changer commands;
c) sending MODE SELECT commands, including MODE SELECT commands that:
  A) disable reporting of recovered errors by a block CSCD by setting the PER bit to zero in the Read-Write Error Recovery mode page (see SBC-5);
  B) disable reporting of recovered errors by a stream CSCD by setting the PER bit to zero in the Read-Write Error Recovery mode page (see SSC-5); and/or
  C) disable reporting of thin provisioning threshold events by a block CSCD by setting the LBPERE bit to zero in the Read-Write Error Recovery mode page;

d) sending persistent reservation commands;
e) sending tape positioning commands; and/or
f) performing the preparatory actions, if any, described in the applicable command standards.

After all preparatory actions have been completed, the third-party copy command (e.g., the EXTENDED COPY command) should be sent to the copy manager to originate the copy operation (see 5.19.4.3).

5.19.4.2 List identifiers for third-party copy commands

A third-party copy command (see 5.19.3) may:

a) take a long time to complete;
b) have substantial command-specific data to return upon the completion of processing (e.g., held data (see 5.19.4.4)); and
c) be processed as a background operation (e.g., in response to an IMMED bit being set to one (see 5.19.4.3)).

List identifiers allow an application client to specify the copy operation (see 5.19.4.3) for which a monitoring function or management function is to be performed, as follows:

1) the application client specifies the list identifier by which a third-party copy operation is to be identified in the command or parameter list that originates the copy operation; and
2) the application client specifies the same list identifier in any command that monitors or manages the copy operation:
   A) starting from the time the copy operation is originated; and
   B) continuing until:
      a) all data associated with the copy operation has been delivered to the application client; or
      b) the application client specifies that the associated data is to be discarded.

List identifiers are specified in a LIST IDENTIFIER field whose location depends on the third-party command being processed.

Unless otherwise specified, the LIST IDENTIFIER field contains a value that uniquely identifies a copy operation among all those being processed that were received on a specific I_T nexus. If the copy manager detects a duplicate list identifier value, then the copy manager shall terminate the originating third-party copy command (see table 76 in 5.19.3) with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to OPERATION IN PROGRESS.

5.19.4.3 Third-party copy commands and operations

Third-party copy commands that originate copy operations (see table 76 in 5.19.3) may support the IMMED bit to allow the application client to specify that the processing of a copy operation continue after the processing of the originating command has been completed.

If a third-party copy command supports an IMMED bit and that IMMED bit is set to one, the copy manager:

1) shall return CHECK CONDITION status if any errors are detected in the CDB;
2) shall transfer all of the parameter list, if any, to the copy manager;
3) may validate the parameter list and return CHECK CONDITION status if errors are detected;
4) shall complete the command with GOOD status; and
5) shall complete processing of all specified copy operations as a background operation (see SAM-6).

A third-party copy command definition may place additional restrictions on the use of the IMMED bit.

If the IMMED bit is not supported by a command, then the copy manager shall process that command as if the IMMED bit were set to zero.

If the IMMED bit, if any, is set to:

   a) zero, then the copy manager shall not complete processing of the third-party copy command until the copy manager has completed processing of the copy operation originated by the command (i.e., the copy manager processes the copy operation in the foreground); or
   b) one, then the copy manager may complete processing of the third-party copy command that originated the copy operation before completing the copy operation (i.e., the copy manager processes the copy operation in the background). Copy operations that are processed in the background shall not generate deferred errors (see SAM-6) for the errors encountered, if any, during this processing. Instead, the error information (e.g., status, sense key, additional sense code) shall be made available to the application client through use of one of the commands described in 5.19.4.4.

5.19.4.4 Monitoring progress of and retrieving results from third-party copy commands

The RECEIVE COPY STATUS command (see 6.23) returns information about the current processing status of the copy operation (see 5.19.4.3) specified by the list identifier (see 5.19.4.2). The parameter data for the following commands contain the parameter data for the RECEIVE COPY STATUS command as a header (i.e., the shared third-party copy status header):

   a) RECEIVE COPY DATA (see 6.23); and
   b) RECEIVE ROD TOKEN INFORMATION (see 6.25).

The status information for a copy operation (see 5.19.4.3) shall be available at any time the copy operation is in progress (i.e., whenever the COPY OPERATION STATUS field is set to 10h, 11h, or 12h).

After the completion of a copy operation (see 5.19.4.3) (i.e., whenever the COPY OPERATION STATUS field is set to 01h, 02h, 03h, 05h, 06h or 60h), the copy manager shall preserve all status information for that copy operation for a vendor specific period of time. The copy manager shall discard the status information in which the COPY OPERATION STATUS field is set to 01h, 02h, 03h, 05h, 06h or 60h if:

   a) another third-party copy command that originates a copy operation (see table 76 in 5.19.3) is received on the same I_T nexus and the list identifier matches the list identifier associated with the status information;
   b) the copy manager detects a logical unit reset condition or I_T nexus loss condition (see SAM-6); or
   c) the copy manager requires the resources used to preserve the status information.

The copy manager may discard the sense data in the status information in which the COPY OPERATION STATUS field is set to 01h, 02h, 03h, 05h, 06h or 60h after that data has been returned by a RECEIVE COPY STATUS command received on the same I_T nexus with a matching list identifier.

The copy manager shall not discard the status information for a copy operation (see 5.19.4.3) in response to:

   a) an ABORT TASK task management function (see SAM-6);
   b) an ABORT TASK SET task management function;
   c) a CLEAR TASK SET task management function;
   d) a PERSISTENT RESERVE OUT command with PREEMPT AND ABORT service action (see 6.15);
   e) a COPY OPERATION ABORT command (see 6.4); or
   f) a COPY OPERATION CLOSE command (see 6.5).

In the parameter data for all the commands with the shared third-party copy status header, the contents of the COPY OPERATION STATUS field (see table 230 in 6.23) indicate the current processing status of the specified copy operation. Unless otherwise specified, the contents of the COPY OPERATION STATUS field are not affected by whether the copy operation is being or was performed in the foreground or background.

5.19.4.5 Held data

A copy operation may hold some or all of the data it processes for retrieval by the application client (e.g., the processing defined for the EXTENDED COPY command stream→stream&application client segment descriptor (see 6.6.6.5)). Held data is retrieved using the RECEIVE COPY DATA command (see 6.22).

If a copy manager supports any third-party copy commands (see 5.19.3) or an EXTENDED COPY command copy function (see 6.6.6) capable of holding data for retrieval by the application client, then the copy manager shall support the RECEIVE COPY DATA command and the Third-party Copy VPD page Held Data descriptor (see 7.7.18.12).

After the completion of a third-party copy command that originates a copy operation (see table 76 in 5.19.3), the copy manager shall preserve all held data for a vendor specific period of time. The application client should retrieve the held data (e.g., by sending a third-party copy command that retrieves the results of a previously originated copy operation (see table 76 in 5.19.3)) as soon as possible after the completion of the copy operation to increase the probability of retrieving the data before that data is discarded by the copy manager. The copy manager shall discard the held data:

 a) after all the held data for a specific copy operation has been successfully transferred to the application client;
 b) if a RECEIVE COPY DATA command (see 6.22) has been received on the same I_T nexus with a matching list identifier (see 5.19.4.2), with the ALLOCATION LENGTH field set to zero;
 c) if another third-party copy command that originates a copy operation is received on the same I_T nexus and the list identifier matches the list identifier associated with the held data;
 d) if the copy manager detects a logical unit reset condition or I_T nexus loss condition (see SAM-6); or
 e) if the copy manager requires the resources used to preserve the held data.

The copy manager shall not discard the held data in response to:

 a) an ABORT TASK task management function (see SAM-6);
 b) an ABORT TASK SET task management function;
 c) a CLEAR TASK SET task management function;
 d) a PERSISTENT RESERVE OUT command with PREEMPT AND ABORT service action (see 6.15);
 e) a COPY OPERATION ABORT command (see 6.4); or
 f) a COPY OPERATION CLOSE command (see 6.5).

The copy manager indicates the minimum amount of held data it supports in the HELD DATA LIMIT field that is returned in the Held Data descriptor (see 7.7.18.12) in the Third-party Copy VPD page (see 7.7.18).

The HELD DATA LIMIT field indicates the length, in bytes, of the minimum amount of data the copy manager shall hold for return to the application client. If the processing of a copy operation requires more data to be held, the copy manager may discard some of the held data in a vendor specific manner that retains the held bytes from the most recently processed portion of the copy operation. The discarding of held data bytes shall not be considered an error.

The held data discarded (HDD) bit indicates whether held data has been discarded for the copy operation specified by a list identifier (see 5.19.4.2). If the HDD bit is set to one, held data has been discarded. If the HDD bit is set to zero, held data has not been discarded. The HDD bit is in the parameter data for the RECEIVE COPY DATA command (see 6.22).

5.19.4.6 Aborting third-party copy commands and copy operations

A task manager shall ensure that all commands and data transfers generated by a third-party copy operation have been terminated and are no longer transferring data before allowing the completion of the task management function or command (e.g., the PERSISTENT RESERVE OUT command with PREEMPT AND ABORT service action) in response to the following causes for the termination of a third-party copy command:

a) an ABORT TASK task management function (see SAM-6);
b) an ABORT TASK SET task management function (see SAM-6);
c) a CLEAR TASK SET task management function (see SAM-6);
d) a PERSISTENT RESERVE OUT command with PREEMPT AND ABORT service action (see 5.14.11.2.6); and
e) other SCSI device conditions described in SAM-6 that abort copy operations.

5.19.4.7 The COPY OPERATION ABORT command

Aborting a copy operation is not always possible with a task management function (e.g., a copy operation (see 5.19.4.3) that was originated by a third-party copy command with the IMMED bit set to one). The COPY OPERATION ABORT command (see 6.4) provides an abort capability that is equivalent to an ABORT TASK task management function for any copy operation that is able to be specified with a list identifier (see 5.19.4.2) without regard for whether the copy operation is being performed in the foreground or background (see 5.19.4.3).

Before completing the COPY OPERATION ABORT command, the copy manager shall ensure that all commands and data transfers generated by that copy operation have been terminated and are no longer transferring data.

All foreground copy operations and background copy operations associated with the specified list identifier shall be terminated with CHECK CONDITION status with the sense key set to COPY ABORTED and the additional sense code set to COMMANDS CLEARED BY DEVICE SERVER (see 5.19.4.3).

5.19.4.8 The COPY OPERATION CLOSE command

The COPY OPERATION CLOSE command (see 6.5) provides the capability of ending the copy operation identified by a list identifier. The copy manager should ensure that the copy source and copy destination are consistent. A subsequent RECEIVE COPY STATUS command (see 6.23) indicates how the copy operation was ended (e.g., operation ended with errors or operation ended without errors).

5.19.5 Responses to the conditions that result from SCSI events

The effects on copy operations that are produced by the conditions that result from SCSI events (see SAM-6) are shown in table 78.

Table 78 – Responses to the conditions that result from SCSI events

Condition that results from a SCSI event	Effects of condition on copy operations
Power on Hard reset Logical unit reset Power loss expected	All foreground and background copy operations shall be aborted as if a COPY OPERATION ABORT command (see 6.4) has been received for each copy operation.
I_T nexus loss	All foreground and background copy operations that require access to the affected I_T nexus shall be aborted as if a COPY OPERATION ABORT command has been received for each copy operation.

5.19.6 RODs and ROD tokens

5.19.6.1 RODs and ROD related tokens overview

A ROD provides a way to represent multiple bytes of data that may or may not be addressable as the content of some media (e.g., one or more ranges of contiguous logical blocks that may be addressed as LBAs or maintained as a point in time copy (see 5.19.6.2.3) of the contents of the specified LBA ranges). Each ROD is created and maintained by a copy manager as specified by this standard.

The types of RODs are described in 5.19.6.2. The process of creating and populating a ROD is described in 5.19.6.3.

A ROD token is a token that a copy manager transfers to an application client to represent a specified ROD outside the copy manager. Application clients may use ROD tokens as follows:

   a) if a valid ROD token is received by the copy manager that created it, then that copy manager is able to associate the ROD token with the original ROD and process the data represented by the ROD in specified ways (e.g., the ways specified by segment descriptors in an EXTENDED COPY command);
   b) if a ROD token is received by a copy manager other than the copy manager that created it, then the receiving copy manager may be able to process the data that the ROD token represents by communicating with the copy manager that created the ROD token. The communications between the copy managers shall conform to the models described in this standard but are not required to use the commands or data transfer mechanisms described in this standard; and
   c) if a ROD token is transferred from one application client to another by a means outside the scope of this standard, then the second application client may use the ROD token in any of the ways described in this subclause.

The format of a ROD token is defined in 5.19.6.4. The interval of time during which the ROD token remains valid is called the ROD token lifetime (see 5.19.6.7).

ROD management tokens (see 5.19.6.4) are used to manage (e.g., delete) ROD tokens.

5.19.6.2 ROD types

5.19.6.2.1 ROD types overview

A copy manager uses the ROD types shown in table 79.

Table 79 – ROD types

Type code ranges	Type code range applicability	Type codes defined by this standard	Description	Reference
0000 0000h	Copy manager internal ROD	0000 0000h	ROD type specified by ROD token	command definition [a]
0000 0001h to 0000 FFFFh	Reserved			
0001 0000h to FEFF FFFFh	Any device type	0001 0000h	Access upon reference	5.19.6.2.2
		0080 0000h	Point in time copy – default	5.19.6.2.3.2
		0080 0001h	Point in time copy – change vulnerable	5.19.6.2.3.3
		0080 0002h	Point in time copy – persistent	5.19.6.2.3.4
		0080 0003h	Point in time copy – copy on write	5.19.6.2.3.6
		0080 FFFFh	Point in time copy – any	5.19.6.2.3.5
		all others in this range	Reserved	
FF00 0000h to FFFF FFEFh	Device type specific			applicable command standard
FFFF FFF0h to FFFF FFFFh	Vendor specific ROD token body and ROD token extension (see 5.19.6.4 and 5.19.6.5)			
[a] Some commands (e.g., an EXTENDED COPY command with the ROD CSCD descriptor (see 6.6.5.10) in the parameter list (see 5.19.8.1)) use this ROD type code when processing a ROD token received by the copy manager. Details of such usage are specific to the command.				

If a third-party copy command requests the creation of a ROD and the copy manager does not have sufficient resources to create or maintain the ROD, then the copy manager shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INSUFFICIENT RESOURCES TO CREATE ROD.

A copy manager shall indicate the types of RODs it supports in the Supported ROD Types third-party copy descriptor (see 7.7.18.9) in the Third-party Copy VPD page.

5.19.6.2.2 Access upon reference type RODs

Access upon reference type RODs are RODs in which the bytes are represented by addressing information (e.g., their LBAs for block devices). The copy manager that creates the ROD is not required to:

  a) access the bytes until the ROD is used as a copy source or copy destination; or
  b) maintain any specific data contents in association with the ROD.

An access upon reference type ROD shall remain valid as long as the addresses for the bytes remain valid (e.g., a MODE SELECT command that decreases the number of logical blocks on a block device in a way that eliminates one of the LBAs in an access upon reference type ROD causes the ROD to become invalid). Invalidating a ROD in this way may cause it to become invalid before its specified lifetime (see 5.19.6.7) has elapsed.

5.19.6.2.3 Point in time copy RODs

5.19.6.2.3.1 Point in time copy RODs overview

Point in time copy RODs are RODs for which the data returned when the ROD is used as a copy source is the data that was present when the ROD was populated (see 5.19.6.3). The copy manager that creates the ROD shall maintain the data that populates the ROD for as long as the ROD remains valid (see 5.19.6.7). The method that the copy manager uses to maintain the data is outside the scope of this standard.

If the copy manager is unable to maintain the data that populates a point in time copy ROD, the copy manager shall invalidate this type of ROD. Invalidating a ROD in this way may cause it to become invalid before its specified lifetime (see 5.19.6.7) has elapsed.

If a third-party copy command that originates a copy operation (see table 76 in 5.19.3) specifies a point in time copy ROD as a copy destination, then the copy manager shall terminate the copy operation (see 5.19.4.3) originated by the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

5.19.6.2.3.2 Point in time copy – default type RODs

A point in time copy – default type ROD is a point in time copy ROD (see 5.19.6.2.3.1) for which the method that maintains the data that populates the ROD is vendor specific.

5.19.6.2.3.3 Point in time copy – change vulnerable type RODs

A point in time copy – change vulnerable type ROD is a point in time copy ROD (see 5.19.6.2.3.1) for which the copy manager shall create the ROD using the method that consumes the fewest resources without regard for whether this increases the chance that the ROD may become invalid before its specified lifetime (see 5.19.6.7) has elapsed.

The copy manager may invalidate this type of ROD if the data that populated that ROD when it was created is modified (e.g., by a write command) or becomes invalid (e.g., a MODE SELECT command decreases the number of blocks on a logical block device in a way that eliminates one of the LBAs in the ROD).

5.19.6.2.3.4 Point in time copy – persistent type RODs

A point in time copy – persistent type ROD is a point in time copy ROD (see 5.19.6.2.3.1) for which the copy manager shall maintain the data present when the ROD was populated for the ROD's specified lifetime (see 5.19.6.7) regardless of modifications to the data that populated the ROD when it was created.

A point in time copy – persistent type ROD may become invalidated before the specified lifetime for reasons other than a modification to the data that populated the ROD when it was created (see 5.19.6.7).

5.19.6.2.3.5 Point in time copy – any type RODs

A point in time copy – any type ROD is a point in time copy ROD (see 5.19.6.2.3.1) for which the copy manager shall create the ROD using one of the following ROD types, in order of preference:

    1) point in time copy – persistent (see 5.19.6.2.3.4); or
    2) point in time copy – change vulnerable (see 5.19.6.2.3.3).

If a ROD token (see 5.19.6.4 and 5.19.6.5) is returned for a point in time copy – any type ROD, the value in the ROD TOKEN field shall indicate the type of ROD the copy manager created (e.g., 0080 0001h for point in time copy – change vulnerable).

5.19.6.2.3.6 Point in time copy – copy on write

A point in time copy – copy on write type ROD is a point in time copy ROD (see 5.19.6.2.3.1) for which the copy manager shall maintain the data present when the ROD was populated for the ROD's specified lifetime (see 5.19.6.7) regardless of modifications to the data that populated the ROD when it was created. Operations using this type of ROD shall be performed only if those copy operations are able to be performed using a non-read/write method (e.g., a copy on write snapshot method or a copy on write clone method). If the copy operations are not able to be performed using a copy on write method, then the command shall be terminated with CHECK CONDITION status, with the sense key set to COPY ABORTED, and the additional sense code set to FAST COPY NOT POSSIBLE.

A point in time copy – copy on write type ROD may become invalidated before the specified lifetime for reasons other than a modification to the data that populated the ROD when it was created (see 5.19.6.7).

5.19.6.3 Populating a ROD or ROD token

The content of a ROD is established when the ROD is populated. Details of how a ROD is populated are defined by the command or commands that cause the ROD to become populated.

After a ROD is populated, it may be:

    a) used by later processing steps defined by the command that caused the ROD to be populated (i.e., used inside the copy manager that created the ROD); or
    b) used to create a ROD token (see 5.19.6.4) that may be used by application clients and copy managers in the ways described in 5.19.6.1.

Commands are not required to provide a means to use a ROD inside the copy manager, but any ROD tokens that a copy manager creates during the processing of a command shall be made available for transfer to the application client using the RECEIVE ROD TOKEN INFORMATION command (see 6.25).

After the completion of a copy operation (see 5.19.4.3), the copy manager shall preserve all created ROD tokens for a vendor specific period of time. The application client should retrieve the ROD tokens using the RECEIVE ROD TOKEN INFORMATION command as soon as possible after the completion of the copy operation to increase the probability of retrieving the data before that data is discarded by the copy manager. The copy manager shall discard the parameter data for the created ROD tokens:

    a) after all the ROD tokens created by a specific copy operation (see 5.19.4.3) have been transferred without errors to the application client;

   b) if a RECEIVE ROD TOKEN INFORMATION command has been received on the same I_T nexus with a matching list identifier (see 5.19.4.2), with the ALLOCATION LENGTH field set to zero;

   c) if another a third-party command that originates a copy operation (see table 76 in 5.19.3) is received on the same I_T nexus and the list identifier matches the list identifier associated with the ROD tokens;

   d) if the copy manager detects a logical unit reset condition or I_T nexus loss condition (see SAM-6); or

   e) if the copy manager requires the resources used to preserve the data.

The copy manager shall not discard the data returned by a RECEIVE ROD TOKEN INFORMATION command in response to:

   a) an ABORT TASK task management function (see SAM-6); or

   b) a COPY OPERATION ABORT command (see 6.4).

The format of a ROD token is defined in 5.19.6.4. The interval of time during which the ROD token remains valid is called the ROD token lifetime (see 5.19.6.7).

If a third-party copy command attempts to populate a ROD with the same data more than one time (e.g., specifying the same LBA twice), then the copy manager shall terminate the copy operation (see 5.19.4.3) originated by the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

EXAMPLE 1 – The EXTENDED COPY command (see 6.6) defines a CSCD descriptor that establishes an internal ROD and segment descriptors that populate that ROD. The populated ROD may be used by other segment descriptors, and may be returned as a ROD token using the methods described in this subclause.

EXAMPLE 2 – The POPULATE TOKEN command (see SBC-5) establishes and populates a ROD whose only use during the processing of the POPULATE TOKEN command is in the creation of a ROD token that is returned using the methods described in this subclause.

5.19.6.4 ROD token format

The ROD token format is shown in table 80.

Table 80 – ROD token

Bit Byte	7	6	5	4	3	2	1	0
	ROD token header							
0 ••• **3**	(MSB) ROD TYPE							(LSB)
4 **5**	Reserved							
6 **7**	(MSB) ROD TOKEN LENGTH (n-7)							(LSB)
	ROD token body (if any)							
8 ••• **15**	(MSB) COPY MANAGER ROD TOKEN IDENTIFIER							(LSB)
16 ••• **47**	CREATOR LOGICAL UNIT DESCRIPTOR							
48 ••• **63**	(MSB) NUMBER OF BYTES REPRESENTED							(LSB)
64 ••• **95**	ROD token type specific data							
	ROD token extension (if any)							
96 ••• **127**	Device type specific data							
128 ••• **n**	ROD token type and copy manager specific data							

Every ROD token shall include the ROD TYPE field and the ROD TOKEN LENGTH field. Except for the ROD TYPE field and the ROD TOKEN LENGTH field, the definition for any ROD token format may not include the other fields shown in table 80. The COPY MANAGER ROD TOKEN IDENTIFIER field, CREATOR LOGICAL UNIT DESCRIPTOR field, NUMBER OF BYTES REPRESENTED field, and ROD token type specific data bytes shall be included in the ROD token body if:

a) information about the ROD token is returned by the REPORT ALL ROD TOKENS command (see 6.28); or

b) any fields are defined in the ROD token extension.

EXAMPLE – The block device zero ROD token (see SBC-5) has a value selected from table 79 (see 5.19.6.2.1) in the ROD TYPE field, and the ROD TOKEN LENGTH field set to 01F8h. All bytes in the ROD token body and ROD token extension are reserved. This is a valid ROD token format because the block device zero ROD token is not returned by the REPORT ALL ROD TOKENS command.

Commands that manage ROD tokens (e.g., the REPORT ALL ROD TOKENS command (see 6.28)) use a ROD management token that consists of the ROD token header and the ROD token body in the ROD token being managed (i.e., the ROD token extension is omitted in ROD management tokens). The ROD TOKEN LENGTH field is not modified when a ROD management token is built from a ROD token (i.e., the ROD TOKEN LENGTH field does not indicate the length of the ROD management token).

The ROD TYPE field (see table 79 in 5.19.6.2.1) indicates the use and content of the ROD token bytes that follow the header.

The ROD TOKEN LENGTH field indicates the number of bytes that follow in the ROD token. The minimum size of a ROD token shall be 512 bytes (i.e., the minimum value in the ROD TOKEN LENGTH field is 01F8h). Bytes in unused ROD token fields shall be reserved (e.g., in a ROD token that does not include the ROD token body, the bytes assigned to the COPY MANAGER ROD TOKEN IDENTIFIER field, CREATOR LOGICAL UNIT DESCRIPTOR field, and NUMBER OF BYTES REPRESENTED field are reserved).

If present, the COPY MANAGER ROD TOKEN IDENTIFIER field contains a value that differentiates this ROD token from all other valid ROD tokens created by and known to a specific copy manager. No two ROD tokens known to a specific copy manager shall have the same value in the COPY MANAGER ROD TOKEN IDENTIFIER FIELD. After a ROD token becomes invalid, the copy manager should not reuse the copy manager ROD token identifier value from that ROD token in another ROD token for as long as possible, and shall not reuse that value until at least 50 000 ROD tokens have been created by that copy manager.

If present, the CREATOR LOGICAL UNIT DESCRIPTOR field contains an Identification Descriptor CSCD descriptor (see 6.6.5.6) for the logical unit that contains the copy manager that created the ROD token. That Identification Descriptor CSCD descriptor shall contain a designation descriptor with the DESIGNATOR TYPE field set to:

    a)   2h (i.e., EUI-64-based);
    b)   3h (i.e., NAA); OR
    c)   Ah (i.e., UUID identifier).

If present, the NUMBER OF BYTES REPRESENTED field is set to the total number of bytes that the ROD token represents. If the number of bytes represented by the ROD token is unknown or greater than FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFEh, then the NUMBER OF BYTES REPRESENTED field shall be set to FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFFh. Command standards may define restrictions on the contents of the NUMBER OF BYTES REPRESENTED field.

If present, the ROD token type specific data contains one or more fields whose contents are based on the ROD token type.

If present, the device type specific data contains one or more fields whose contents are defined by the command standard for the device type associated with the copy manager that created the ROD token.

If present, the ROD token type and copy manager specific data contains one or more fields whose contents are dependent on the ROD token type and the copy manager that created the ROD token.

5.19.6.5 Generic ROD tokens

5.19.6.5.1 Generic ROD token format

Unless a different format is defined, ROD tokens for the ROD types other than 00h (see table 79 in 5.19.6.2.1) have the format shown in table 81.

Table 81 – Generic ROD token

Bit Byte	7	6	5	4	3	2	1	0
ROD token header								
0 ••• 3	(MSB)			ROD TYPE				(LSB)
4 5				Reserved				
6 7	(MSB)			ROD TOKEN LENGTH (n-7)				(LSB)
ROD token body								
8 ••• 15	(MSB)			COPY MANAGER ROD TOKEN IDENTIFIER				(LSB)
16 ••• 47				CREATOR LOGICAL UNIT DESCRIPTOR				
48 ••• 63	(MSB)			NUMBER OF BYTES REPRESENTED				(LSB)
64 ••• 95				Reserved				
ROD token extension								
96 ••• 127				Device type specific data				
128 ••• t				TARGET DEVICE DESCRIPTOR				
t+1 ••• n				EXTENDED ROD TOKEN DATA				

The ROD TYPE field is defined in 5.19.6.4 and the coded values that may be used in the ROD TYPE field are defined in 5.19.6.2.1. The ROD TYPE field shall be set to one of the values shown in table 82. The ROD TYPE field shall not be set to 0080 FFFFh (i.e., point in time copy – any) (see 5.19.6.2.3.5).

Table 82 – ROD TYPE field in generic ROD

Code	Description	ROD TOKEN LENGTH field contents	TARGET DEVICE DESCRIPTOR FIELD size (in bytes)	ROD type Reference
0001 0000h	Access upon reference	01F8h	128	5.19.6.2.2
0080 0000h	Point in time copy – default	01F8h	128	5.19.6.2.3.2
0080 0001h	Point in time copy – change vulnerable	01F8h	128	5.19.6.2.3.3
0080 0002h	Point in time copy – persistent	01F8h	128	5.19.6.2.3.4
all others	see table 79 in 5.19.6.2.1			

The ROD TOKEN LENGTH field is defined in 5.19.6.4, and shall be set to the value shown in table 82 based on the contents of the ROD TYPE field.

The COPY MANAGER ROD TOKEN IDENTIFIER field, CREATOR LOGICAL UNIT DESCRIPTOR field, and NUMBER OF BYTES REPRESENTED field are defined in 5.19.6.4.

The device type specific data is specified by the command standard for the device type indicated by the CREATOR LOGICAL UNIT DESCRIPTOR field (see 5.19.6.4) (e.g., for the PERIPHERAL DEVICE TYPE field set to 00h, see SBC-5).

The TARGET DEVICE DESCRIPTOR field contains a designation descriptor for the SCSI target device (see 7.7.6) that contains the logical unit indicated by the descriptor in CREATOR LOGICAL UNIT DESCRIPTOR field. The designation descriptor shall have the ASSOCIATION field set to 10b (i.e., SCSI target device) and the DESIGNATOR TYPE field set to:

   a) 2h (i.e., EUI-64-based);
   b) 3h (i.e., NAA);
   c) 8h (i.e., SCSI name string); or
   d) Ah (i.e., UUID identifier).

The EXTENDED ROD TOKEN DATA field shall contain at least 256 bits of secure random number material (see SFSC) generated when the ROD token was created, and may contain information that is used by the copy manager that created the ROD token to process the ROD token (e.g., an expiration time in a vendor specific format). The EXTENDED ROD TOKEN DATA field should not contain data that enables an entity outside the SCSI target device in which the ROD token was created to determine the data (e.g., LBAs or logical blocks) that the ROD token represents.

Those portions of the EXTENDED ROD TOKEN DATA field that do not contain defined values should be set to unpredictable random values. The contents of the EXTENDED ROD TOKEN DATA field may be defined to contain:

   a) zero or more values that are based on the ROD represented by the generic ROD token (e.g., pointers, expiration time); and
   b) zero or more values used by the copy manger to determine whether the generic ROD token is valid (e.g., cryptographic integrity check values, message authentication codes, digital signatures).

5.19.6.5.2 Validating generic ROD tokens

5.19.6.5.2.1 Overview of validating generic ROD tokens

A copy manager shall ensure that a generic ROD token (see 5.19.6.5.1) is valid before performing any action based on the contents of that ROD token. The determination of whether a generic ROD token is valid shall be performed only by the copy manager that created that ROD token. If the processing copy manager is in the same SCSI target device as the copy manager that created the ROD token, then the two copy managers may exchange information using a method outside the scope of this standard to accomplish the required validation.

If a copy manager is unable to validate the generic ROD token, then no data shall be transferred by the command that contains the invalid ROD token, and the copy operation (see 5.19.4.3) shall be terminated as described in 5.19.6.5.2.3.

If a command containing a generic ROD token is processed by a copy manager that is not in the same SCSI target device as the copy manager that created the ROD token, then the actions of the processing copy manager depend on the contents of the REMOTE TOKENS field in the ROD Features third-party copy descriptor (see 7.7.18.8) as follows:

   a) if the REMOTE TOKENS field is set to 0h, the processing copy manager may consider the generic ROD token to be invalid without contacting another copy manager (e.g., as a result of the processing copy manager being unable to identify or contact the copy manager that created the ROD token) and terminate the command that contains the ROD token as described in 5.19.6.5.2.3; or
   b) if the REMOTE TOKENS field is not set to 0h, the processing copy manager shall:
       1) use the information in the generic ROD token to locate the copy manager that created the ROD token;
       2) communicate the generic ROD token to the creating copy manager with a request to determine the validity of the ROD token (e.g., send an EXTENDED COPY command with a verify CSCD segment descriptor (see 6.6.6.9)); and
       3) if the generic ROD token is invalid, the copy manager shall terminate the copy operation (see 5.19.4.3) as described in 5.19.6.5.2.3.

The process of determining the validity of a generic ROD token involves the following checks. A generic ROD token:

   a) shall be invalid if the contents the generic ROD token do not match the equivalent information stored by the copy manager for any ROD token created by the copy manager as described in this subclause;
   b) should be invalid if the generic ROD token lifetime has elapsed (see 5.19.6.7); and
   c) may be invalid based on vendor specific tests.

The check for whether a generic ROD token matches a generic ROD token created by the copy manager may use:

   a) exact validation that detects all differences (e.g., by comparing the generic ROD token to copies of valid generic ROD tokens saved by the copy manager when those generic ROD tokens were created) to which the additional requirements stated in 5.19.6.5.2.2 do not apply; or
   b) inexact validation that does not detect all differences (e.g., by comparing a hash of the generic ROD token to hashes of valid generic ROD tokens) and implementation of the additional requirements described in 5.19.6.5.2.2.

If a copy manager determines that a generic ROD token is invalid, the copy manager shall terminate the copy operation (see 5.19.4.3) as described in 5.19.6.5.2.3.

5.19.6.5.2.2 Inexact validation of generic ROD tokens

A copy manager may use the SHA-256 secure hash function to:

  a) compute a hash for each generic ROD token as part of creating that generic ROD token; and
  b) compare the equivalent hash for any generic ROD token to be validated to the precomputed hash values for each of the generic ROD tokens that the copy manager considers valid.

Any generic ROD token inexact validation process shall detect generic ROD tokens that were never created by the copy manager with a certainty that is greater than or equal to that of SHA-256 hash (e.g., use of the SHA-512 secure hash meets this requirement).

A copy manager that uses a secure hash function as the only means of generic ROD token validation is exposed to collision attacks against that hash function. A more secure technique is to use the secure hash as part of a keyed cryptographic integrity check (e.g., the HMAC SHA-256 message authentication code), with a secret key that is confidential to the copy manager.

Copy managers shall not use any of the following computational techniques as the only means of generic ROD token validation:

  a) any form of CRC;
  b) any form of arithmetic checksum;
  c) an arithmetic hash that is not a secure hash; and
  d) a secure hash with a known collision resistance that is less than that of SHA-256 (e.g., most secure hash functions whose result contains less than 256 bits).

5.19.6.5.2.3 Validation errors for generic ROD tokens

If the copy manager determines that a generic ROD token is invalid, the copy manager shall:

  a) not perform any of the data transfers requested by the command that specified the invalid ROD token;
  b) terminate the copy operation (see 5.19.4.3); and
  c) return an error using the method described in 5.19.4.3 with CHECK CONDITION status with the sense key and additional sense code associated with the highest priority error detected from among those shown in table 83.

Table 83 – Generic ROD token errors sorted by reporting importance

Error detected	Sense key	Additional sense code	Priority
Internal inconsistency or corruption problem in the generic ROD token format	ILLEGAL REQUEST	INVALID TOKEN OPERATION, TOKEN CORRUPT	Highest
Generic ROD token type that is not supported by the copy manager	ILLEGAL REQUEST	INVALID TOKEN OPERATION, UNSUPPORTED TOKEN TYPE	
Remote generic ROD token [a] and the REMOTE TOKENS field [b] is set to 0h	ILLEGAL REQUEST	INVALID TOKEN OPERATION, REMOTE TOKEN USAGE NOT SUPPORTED	
Remote generic ROD token [a] with the REMOTE TOKENS field [b] not set to 0h for which the copy manager is unable to contact the copy manager that created the ROD token	COPY ABORTED	COPY TARGET DEVICE NOT REACHABLE	
Remote generic ROD token [a] with the REMOTE TOKENS field [b] not set to 0h for which the creating copy manager returns an error	sense key returned by creating copy manager	additional sense code returned by creating copy manager	
Generic ROD token with a lifetime that has expired or an inactivity timeout that has been exceeded [c]	ILLEGAL REQUEST	INVALID TOKEN OPERATION, TOKEN EXPIRED	
Generic ROD token that does not match any valid generic ROD token created by the copy manager	ILLEGAL REQUEST	INVALID TOKEN OPERATION, TOKEN UNKNOWN	
Generic ROD token that has been revoked by a system administrator [c]	ILLEGAL REQUEST	INVALID TOKEN OPERATION, TOKEN REVOKED	
Generic ROD token that has been deleted in response to an application client request [c]	ILLEGAL REQUEST	INVALID TOKEN OPERATION, TOKEN DELETED	
Generic ROD token that has an error not described elsewhere in this table	ILLEGAL REQUEST	INVALID TOKEN OPERATION, CAUSE NOT REPORTABLE	Lowest

[a] A remote generic ROD token is a generic ROD token that was created by a copy manager that is not located in the same SCSI target device as the processing copy manager.

[b] The REMOTE TOKENS field is in the ROD Features third-party copy descriptor (see 7.7.18.8).

[c] See 5.19.6.7 for details about generic ROD tokens:
   a) whose lifetime that has expired;
   b) whose inactivity timeout that has been exceeded;
   c) that have been revoked by a system administrator; or
   d) that have been deleted in response to an application client request.

5.19.6.6 ROD token usage

If the ROD token lifetime is long enough to allow all of the following steps to be processed and no other factors cause the ROD token to become invalid, then creation and use of the ROD token in multiple third-party copy commands is accomplished as follows:

1) create one or more ROD token (see 5.19.8.5.2) in an initial third-party copy command (e.g., EXTENDED COPY command (see 6.6) or POPULATE TOKEN command (see SBC-5));
2) retrieve the ROD tokens using the RECEIVE ROD TOKEN INFORMATION command (see 6.25); and
3) one or more subsequent third-party copy commands (e.g., EXTENDED COPY command or WRITE USING TOKEN command (see SBC-5)) may specify the ROD token in the parameter list.

Details of the how the EXTENDED COPY commands are used in the steps shown in this subclause are described in 5.19.8.6. Details of the how the POPULATE TOKEN command and WRITE USING TOKEN command are used in the steps shown in this subclause are described in SBC-5.

If a copy manager processes a third-party copy command that contains a valid ROD token in the parameter list, then the handling of access to the ROD specified by the ROD token and to the data represented by that ROD depends on the relationship of the copy manager that processes the command to the copy manager that created the ROD token as shown in table 84.

Table 84 – Copy manager relationships for processing ROD tokens

Relationship between the copy manager that processes the command and the copy manager that created the ROD token	REMOTE TOKENS field [a] contents returned by the processing copy manager	Description
The two copy managers are the same	n/a	No errors shall be returned regarding access to the valid ROD token's contents.
The two copy managers are in the same SCSI target device	n/a	The processing copy manager shall: a) communicate with the copy manager that created the ROD token to access the data that the ROD token represents; and b) not return any errors regarding access to the valid ROD token's contents.
The two copy managers are in different SCSI target devices	0h	The processing copy manager shall terminate the copy operation (see 5.19.4.3) as described in 5.19.6.5.2.3.
	not 0h	The processing copy manager: a) shall attempt to communicate with the copy manager that created the ROD token to access the data that the ROD token represents; and b) may return errors based on the inability to locate or communicate with the copy manager that created the ROD token (see 5.19.6.5.2.3).
[a] The REMOTE TOKENS field is in the ROD Features third-party copy descriptor (see 7.7.18.8).		

A copy manager indicates that it is capable of communicating with a copy manager that is not located in the same SCSI target device as itself by setting the REMOTE TOKENS field to a value other than 0h in the ROD Features third-party copy descriptor (see 7.7.18.8).

Whenever one copy manager communicates with another copy manager to access the data that the ROD token represents, the communication is modelled as the sending of EXTENDED COPY commands (see 6.6) and RECEIVE COPY DATA commands (see 6.22). However, any communication between copy managers that accomplishes the equivalent of this result conforms to this standard.

EXAMPLE – The process by which one copy manager obtains all the bytes in a ROD may use an EXTENDED COPY command that contains the block→block&application client segment descriptor (see 6.6.6.4) with a null logical unit whose device type is direct access block device (see table 119 in 6.6.6.1) as the copy destination followed by a RECEIVE COPY RESULTS command that retrieves the held data.

In addition to converting a ROD token created by another copy manger to the data that the ROD token represents, a copy manager may indicate that it is capable of communicating with another copy manager in another SCSI target device for the purpose of creating a ROD token by setting the REMOTE TOKENS field to 6h in the ROD Features third-party copy descriptor (see 7.7.18.8).

5.19.6.7 ROD token lifetime

When a ROD token is created, the copy manager that creates the ROD token assigns it a lifetime interval based on inputs to the ROD token creation process (e.g., the REQUESTED ROD TOKEN LIFETIME field in the ROD CSCD descriptor (see 6.6.5.10)) that is used as follows:

    a)   until the lifetime elapses, the copy manger should not make the ROD token invalid; and
    b)   after the lifetime elapses, the copy manager should invalidate the ROD token.

When a ROD token is created, the copy manager that creates the ROD token assigns it an inactivity timeout that is based on inputs to the ROD token creation process (e.g., the REQUESTED ROD TOKEN INACTIVITY TIMEOUT field in the ROD CSCD descriptor (see 6.6.5.10)) that is used as follows:

    a)   after the completion of a third-party copy command that originates a copy operation (see table 76 in 5.19.3) that specifies the ROD token, the copy manager should not make the ROD token invalid before the inactivity timeout has expired; and
    b)   after the inactivity timeout has expired, the copy manager should invalidate the ROD token.

A ROD token may be invalidated for reasons other than its lifetime elapsing or inactivity timeout expiring, including the following:

    a)   an application client request to delete a ROD token (e.g., setting the DEL_TKN bit to one in the ROD CSCD descriptor (see 6.6.5.10) of an EXTENDED COPY command);
    b)   a ROD token cancellation made by the copy manager in response to operating conditions (e.g., point in time copy (see 5.19.6.2.3) processing requirements, excessive writes to the represented data, resource reclamation to create a new ROD token); and
    c)   a system administrator request to revoke a ROD token for management reasons.

If any of the conditions described in this subclause cause a ROD token to become invalid, then the copy manager shall maintain a record of them for reporting purposes (see 5.19.6.5.2.3) for at least the lifetime of the ROD token established at the time the ROD token was created, and should maintain the record for twice the lifetime of the ROD token.

5.19.7 Tape stream mirroring

5.19.7.1 Overview

A tape stream mirroring copy operation provides a method for stream devices to create an identical sequence of data written on the copy source and copy destination. A tape stream mirroring copy operation is performed by a copy manager in the logical unit associated with the copy source. While performing a tape stream mirroring copy operation the copy manager is aware of the commands and data received by the device server for the copy source and the responses returned by that device server. The copy manager determines if commands to produce equivalent results are sent to the copy destination.

The application client writes logical objects (see SSC-5) to the copy source (e.g., write commands and write filemarks commands to a sequential access device) and changes the logical position of the copy source. As part of this device server processing the copy manager may send commands to write logical objects and position the copy destination in a way that produce equivalent results on the copy source and the copy destination. If the copy manager detects an exception condition on the copy destination, the copy manager performs the actions specified by the SCOTI bit (see 6.6.6.20).

The copy manager performs the tape stream mirroring copy operation as specified by a segment descriptor (e.g., segment descriptor 19h (see 6.6.6.20)) and that segment descriptor is the last segment descriptor in the EXTENDED COPY command parameter list (see 6.6.2). The tape stream mirroring copy operation is performed as a background operation (i.e., the IMMED bit is set to one).

A tape stream mirroring copy operation is performed as follows:

1) the application client prepares the copy source and copy destination (see 5.19.4.1);
2) the application client sends the EXTENDED COPY command with the IMMED bit set to one to the copy manager;
3) the copy manager:
    1) processes the EXTENDED COPY command;
    2) returns GOOD status for the command; and
    3) continues processing the command as a background operation (see 5.19.4.3);
4) the copy manager performs the copy functions specified by the segment descriptors in the segment descriptor list;
5) the application client monitors the progress of the copy operation using the RECEIVE COPY STATUS command (see 6.23) as described in 5.19.4.4 until the SEGMENTS PROCESSED field in the RECEIVE COPY STATUS command parameter data indicates the tape stream mirroring segment descriptor is being processed;
6) the application client sends commands to the copy source and the copy manager sends commands to produce equivalent data and positioning on the copy destination;
7) the application client monitors the progress of the tape stream mirroring copy operation using the RECEIVE COPY STATUS command as described in 5.19.4.4; and
8) the copy manager continues the tape stream mirroring copy operation until the copy manager:
    A) completes the copy operation without errors;
    B) completes the copy operation with errors;
    C) processes a COPY OPERATION CLOSE command (see 5.19.4.7);
    D) processes a COPY OPERATION ABORT command (see 5.19.4.8); or
    E) is affected by a task management function (see 5.19.5).

The SET TAPE STREAM MIRRORING command (see SSC-5 and ADC-4) and the REPORT TAPE STREAM MIRRORING command (see SSC-5) are used to configure how subsequent tape stream mirroring copy operations are performed.

5.19.7.2 Tape stream mirroring security

A method for enabling and disabling the capability of performing a tape stream mirroring copy operation is described in SSC-5 and ADC-4. A sequential access device that supports the tape stream mirroring copy operation shall support the TSMC bit in the Sequential-access Device Capabilities VPD page (see SSC-5). If the sequential access device is not capable of performing a tape stream mirroring copy operation, then an EXTENDED COPY command that includes a segment descriptor specifying a tape stream mirroring copy operation shall be terminated as described in SSC-5.

The SET TAPE STREAM MIRRORING command (see SSC-5 and ADC-4) and the REPORT TAPE STREAM MIRRORING command (see SSC-5) are used by the application client to prepare for a tape stream mirroring copy operation specified by a subsequent EXTENDED COPY command. A tape stream mirroring copy operation is allowed or prevented on a sequential access device that is capable of performing a tape stream mirroring copy operation as described in SSC-5 and ADC-4. The current configuration of how subsequent tape stream mirroring copy operations are performed is reported by the REPORT TAPE STREAM MIRRORING command (see SSC-5).

5.19.8 The EXTENDED COPY command

5.19.8.1 EXTENDED COPY parameter list

The EXTENDED COPY command (see 6.6) use a parameter list with several elements to define a flexible interface to third-party copy functions (see figure 8).
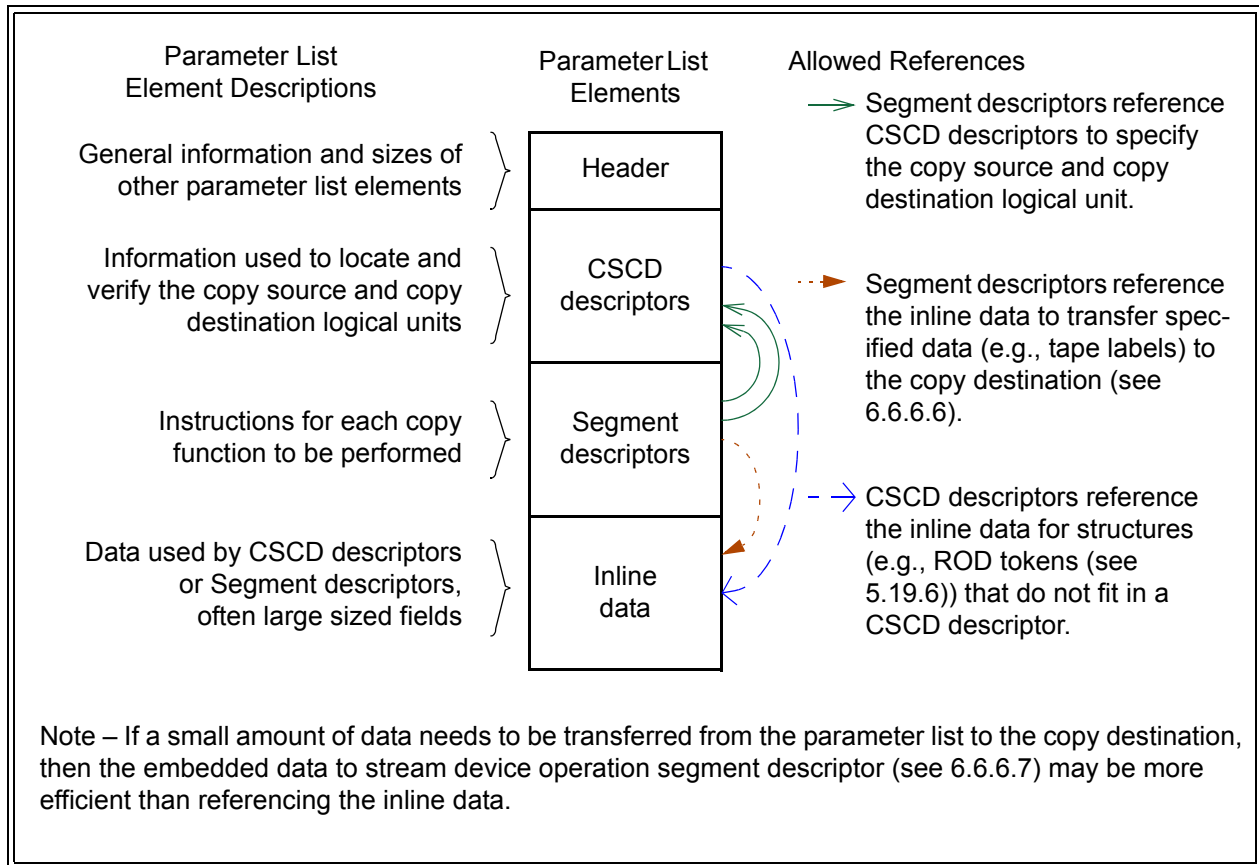
Figure 8 – EXTENDED COPY parameter list structure diagram

EXTENDED COPY parameter list elements that are not used are not included in the parameter list (e.g., the length of the inline data element is zero if no inline data is referenced).

5.19.8.2 EXTENDED COPY command processing

To process an EXTENDED COPY command, the copy manager:

1) shall determine the global processing conditions for the command (e.g., the value of the IMMED bit (see 6.6.2));
2) shall determine the first parameter list byte for each parameter list element shown in figure 8 (see 5.19.8.1) based on fields in the header;
3) may validate the contents of one or more CSCD descriptors (see 5.19.8.1) and terminate the EXTENDED COPY command if errors are detected;
4) may validate the contents of one or more segment descriptors and terminate the EXTENDED COPY command if errors are detected;
5) depending on the value of the IMMED bit in an EXTENDED COPY command:
   A) shall return command completion if the IMMED bit is set to one; or
   B) shall not return status for the command until the copy operation (see 5.19.4.3) is completed or terminated if the IMMED bit is set to zero;
   and
6) shall process the segment descriptors in the order in which they appear in the parameter list as described in this subclause.

The copy functions performed by an EXTENDED COPY command are specified by the segment descriptors. All other elements of the EXTENDED COPY parameter list (see 5.19.8.1) are present to support the segment descriptors in their specification of the copy functions to be performed.

If a CSCD descriptor is referenced by a segment descriptor (see 5.19.8.1), the information in that CSCD descriptor should be validated at the time the referencing segment descriptor is processed. The SCSI devices participating in a SCSI domain may change between the time that processing of an EXTENDED COPY command begins and the time that processing of a specific segment descriptor begins.

The copy manager shall perform the copy functions specified by the segment descriptors (see 5.19.8.1) using a model in which commands are sent from the copy manager application client to local device servers and/or remote device servers. The specific commands sent by the copy manager to the copy sources and copy destinations while processing the segment descriptors are vendor specific. Upon successful completion of the copy operation (see 5.19.4.3), all copy sources and copy destinations that are stream devices shall be positioned at deterministic locations such that they may be repositioned to the same location by the application client with appropriate commands.

During the processing of a segment descriptor, the copy manager may be required to:

a) manage the movement of data from a copy source to a copy destination as follows:
   A) read source data by issuing data input commands to the copy source;
   B) process data in a way that may designate data as destination data (i.e., data intended for transfer to the copy destination); and
   C) write some or all of the destination data to the copy destination;
b) manage the movement of a specified portion of the embedded data or inline data to a copy destination as follows:
   A) designate the specified portion of the embedded data or inline data as destination data intended for transfer to the copy destination; and
   B) write some or all of the destination data to the copy destination;
   or
c) perform functions that are specific to the device type (e.g., writing filemarks) to a copy destination.

As part of processing a segment descriptor, the copy manager may verify the information in a CSCD descriptor's device specific fields. However, while verifying the information, the copy manager shall not send any commands that change the position of read/write media on the CSCD without repositioning the media to its original position. Any errors encountered while verifying the information shall be processed as described in 5.19.8.4.

The number of blocks to read and write, the number of bytes to process, and the nature of processing are determined by:

    a) the segment descriptor type code;
    b) the parameters of the segment descriptor; and
    c) the amount of residual source or destination data retained from the previous segment, if any.

Except as otherwise specified by particular segment descriptor type codes, the processing of a segment descriptor is performed as follows:

    a) just enough whole block reads shall be performed to supply, together with residual source data from the previous segment or segments, the number of bytes to be processed;
    b) processing consists of removing bytes from the source data and designating them as destination data, without change; and
    c) as many whole block writes as possible shall be performed with the destination data, including any residual destination data from the previous segment or segments.

Any residual source data from the previous segment or segments shall be processed before any data read from the copy source during processing of the current segment descriptor. Any residual destination data from the previous segment or segments shall be written before any data processed during processing of the current segment descriptor.

Segment descriptor processing requirements that are specific to one or more segment descriptor type codes are described in table 85 and the referenced subclauses.

Table 85 – Segment descriptor type specific copy manager processing requirements (part 1 of 3)

Segment descriptor type code	Reference	Description
00h (i.e., block→stream) or 0Bh (i.e., block→stream&application client)	6.6.6.2	The number of bytes processed is determined by the BLOCK DEVICE NUMBER OF BLOCKS field for the copy source (see applicable type code definition subclauses for details). [a]
02h (i.e., block→block) with DC=0 or 0Dh (i.e., block→block&application client) with DC=0	6.6.6.4	
02h (i.e., block→block) with DC=1 or 0Dh (i.e., block→block&application client) with DC=1	6.6.6.4	The number of blocks or the byte range specified shall be output to the copy destination. If residual destination data is sufficient to perform the output, then no data shall be processed. Otherwise, just as much data as needed shall be processed (which may involve reading data from the copy source) so that the destination data (which includes any residual destination data from the previous segment) is sufficient. [a]
01h (i.e., stream→block) or 0Ch (i.e., stream→block&application client)	6.6.6.3	
09h (i.e., stream→block<o>)	6.6.6.11	

[a] For segment descriptor type codes 0Bh, 0Ch, 0Dh and 0Eh, a copy of the processed data shall also be held for retrieval by the application client (see 5.19.4.5).

Table 85 – Segment descriptor type specific copy manager processing requirements (part 2 of 3)

Segment descriptor type code	Reference	Description
03h (i.e., stream→stream) or 0Eh (i.e., stream→stream&application client)	6.6.6.5	The number of bytes specified in the segment descriptor shall be processed. [a]
04h (i.e., inline→stream)	6.6.6.6	The specified number of bytes of inline or embedded data shall be appended to the destination data, and no source data shall be processed.
05h (i.e., embedded→stream)	6.6.6.7	
06h (i.e., stream→discard)	6.6.6.8	The specified number of bytes shall be removed from the source data and discarded.
07h (i.e., verify CSCD operation)	6.6.6.9	No data shall be processed and no reads or writes shall be performed on CSCDs. Residual source or destination data, if any, shall be retained or discarded as if the CAT bit were set to one.
10h (i.e., filemark→tape)	6.6.6.13	
14h (i.e., register persistent reservation key)	6.6.6.17	
15h (i.e., Third party persistent reservations source I_T nexus)	6.6.6.18	
17h (i.e., positioning→tape)	6.6.6.15	
18h (i.e., <loi>tape→<loi>tape)	6.6.6.16	The specified source logical object range (see SSC-5) shall be read into source data, the number of logical objects specified shall be moved from source data to destination data, and the specified destination logical object range shall be written using destination data.
19h (i.e., <loi>tape->→<loi>tape mirror)	6.6.6.20	The equivalent effects of data transfer and positioning requested for the copy source shall be mirrored to the specified CSCD. Mirroring shall continue until stopped by the copy manager.
08h (i.e., block<o>→stream)	6.6.6.10	The required blocks shall be read from the copy source, the designated byte range shall be extracted as source data, and the designated number of bytes shall be processed starting with residual source data, if any.
0Ah (i.e., block<o>→block<o>)	6.6.6.12	The source byte range specified shall be read into source data, the number of bytes specified shall be moved from source data to destination data, and the specified destination byte range shall be written using destination data.
0Fh (i.e., stream→discard&application client)	6.6.6.8	The specified number of bytes shall be removed from the source data and held for retrieval by the application client.

[a] For segment descriptor type codes 0Bh, 0Ch, 0Dh and 0Eh, a copy of the processed data shall also be held for retrieval by the application client (see 5.19.4.5).

Table 85 – Segment descriptor type specific copy manager processing requirements (part 3 of 3)

Segment descriptor type code	Reference	Description
13h (i.e., <i>tape→<i>tape)	6.6.6.14	The data movement, if any, shall not involve processing as described in this subclause. Residual source or destination data, if any, shall not be used and shall be retained or discarded as if the CAT bit were set to one.
16h (i.e., <i>block→<i>block)	6.6.6.19	
BEh (i.e., ROD←block ranges(n))	6.6.6.21	
BFh (i.e., ROD←block range(1))	6.6.6.22	
^a For segment descriptor type codes 0Bh, 0Ch, 0Dh and 0Eh, a copy of the processed data shall also be held for retrieval by the application client (see 5.19.4.5).		

The results are outside the scope of this standard if:

    a) the copy source LBA range overlaps the copy destination LBA range;
    b) both LBA ranges are in the same logical unit; and
    c) both LBA ranges are specified in the same segment descriptor.

Reads and writes shall be performed using whole block transfer lengths determined by the block size, transfer length, or both. Therefore some source data may remain unprocessed and some destination data may not have been transferred at the end of a segment. If so, the residue shall be handled according to the CAT bit in the segment descriptor and the PAD bits of the source and destination target descriptors, as defined in table 86.

Table 86 – PAD and CAT bit definitions (part 1 of 2)

PAD bit in			
Source CSCD descriptor	Destination CSCD descriptor	CAT bit	Copy manager action
0 or 1	0 or 1	1	Any residual source data shall be retained as source data for a subsequent segment descriptor. Any residual destination data shall be retained as destination data for a subsequent segment descriptor. It shall not be an error if either the source CSCD ID or destination CSCD ID index in the subsequent segment descriptor does not match the corresponding CSCD ID index with which residual data was originally associated. If the CAT bit is set to one in the last segment descriptor in the parameter data (see 5.19.8.1), then any residual data shall be discarded and this shall not be considered an error.
1	1	0	Any residual source data shall be discarded. Any residual destination data shall be padded with zeroes to make a whole block transfer. ^a

^a If the CAT bit is set to zero in the segment descriptor and the PAD bit is set to one in the destination CSCD descriptor, then the copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to COPY ABORTED, and the additional sense code set to UNEXPECTED INEXACT SEGMENT if any of the following conditions are met:
    a) if any residual destination data is present after writing the designated byte range for a segment descriptor of type 09h (i.e., stream→block <o>) or 0Ah (i.e., block<o>→block<o>); or
    b) if any residual destination data is present after the designated number of blocks have been written for a segment descriptor of type 02h (i.e., block→block) with DC set to one, 0Dh (i.e., block →block& application client) with DC set to one, 01h (i.e., stream→block) or 0Ch (i.e., stream→block& application client).

Table 86 – PAD and CAT bit definitions (part 2 of 2)

PAD bit in		CAT bit	Copy manager action
Source CSCD descriptor	Destination CSCD descriptor		
0	1	0	Any residual source data shall be processed as if the CAT bit is set to one (i.e., discarded on the last segment and retained otherwise). Any residual destination data shall be padded with zeroes to make a whole block transfer. **a**
1	0	0	Any residual source or destination data shall be discarded.
0	0	0	If there is residual source or destination data, the copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to COPY ABORTED, and the additional sense code set to UNEXPECTED INEXACT SEGMENT.

a If the CAT bit is set to zero in the segment descriptor and the PAD bit is set to one in the destination CSCD descriptor, then the copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to COPY ABORTED, and the additional sense code set to UNEXPECTED INEXACT SEGMENT if any of the following conditions are met:
  a) if any residual destination data is present after writing the designated byte range for a segment descriptor of type 09h (i.e., stream→block <o>) or 0Ah (i.e., block<o>→block<o>); or
  b) if any residual destination data is present after the designated number of blocks have been written for a segment descriptor of type 02h (i.e., block→block) with DC set to one, 0Dh (i.e., block →block& application client) with DC set to one, 01h (i.e., stream→block) or 0Ch (i.e., stream→block& application client).

Table 87 defines the PAD bit handling for segment descriptors that have either no copy source or no copy destination.

Table 87 – PAD bit processing if there is no copy source or copy destination

Segment descriptor type code	Reference	Description
04h (i.e., inline→stream)	6.6.6.6	Processing shall be as if the PAD is set to zero for the source CSCD descriptor.
05h (i.e., embedded→stream)	6.6.6.7	
06h (i.e., stream→discard) 0Fh (i.e., stream→discard&application client)	6.6.6.8	Processing shall be as if the PAD is set to zero for the destination CSCD descriptor.

5.19.8.3 EXTENDED COPY command errors detected before segment descriptor processing starts

Errors may occur during processing of an EXTENDED COPY command before the first segment descriptor is processed or before status is returned due to an IMMED bit set to one. These errors include invalid parameters in the CDB or parameter data, invalid segment descriptors, and inability of the copy manager to continue operating. In the event of such an exception condition, the copy manager shall:

  a) terminate the EXTENDED COPY command with CHECK CONDITION status;
  b) set the sense key to a value that describes the exception condition (i.e., not COPY ABORTED); and
  c) not return a value in the INFORMATION field (see 4.4.4).

5.19.8.4 EXTENDED COPY command errors detected during processing of segment descriptors

Errors may occur after the copy manager has begun processing segment descriptors or after status has been returned due to an IMMED bit set to one. These errors include invalid parameters in segment descriptors, invalid segment descriptors, unavailable CSCDs referenced by CSCD descriptors, inability of the copy manager to continue operating, and errors reported by a CSCD. If a copy manager command to a CSCD returns CHECK CONDITION status, the copy manager shall recover the sense data associated with the exception condition and clear any ACA condition associated with the CHECK CONDITION status.

The copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to COPY ABORTED, and the additional sense code set to COPY TARGET DEVICE NOT REACHABLE if it is not possible to complete processing of a segment descriptor as a result of:

a) the copy manager being unable to establish communications with a CSCD;
b) the CSCD not responding to an INQUIRY command; or
c) the data returned to the copy manager in response to an INQUIRY command indicating an unsupported logical unit.

If it is not possible to complete processing of a segment descriptor as a result of the data returned in response to an INQUIRY command indicates a device type that does not match the type in the CSCD descriptor, then the copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to COPY ABORTED, and the additional sense code set to INCORRECT COPY TARGET DEVICE TYPE.

If the copy manager sends a command other than INQUIRY to a CSCD while processing a copy operation (see 5.19.4.3) and the CSCD either fails to respond with status or responds with status other than BUSY, TASK SET FULL, ACA ACTIVE, or RESERVATION CONFLICT, then the copy manager shall terminate the copy operation with CHECK CONDITION status, with the sense key set to COPY ABORTED, and the additional sense code set to THIRD PARTY DEVICE FAILURE.

If a CSCD completes a command from the copy manager with a status of BUSY, TASK SET FULL, ACA ACTIVE, or RESERVATION CONFLICT, then the copy manager shall either retry the command or terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to COPY ABORTED, and the additional sense code set to THIRD PARTY DEVICE FAILURE.

> NOTE 11 - The copy manager is assumed to employ a vendor specific retry policy that minimizes time consuming repetition of retries.

> NOTE 12 - RESERVATION CONFLICT status is listed only to give the copy manager leeway in multi-port cases. The copy manager may have multiple SCSI initiator ports that are capable of reaching a CSCD, and a persistent reservation may restrict access to a single I_T nexus. The copy manager may need to try access from multiple SCSI initiator ports to find the correct I_T nexus.

If a CSCD responds to an input or output request with a GOOD status but less data than expected is transferred, then the copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to COPY ABORTED, and the additional sense code set to COPY TARGET DEVICE DATA UNDERRUN. If an overrun is detected, then the copy manager shall terminate the copy operation with CHECK CONDITION status, with the sense key set to COPY ABORTED, and the additional sense code set to COPY TARGET DEVICE DATA OVERRUN.

After an exception condition is detected during segment descriptor processing:

a) the copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to COPY ABORTED;

b) the copy manager shall return the segment number of the segment that was being processed at the time of the exception in the third and fourth bytes of the COMMAND-SPECIFIC INFORMATION field (see 4.4.5). The segment number is based on the relative position of the segment descriptor in the parameter list (see 5.19.8.1) (i.e., the first segment descriptor in the parameter list is assigned descriptor number zero, the second is assigned one, etc.);

c) if:

A) the copy destination is not a sequential access device (i.e., the value in the PERIPHERAL DEVICE TYPE field is not set to 01h in the destination CSCD descriptor); and

B) any data has been written to the copy destination for the segment being processed at the time the error occurred,

then the copy manager shall return the residual count for the segment in the INFORMATION field (see 4.4.4) using units of:

A) bytes if the destination CSCD descriptor contains 03h (i.e., processor device) in the PERIPHERAL DEVICE TYPE field; or

B) copy destination blocks for all other cases.

The residual count shall be computed by subtracting the number of bytes or blocks successfully written during the processing of the current segment from the number of bytes or blocks which would have been written if all commands had completed with GOOD status and all READ commands had returned the full data length requested. While computing the residual count, the copy manager shall include only the results of commands successfully completed by a copy destination (i.e., commands completed by a copy destination with GOOD status or with CHECK CONDITION status and the EOM bit set to one in the sense data). If the copy manager has used out of order transfers, then the residual count shall be based only on the contiguous transfers completed without error starting at relative byte zero of the segment (i.e., any successfully completed transfers farther from relative byte zero than the first incomplete or unsuccessful transfer shall not contribute to the computation of the residual count). If no data has been written to the copy destination for the segment being processed at the time the error occurred, then the copy manager shall not return a value in the INFORMATION field (see 4.4.4). Segment descriptors that do not specify a transfer count shall not have a valid residual count;

d) if:

A) the copy destination is a sequential access device (i.e., the value in the PERIPHERAL DEVICE TYPE field is set to 01h in the destination CSCD descriptor); and

B) the segment being processed at the time the error occurred specifies data to be written,

then the copy manager shall return the residual count for the segment in the INFORMATION field (see 4.4.4) using units of:

A) copy destination logical objects, if the DESCRIPTOR TYPE CODE field is set to 18h (i.e., <loi>tape→<loi>tape) and the CODE field is set to 0h (i.e., logical objects) in that segment descriptor;

B) copy destination logical blocks, if the segment descriptor DESCRIPTOR TYPE CODE field is set to 18h and the CODE field is set to 1h (i.e., logical blocks);

C) copy destination logical files, if the segment descriptor DESCRIPTOR TYPE CODE field is set to 18h and the CODE field is set to 2h (i.e., logical files);

D) bytes, if the segment descriptor DESCRIPTOR TYPE CODE field is not set to 18h and the FIXED bit is set to zero in the device type specific parameters in the destination CSCD descriptor; and

E) copy destination blocks, for all other cases.

The residual count shall be computed by subtracting the number of units written without error during the processing of the current segment from the number of units which were requested to be written if all commands completed without error and all READ commands returned the full data length recorded on the medium. While computing the residual count, the copy manager shall include only the results of commands completed without error by a copy destination (e.g., commands completed by a copy destination with GOOD status or with CHECK CONDITION status and the EOM bit set to one in the sense data). If the copy manager has used out of order transfers, then the residual count shall be based only on the contiguous transfers completed without error starting at relative byte zero of the segment (i.e., any transfers completed without error farther from relative byte zero than the first incomplete or unsuccessful transfer shall not contribute to the computation of the residual count).

Functions that do not specify a transfer count (e.g., the segment descriptor DESCRIPTOR TYPE CODE field is set to 18h and the CODE field is set to 3h (i.e., all logical objects to EOD)) shall not return a value in the INFORMATION field (see 4.4.4);

e) if the exception condition is reported by the copy source, then:

    A) if fixed format sense data (see 4.4.3) is being returned, then the first byte of the COMMAND-SPECIFIC INFORMATION field shall be set to the starting byte number, relative to the first byte of sense data, of an area that contains the status byte and sense data delivered to the copy manager by the copy source. The status byte and sense data shall not be modified by the copy manager. A zero value indicates that no status byte and sense data is being returned for the copy source; or

    B) if descriptor format sense data (see 4.4.2) is being returned, then the status byte and sense data delivered to the copy manager by the copy source shall be returned in a forwarded sense data descriptor (see 4.4.2.7) with the SENSE DATA SOURCE field set to 1h. The status byte shall not be modified by the copy manager. The sense data may be truncated by the copy manager but shall not be modified in any other way. If the sense data is truncated, then the FSDT bit in the forwarded additional sense data descriptor shall be set to one;

f) if the exception condition is reported by the copy destination, then:

    A) if fixed format sense data (see 4.4.3) is being returned, then the second byte of the COMMAND-SPECIFIC INFORMATION field shall be set to the starting byte number, relative to the first byte of sense data, of an area that contains the status byte and sense data delivered to the copy manager by a copy destination. The status byte and sense data shall not be modified by the copy manager. A zero value indicates that no status byte and sense data is being returned for the copy destination; or

    B) if descriptor format sense data (see 4.4.2) is being returned, then the status byte and sense data delivered to the copy manager by the copy destination shall be returned in a forwarded sense data descriptor (see 4.4.2.7) with the SENSE DATA SOURCE field set to indicate the copy destination that reported the exception condition (see table 43). The status byte shall not be modified by the copy manager. The sense data may be truncated by the copy manager but shall not be modified in any other way. If the sense data is truncated, then the FSDT bit in the forwarded additional sense data descriptor shall be set to one;

g) if segment processing is terminated as a result of a CSCD is unreachable or as the result of a failure in a command sent to a CSCD, then the sense key specific information shall be set as described in 4.4.2.4.5, with the FIELD POINTER field indicating the first byte of the CSCD descriptor that specifies the CSCD;

h) if, during the processing of a segment descriptor, the copy manager detects an error in the segment descriptor, then the sense key specific information shall be set as described in 4.4.2.4.5, with the FIELD POINTER field indicating the byte in error. The FIELD POINTER field may be used to indicate an offset into either the parameter data or the segment descriptor. The SD bit is used to differentiate between these two cases. The SD bit shall be set to zero to indicate the FIELD POINTER field is set to an offset from the start of the parameter data. The SD bit shall be set to one to indicate the FIELD POINTER field is set to an offset from the start of the segment descriptor; and

i) if the LIST ID USAGE field is set to 00b or 10b in the parameter data (see 5.19.8.1), the copy manager shall preserve information for:

    A) the RECEIVE COPY STATUS command (see 6.23), if supported;

    B) the RECEIVE COPY DATA command (see 6.22), if supported; and

    C) the RECEIVE ROD TOKEN INFORMATION command (see 6.25), if supported.

The preserved information, if any, shall be discarded as described in 6.23.

5.19.8.5 EXTENDED COPY considerations for RODs and ROD tokens

5.19.8.5.1 EXTENDED COPY command CSCD ROD identifiers

All ROD CSCD descriptors (see 6.6.5.10) create an identifier for the ROD that they describe. The identifier is the CSCD descriptor ID (see table 119 in 6.6.6.1) for the ROD CSCD descriptor.

A ROD identifier identifies a ROD that is one of the following:

   a) specified by segment descriptors that populate the ROD (see 5.19.8.5.2) in the EXTENDED COPY parameter list (see 5.19.8.1); or
   b) the conversion of a ROD token into an identifier using the following entries in the EXTENDED COPY parameter list:
      A) copying the ROD token to the inline data (see 5.19.8.1) in the EXTENDED COPY parameter list; and
      B) referencing the copied ROD token in a ROD CSCD descriptor in which the ROD TYPE field is set to zero.

If the R_TOKEN bit is set to one in a ROD CSCD descriptor (see 6.6.5.10) in which the ROD TYPE field is not set to zero, then the identified ROD is used to create a ROD token that is made available for transfer to the application client using the RECEIVE ROD TOKEN INFORMATION command (see 6.25) and used as described in 5.19.6.6.

After the copy manager finishes processing the copy operation (see 5.19.4.3) originated by an EXTENDED COPY command, all the ROD identifiers created by that command shall become invalid.

If a ROD identifier becomes invalid (see 5.19.6.2.2, 5.19.6.2.3, and 5.19.6.7) before processing has been completed for the copy operation (see 5.19.4.3) originated by the EXTENDED COPY command in which the ROD identifier is defined, then any attempt to use the ROD as a copy source or copy destination shall cause the copy manager to terminate the copy operation as if an unreachable CSCD device had been encountered (see 5.19.8.4).

5.19.8.5.2 Populating an EXTENDED COPY command ROD

If the ROD TYPE field (see 6.6.5.10) is not set to zero in the ROD CSCD descriptor, the following segment descriptors are used to populate a ROD as described 5.19.6.3:

   a) populate a ROD from one or more block device ranges (see 6.6.6.21); and
   b) populate a ROD from one block device range (see 6.6.6.22).

If one of the segment descriptors listed in this subclause specifies the CSCD descriptor ID (see table 119 in 6.6.6.1) of the ROD CSCD descriptor as the copy destination and no errors are detected, then the specified ROD is populated with the information associated with the ROD type (see 5.19.6.2) based on the contents of the segment descriptor.

If the CSCD descriptor ID of a ROD CSCD descriptor in which the ROD TYPE field (see 6.6.5.10) is set to zero is specified as the copy destination in one of the segment descriptors listed in this subclause, then the copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST. The sense key specific data, if any, shall identify the CSCD descriptor ID in the segment descriptor as the field that is in error.

Bytes shall be added to the ROD in the order that the segment descriptors are present in the EXTENDED COPY parameter data (see 5.19.8.1). If a single segment descriptor specifies multiple ROD byte sources, the bytes shall be added to the ROD in the order that the bytes are present in that segment descriptor.

The process of populating the ROD ends when:

a) the CSCD descriptor ID for the ROD CSCD descriptor is specified as a copy source or copy destination in a segment descriptor that is not one of those listed in this subclause; or
b) processing of the copy operation (see 5.19.4.3) originated by the EXTENDED COPY command ends.

If one of the segment descriptors listed in this subclause specifies the CSCD descriptor ID of the ROD CSCD descriptor as the copy destination after the process of populating the ROD has ended, then the copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to COPY ABORTED, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

If the R_TOKEN bit is set to one in the ROD CSCD descriptor (see 6.6.5.10), then the copy manager shall create a ROD token (see 5.19.6) for the populated ROD and prepare the ROD token for retrieval using the RECEIVE ROD TOKEN INFORMATION command (see 6.25).

The copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to COPY ABORTED, and the additional sense code set to INVALID FIELD IN PARAMETER LIST if:

a) the value in PERIPHERAL DEVICE TYPE field of a copy source specified in a segment descriptor does not match the value in the PERIPHERAL DEVICE TYPE field in ROD CSCD descriptor (see 6.6.5.10); or
b) characteristics (e.g., logical block length, protection information characteristics (see SBC-5)) associated with the data specified by a segment descriptor are incompatible with the characteristics associated with the data specified by a previous segment descriptor, if any.

5.19.8.6 EXTENDED COPY command use of RODs when device type is direct access block device

The copy manager shall cause a ROD that was created by a copy manager associated with a logical unit whose device type is direct access block device (i.e., PERIPHERAL DEVICE TYPE field set to 00h) to function as a block device that:

a) exists only while the copy operation (see 5.19.4.3) originated by the EXTENDED COPY command is being processed;
b) may be used by any segment descriptor (see 6.6.6.1) that operates on a block device as a:
    A) copy source; or
    B) copy destination, if allowed by the ROD type (see 5.19.6.2);
c) has the following block device characteristics:
    A) a contiguous range of logical blocks;
    B) LBAs numbered from zero to the number of logical blocks represented by the ROD (see 5.19.8.5.2) minus one;
    C) data that matches the data that is in the ROD; and
    D) characteristics that match those of the logical blocks that are represented by the ROD, including at least the following:
        a) a DISK BLOCK LENGTH field in the device type specific CSCD descriptor parameters (see 6.6.5.3) that is set to the logical block length of each logical block represented by the ROD; and
        b) protection information that matches the protection information of the logical blocks that are represented by the ROD;
    and

    d) may have logical block provisioning information equivalent to the logical block provisioning information of the logical blocks that are represented by the ROD (see 5.19.6).

5.19.8.7 EXTENDED COPY command interactions with aliases

An application client may use alias values to reference SCSI target devices or SCSI target ports in the EXTENDED COPY command parameter list (see 5.19.8.1). The alias list provides a mechanism for eight-byte third party identifier fields to reference a third party device or port whose name or addressing information is longer than eight bytes.

EXAMPLE – An application may use the CHANGE ALIASES command (see 6.3) to establish an association between an alias value and a SCSI target device or target port designation. Then, the application client may send an EXTENDED COPY command containing in the parameter data an Alias CSCD descriptor (see 6.6.5.7) that includes this alias value.

After the completion of the EXTENDED COPY command, an application should clear all associated alias values from the device server's alias list by sending a CHANGE ALIASES command that requests association of each alias value to a NULL DESIGNATION (see 6.3.4.2) alias format.

6 Commands for all device types

6.1 Summary of commands for all device types

The operation codes for commands that apply to all device types are listed in table 88.

Table 88 – Commands for all device types (part 1 of 2)

Command	Operation code	Support	Reference
BIND	9Fh/0Eh [a]	O	6.2
CHANGE ALIASES	A4h/0Bh [a]	O	6.3
COPY OPERATION ABORT	83h/1Ch [a]	O	6.4
COPY OPERATION CLOSE	83h/1Dh [a]	O	6.5
EXTENDED COPY	83h/01h [a]	O	6.6
EXTENDED COPY(LID1)			SPC-4
INQUIRY	12h	M	6.7
LOG SELECT	4Ch	O	6.8
LOG SENSE	4Dh	O	6.9
MANAGEMENT PROTOCOL IN	A3h/10h [a]	O	6.10
MANAGEMENT PROTOCOL OUT	A4h/10h [a]	O	6.11
MODE SELECT(10)	55h	O	6.12
MODE SENSE(10)	5Ah	O	6.13
PERSISTENT RESERVE IN	5Eh	O	6.14
PERSISTENT RESERVE OUT	5Fh	O	6.15
PREPARE BINDING REPORT	9Fh/0Ch [a]	O	6.16
READ ATTRIBUTE	8Ch	O	6.17
READ BUFFER(10)	3Ch	O	6.18
READ BUFFER(16)	9Bh	O	6.19
READ MEDIA SERIAL NUMBER	ABh/01h [a]	O	6.20
RECEIVE BINDING REPORT	9Eh/0Fh [a]	O	6.21
RECEIVE COPY DATA	84h/06h [a]	O	6.22
RECEIVE COPY DATA(LID1)			SPC-4
RECEIVE COPY FAILURE DETAILS(LID1)			SPC-4
RECEIVE COPY OPERATING PARAMETERS			SPC-4
RECEIVE COPY STATUS	84h/05h [a]	O	6.23
RECEIVE COPY STATUS(LID1)			SPC-4
RECEIVE DIAGNOSTIC RESULTS	1Ch	O	6.24

Key: M = Command support is mandatory.
O = Command support is optional for this standard. See the applicable command standard for additional support requirements.

A numeric ordered listing of operation codes is provided in clause E.3.

[a] This command is defined by a combination of operation code and service action. The operation code value is shown preceding the slash and the service action value is shown after the slash.
[b] The well known logical unit support requirements for this command are defined in clause 8.
[c] The following operation codes are obsolete: 15h, 16h, 17h, 18h, 1Ah, 39h, 3Ah, 40h, 56h, 57h, 86h, and 87h.

Table 88 – Commands for all device types (part 2 of 2)

Command	Operation code	Support	Reference
RECEIVE ROD TOKEN INFORMATION	84h/07h [a]	O	6.25
REMOVE I_T NEXUS	A4h/0Ch [a]	O	6.26
REPORT ALIASES	A3h/0Bh [a]	O	6.27
REPORT ALL ROD TOKENS	84h/08h [a]	O	6.28
REPORT IDENTIFYING INFORMATION	A3h/05h [a]	O	6.29
REPORT LUNS	A0h	M [b]	6.30
REPORT PRIORITY	A3h/0Eh [a]	O	6.31
REPORT SUPPORTED OPERATION CODES	A3h/0Ch [a]	O	6.32
REPORT SUPPORTED TASK MANAGEMENT FUNCTIONS	A3h/0Dh [a]	O	6.33
REPORT TARGET PORT GROUPS	A3h/0Ah [a]	O	6.34
REPORT TIMESTAMP	A3h/0Fh [a]	O	6.35
REQUEST SENSE	03h	O	6.36
SECURITY PROTOCOL IN	A2h	O	6.37
SECURITY PROTOCOL OUT	B5h	O	6.38
SEND DIAGNOSTIC	1Dh	O	6.39
SET AFFILIATION	9Fh/0Dh [a]	O	6.40
SET IDENTIFYING INFORMATION	A4h/06h [a]	O	6.41
SET PRIORITY	A4h/0Eh [a]	O	6.42
SET TARGET PORT GROUPS	A4h/0Ah [a]	O	6.43
SET TIMESTAMP	A4h/0Fh [a]	O	6.44
TEST BIND	9Fh/0Bh [a]	O	6.45
TEST UNIT READY	00h	M	6.46
UNBIND	9Fh/0Fh [a]	O	6.47
WRITE ATTRIBUTE	8Dh	O	6.48
WRITE BUFFER	3Bh	O	6.49
Obsolete [c]			
Key: M = Command support is mandatory. O = Command support is optional for this standard. See the applicable command standard for additional support requirements.			
A numeric ordered listing of operation codes is provided in clause E.3.			
[a] This command is defined by a combination of operation code and service action. The operation code value is shown preceding the slash and the service action value is shown after the slash. [b] The well known logical unit support requirements for this command are defined in clause 8. [c] The following operation codes are obsolete: 15h, 16h, 17h, 18h, 1Ah, 39h, 3Ah, 40h, 56h, 57h, 86h, and 87h.			

6.2 BIND command

A BIND command (see table 89) that is received by an administrative logical unit (see SAM-6) requests that the device server perform a bind operation (see 5.8.9).

If a BIND command is received by a logical unit that is not an administrative logical unit (see SAM-6), the device server shall terminate the BIND command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST and the additional sense code set to NOT AN ADMINISTRATIVE LOGICAL UNIT.

If the device server in an administrative logical unit supports the BIND command, the device servers in all subsidiary logical units contained in that logical unit conglomerate (see SAM-6) shall support the UNBIND command (see 6.47).

Table 89 – BIND command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (9Fh)							
1	Reserved			SERVICE ACTION (0Eh)				
2	Reserved							NRD
3 ••• 11	Reserved							
12	(MSB)			PARAMETER LIST LENGTH				
13								(LSB)
14	Reserved							
15	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 89 for the BIND command.

The SERVICE ACTION field is defined in 4.2.5.2 and shall be set as shown in table 89 for the BIND command.

The no redirect (NRD) bit specifies whether a command redirection response (see 5.8.9.6) is allowed.

If the NRD bit is set to one, the device server shall:

a) perform the requested bind operation (see 5.8.9); or
b) terminate the BIND command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to EXPLICIT BIND NOT ALLOWED if the requested bind operation is not able to be completed.

The device server shall return a redirect response as described in 5.8.9.6 if:

a) the NRD bit is set to zero; and
b) the requested bind operation fails as a result of:
   A) the specified subsidiary logical unit (see table 90) is not able to be bound to the administrative logical unit processing the BIND command; and
   B) the specified subsidiary logical unit is able to be bound to a different administrative logical unit.

The PARAMETER LIST LENGTH field is defined in 4.2.5.5.

The CONTROL byte is defined in SAM-6.

The format of the parameter list for the BIND command is shown in table 90.

Table 90 – BIND parameter list

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
•••			BIND PARAMETER DATA LENGTH (n-3)					
3								(LSB)
4								
•••			Reserved					
7								
8	(MSB)							
•••			HOST BIND IDENTIFIER					
23								(LSB)
24								
•••			SUBSIDIARY LU DESIGNATOR					
k								
k+1	(MSB)							
k+2			INFORMATION STRING LENGTH (n-k+2)					(LSB)
k+3	(MSB)							
•••			INFORMATION STRING					
n								(LSB)

The BIND PARAMETER DATA LENGTH field specifies the number of bytes that follow in the parameter data.

The HOST BIND IDENTIFIER field specifies the host bind identifier (see 5.8.2). The HOST BIND IDENTIFIER field contains a value that identifies an application client.

If the HOST BIND IDENTIFIER field is set to FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFFh, the device server shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

The SUBSIDIARY LU DESIGNATOR field contains a designation descriptor (see 7.7.6.1) that specifies the subsidiary logical unit for the request. The device server shall terminate the BIND command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN PARAMETER LIST if the designation descriptor does not contain:

    a) the ASSOCIATION field set to 00b (i.e., logical unit);
    b) the DESIGNATOR field set to a value that specifies an existing logical unit; and
    c) the DESIGNATOR TYPE field set to:
        A) 2h (i.e., EUI);
        B) 3h (i.e., NAA);
        C) 8h (i.e., SCSI name string); or
        D) Ah (i.e., UUID).

The INFORMATION STRING LENGTH field contains the length of the information string in bytes.

The INFORMATION STRING field contains a vendor specific byte encoded character string. The contents of the INFORMATION STRING field should be stored by the device server so that it may be read by means outside the scope of this standard.

6.3 CHANGE ALIASES command

6.3.1 CHANGE ALIASES command introduction

The CHANGE ALIASES command (see table 91) requests the device server to make changes to a list of associations between eight-byte alias values and SCSI target device or SCSI target port designations that the device server maintains. This command uses the MAINTENANCE OUT CDB format (see 4.2.2.3.4). A designation contains a name and optional identifier information that specifies a SCSI target device or SCSI target port (see 6.3.2). The alias list may be queried by the application client via the REPORT ALIASES command (see 6.27). If the REPORT ALIASES command is supported, the CHANGE ALIASES command shall also be supported.

Table 91 – CHANGE ALIASES command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (A4h)							
1	Reserved			SERVICE ACTION (0Bh)				
2 ••• 5	Reserved							
6 ••• 9	(MSB) PARAMETER LIST LENGTH (LSB)							
10	Reserved							
11	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 91 for the CHANGE ALIASES command.

The SERVICE ACTION field is defined in 4.2.5.2 and shall be set as shown in table 91 for the CHANGE ALIASES command.

The PARAMETER LIST LENGTH field specifies the length in bytes of the parameter data that shall be transferred from the application client to the device server. A parameter list length value of zero specifies that no data shall be transferred and no changes shall be made in the alias list.

The CONTROL byte is defined in SAM-6.

If the parameter list length results in the truncation of the header or any alias entry, the device server shall make no changes to the alias list and shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to PARAMETER LIST LENGTH ERROR.

On successful completion of a CHANGE ALIASES command, the device server shall maintain an association of each assigned eight-byte alias value to the SCSI target device or SCSI target port designation. These associations shall be cleared by a logical unit reset or I_T nexus loss. The device server shall maintain a separate alias list for each I_T nexus.

A CHANGE ALIASES command may add, change, or remove entries from the alias list. Alias list entries not referenced in the CHANGE ALIASES parameter data shall not be changed.

If the device server has insufficient resources to make all requested changes to the alias list, then the device server shall make no changes to the alias list and shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INSUFFICIENT RESOURCES.

The parameter list for a CHANGE ALIASES command (see table 92) contains zero or more alias entries. If the device server processes a CHANGE ALIASES command that contains at least one alias entry while there exists any other enabled command that references an alias entry in the alias list, then the device server shall terminate the CHANGE ALIASES command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to OPERATION IN PROGRESS.

Table 92 – CHANGE ALIASES parameter list

Bit Byte	7	6	5	4	3	2	1	0
0 ••• 3	(MSB) 		CHANGE ALIASES PARAMETER DATA LENGTH (n-3)					 (LSB)
4 ••• 7				Reserved				
				Alias entry list				
8 •••				Alias entry (see 6.3.2) [first]				
				⋮				
••• n				Alias entry (see 6.3.2) [last]				

The CHANGE ALIASES PARAMETER DATA LENGTH field should contain the number of bytes of alias entries, and shall be ignored by the device server.

The format of an alias entry is described in 6.3.2.

6.3.2 Alias entry format

One alias entry (see table 93) describes one alias reported via the REPORT ALIASES command (see 6.27) or to be changed via the CHANGE ALIASES command.

Table 93 – Alias entry

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
•••				ALIAS VALUE				
7								(LSB)
8				PROTOCOL IDENTIFIER				
9								
10				Reserved				
11				FORMAT CODE				
12								
13				Reserved				
14	(MSB)							
15				DESIGNATION LENGTH (n-15)				(LSB)
16								
•••				DESIGNATION				
n								

The ALIAS VALUE field is set to the numeric alias value that the device server shall associate with the SCSI target device or target port specified by the values in the PROTOCOL IDENTIFIER field, FORMAT CODE field, and DESIGNATION field.

The PROTOCOL IDENTIFIER field (see table 94) specifies whether the alias entry designation is independent of SCSI transport protocol and the SCSI transport protocol, if any, to which the alias entry applies.

Table 94 – Alias entry PROTOCOL IDENTIFIER field

Code	Description	Reference
00h to 0Fh	Protocol specific designation	7.6.2
10h to 7Fh	Reserved	
80h	Protocol independent designation	6.3.4
81h to FFh	Reserved	

The FORMAT CODE field contents combined with the PROTOCOL IDENTIFIER field contents defines the format of the DESIGNATION field. The subclauses that describe each PROTOCOL IDENTIFIER field usage (see table 94) define the applicable FORMAT CODE field values.

The DESIGNATION LENGTH field specifies the number of bytes of the DESIGNATION field. The DESIGNATION LENGTH value shall be a multiple of four.

The zero-padded DESIGNATION field should designate a unique SCSI target device or target port using the following:

    a) a SCSI device name or a target port name;
    b) zero or more target port identifiers; and
    c) zero or more SCSI transport protocol specific identifiers.

6.3.3 Alias designation validation

The device server shall not validate any designation at the time of processing either the REPORT ALIASES or CHANGE ALIASES command. Such validation shall occur only when the device server uses the alias list to resolve an alias to a designation in the context of third-party commands (e.g., EXTENDED COPY) or any other command that requires reference to the alias list.

If a designation identifies a unique SCSI target device or target port that is within a SCSI domain accessible to the device server, then the designation is considered valid.

Based on the SCSI transport protocol specific requirements for a given designation format, a designation that does not identify a unique SCSI target device or target port within the SCSI domains accessible to the device server is considered invalid.

EXAMPLE 1 – A designation may be considered invalid if the device server has no ports on the SCSI domain of the designated SCSI target device or target port.

A designation having both name and identifier information may be inconsistent if the device server is not able to access the named SCSI target device or target port through one or more of the names or identifiers in the designation. In such cases, the designation shall be processed as valid or invalid according to the SCSI transport protocol specific requirements.

EXAMPLE 2 – In FCP-5, both an N_Port and World Wide Name for a SCSI port may be given in a designation. The designation definition may require that the N_Port be that of the named port. In that case, the designation is invalid. Alternatively, the designation definition may view the N_Port as a hint for the named FC Port accessible to the device server through a different D_ID. In that case, the designation is valid and designates the named FC Port.

> NOTE 13 - If only name information is provided in a designation, it is assumed that the device server has access to a mechanism for resolving names to identifiers. Access to such a service is SCSI transport protocol specific and vendor specific.

6.3.4 Alias entry protocol independent designations

6.3.4.1 Alias entry protocol independent designations overview

The protocol independent alias entry designations have the PROTOCOL IDENTIFIER field set to 80h and the FORMAT CODE field set to one of the codes shown in table 95.

Table 95 – Protocol independent alias entry FORMAT CODE field

Code	Name	Designation Length (bytes)	Designation Contents	Reference
00h	NULL DESIGNATION	0	none	6.3.4.2
01h to FFh	Reserved			

6.3.4.2 NULL DESIGNATION alias format

In response to an alias entry with the NULL DESIGNATION format, the device server shall remove the specified alias value from the alias list. Application clients should use the NULL DESIGNATION format in a CHANGE ALIASES command to remove inactive alias entries from the alias list if that alias entry is no longer needed. The NULL DESIGNATION format shall not appear in REPORT ALIASES parameter data.

6.4 COPY OPERATION ABORT command

The COPY OPERATION ABORT command (see table 96) is a third-party copy command (see 5.19.3) that requests the copy manager to abort the specified copy operation (see 5.19.4.3) as described in 5.19.4.7. Whether the copy operation is being processed in the foreground or background, the effect of the COPY OPERATION ABORT command is equivalent to an ABORT TASK task management function (see SAM-6 and 5.19.4.6).

Table 96 – COPY OPERATION ABORT command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (83h)							
1	Reserved			SERVICE ACTION (1Ch)				
2 ••• 5	(MSB) LIST IDENTIFIER (LSB)							
6 ••• 14	Reserved							
15	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 96 for the COPY OPERATION ABORT command.

The SERVICE ACTION field is defined in 4.2.5.2 and shall be set as shown in table 96 for the COPY OPERATION ABORT command.

The LIST IDENTIFIER field is defined in 5.19.4.2 and 6.6.3.2, and specifies the copy operation to be aborted. If the copy manager is not processing a copy operation with the specified list identifier, the copy manager shall terminate the COPY OPERATION ABORT command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

The CONTROL byte is defined in SAM-6.

6.5 COPY OPERATION CLOSE command

The COPY OPERATION CLOSE command (see table 97) is a third-party copy command (see 5.19.3) that requests the copy manager to end the specified copy operation (see 5.19.4.3) as described in 5.19.4.8.

Table 97 – COPY OPERATION CLOSE command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (83h)							
1	Reserved			SERVICE ACTION (1Dh)				
2	(MSB)							
•••				LIST IDENTIFIER				
5								(LSB)
6	Reserved						TO_MED	IMMED
7								
•••				Reserved				
14								
15	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 97 for the COPY OPERATION CLOSE command.

The SERVICE ACTION field is defined in 4.2.5.2 and shall be set as shown in table 97 for the COPY OPERATION CLOSE command.

The LIST IDENTIFIER field is defined in 5.19.4.2 and 6.6.3.2, and specifies the copy operation to be ended. If the copy manager is not processing a copy operation with the specified list identifier, the copy manager shall terminate the COPY OPERATION CLOSE command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

A to medium (TO_MED) bit set to one specifies that, in the absence of errors, the copy operation is ended after all data has been written to the medium on the copy destination and all positioning has been completed on the copy destination. A TO_MED bit set to zero specifies that the copy operation is ended after all data and positioning commands have been sent to the copy destination.

An immediate (IMMED) bit set to one specifies that the copy manager shall return status for the COPY OPERATION CLOSE command after validating the CDB. An IMMED bit set to zero specifies that the copy manager shall not return status until the copy operation has been ended.

The CONTROL byte is defined in SAM-6.

6.6 EXTENDED COPY command

6.6.1 EXTENDED COPY command introduction

The EXTENDED COPY command (see table 98) is a third-party copy command (see 5.19.3) that requests the copy manager to copy data from one set of copy sources (e.g., a set of source logical units) to a set of copy destinations (e.g., a set of destination logical units). The transfers requested by an EXTENDED COPY command are managed by a copy manager (see SAM-6 and 5.19.2).

Table 98 – EXTENDED COPY command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (83h)							
1	Reserved			SERVICE ACTION (01h)				
2 ••• 9	Reserved							
10 ••• 13	(MSB) PARAMETER LIST LENGTH (LSB)							
14	Reserved							
15	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 98 for the EXTENDED COPY command.

The SERVICE ACTION field is defined in 4.2.5.2 and shall be set as shown in table 98 for the EXTENDED COPY command.

The PARAMETER LIST LENGTH field is defined in 4.2.5.5. A parameter list length of zero specifies that the copy manager shall not transfer any data or alter any internal state, and this shall not be considered an error. If the parameter list length causes truncation of the parameter list, then the copy manager shall transfer no data and shall terminate the EXTENDED COPY command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to PARAMETER LIST LENGTH ERROR.

The CONTROL byte is defined in SAM-6.

6.6.2 EXTENDED COPY parameter data

The format of the EXTENDED COPY parameter list (see 5.19.8.1) is shown in table 99.

Table 99 – EXTENDED COPY parameter list (part 1 of 2)

Bit Byte	7	6	5	4	3	2	1	0
0	PARAMETER LIST FORMAT (01h)							
1	Reserved		STR	LIST ID USAGE		PRIORITY		
2	(MSB)			HEADER CSCD DESCRIPTOR LIST LENGTH (0020h)				
3								(LSB)
4 ••• 14	Reserved							
15	Reserved						G_SENSE	IMMED
16	HEADER CSCD DESCRIPTOR TYPE CODE (FFh)							
17 18 19	Reserved							
20 ••• 23	(MSB)			LIST IDENTIFIER				(LSB)
24 ••• 41	Reserved							
42 43	(MSB)			CSCD DESCRIPTOR LIST LENGTH (n-47)				(LSB)
44 45	(MSB)			SEGMENT DESCRIPTOR LIST LENGTH (m-n)				(LSB)
46 47	(MSB)			INLINE DATA LENGTH (k-m)				(LSB)
	CSCD descriptor list							
48 ••• 79	CSCD descriptor [ID 1] (see 6.6.5)							
	⋮							
n-31 ••• n	CSCD descriptor [ID x] (see 6.6.5)							

Table 99 – EXTENDED COPY parameter list (part 2 of 2)

Bit Byte	7	6	5	4	3	2	1	0
	Segment descriptor list							
n+1 •••	Segment descriptor (see 6.6.6) [first]							
	⋮							
••• m	Segment descriptor (see 6.6.6) [last]							
m+1 ••• k	Inline data							

The PARAMETER LIST FORMAT field (see table 100) specifies the format of the EXTENDED COPY parameter list and shall be set as shown in table 99 for the EXTENDED COPY command defined in this standard.

Table 100 – PARAMETER LIST FORMAT field

Code	Description
01h	The format shown in table 99
all others	Reserved

The STR bit is defined in 6.6.3.1.

The LIST ID USAGE field is defined in 6.6.3.2.

The PRIORITY field is defined in 6.6.3.3.

The HEADER CSCD DESCRIPTOR LIST LENGTH field shall be set as shown in table 99. For compatibility with SPC-3, this field specifies the length of one CSCD descriptor (i.e., a target descriptor in SPC-3 terms) in which the descriptor type is invalid. The EXTENDED COPY command parameter list format replaces the one descriptor with the fields shown in table 99.

The good with sense data (G_SENSE) bit specifies whether the copy manager is required to include sense data with GOOD status. If the G_SENSE bit is set to zero, then the copy manager shall not include sense data with any command that completes with GOOD status. If the G_SENSE bit is set to one and the copy manager completes the EXTENDED COPY command with GOOD status, then the copy manager shall include sense data with the GOOD status in which the sense key is set to COMPLETED, the additional sense code is set to EXTENDED COPY INFORMATION AVAILABLE, and the COMMAND-SPECIFIC INFORMATION field is set to the number of segment descriptors the copy manager has processed.

The immediate (IMMED) bit specifies whether the copy manager returns status for the EXTENDED COPY command before the first segment descriptor is processed (see 5.19.8.2). Processing of the IMMED bit is described in 5.19.4.3.

The copy manager shall terminate the EXTENDED COPY command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB if the IMMED bit is set to one and:

   a) the G_SENSE bit is set to one; or
   b) the LIST ID USAGE field (see 6.6.3.2) is set to 11b.

For interoperability with the EXTENDED COPY command defined in SPC-3, the HEADER CSCD DESCRIPTOR TYPE CODE field shall be set as shown in table 99.

The LIST IDENTIFIER field is defined in 6.6.3.2.

The CSCD DESCRIPTOR LIST LENGTH field is defined in 6.6.3.4.

The SEGMENT DESCRIPTOR LIST LENGTH field is defined in 6.6.3.5.

The INLINE DATA LENGTH field is defined in 6.6.3.6.

The CSCD descriptors are defined in 6.6.3.4 and 6.6.5.

The segment descriptors are defined in 6.6.3.5 and 6.6.6.

The inline data is defined in 6.6.3.6.

6.6.3 Shared EXTENDED COPY parameter list fields

6.6.3.1 STR bit

A sequential striped (STR) bit set to one specifies to the copy manager that the majority of the block device references in the parameter list represent sequential access of several block devices that are striped. This may be used by the copy manager to perform reads from a copy source block device at any time and in any order during processing of an EXTENDED COPY command as described in 6.6.5.3. A STR bit set to zero specifies to the copy manager that disk references, if any, may not be sequential.

6.6.3.2 LIST IDENTIFIER field and LIST ID USAGE field

The LIST IDENTIFIER field identifies the copy operation (see 5.19.4.3) originated by the EXTENDED COPY command to the copy manager as described in 5.19.4.2. The LIST ID USAGE field specifies the usage of the LIST IDENTIFIER field as shown in table 101.

Table 101 – LIST ID USAGE field for the EXTENDED COPY command

Value	Meaning
00b	The contents of the LIST IDENTIFIER field are defined in 5.19.4.2.
	The list identifier value may be used to abort (see 6.4) or to request status for a specific command sent on a specific I_T nexus (e.g., using the RECEIVE COPY STATUS command (see 6.23)). The copy manager shall hold data, if any, for retrieval by the application client as described in 5.19.4.5.
01b	Reserved
10b	The contents of the LIST IDENTIFIER field are defined in 5.19.4.2.
	The list identifier value may be used to abort (see 6.4) or to request status for a specific command sent on a specific I_T nexus (e.g., using the RECEIVE COPY STATUS command (see 6.23)). The copy manager may discard all held data (see 5.19.4.5) accessible to the application client. If the application client requests delivery of data that has been discarded as a result of the LIST ID USAGE field being set to 10b, then the copy manager shall respond as if the EXTENDED COPY command has not been processed.
11b	If the LIST IDENTIFIER field is not set to zero, then the copy manager shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.
	The copy manager shall discard all data accessible to the application client (e.g., using the RECEIVE COPY STATUS command (see 6.23)). If the application client requests delivery of data that has been discarded as a result the LIST ID USAGE field being set to 11b, then the copy manager shall respond as if the EXTENDED COPY command has not been processed.
	If the parameter list contains any segment descriptors (see 6.6.6) that require data to be held for the application client (e.g., the block→block&application client segment descriptor (see 6.6.6.4)), then the copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST, and no segment descriptors shall be processed (see 5.19.8.3).

The copy manager may respond as if the EXTENDED COPY command had never been received, if an EXTENDED COPY command that had the LIST ID USAGE field set to 10b or 11b in its parameter list is specified by the LIST IDENTIFIER field in one of the following commands:

    a) the RECEIVE COPY STATUS command (see 6.23);
    b) the RECEIVE COPY DATA command (see 6.22); and
    c) the RECEIVE ROD TOKEN INFORMATION command (see 6.25).

6.6.3.3 PRIORITY field

The PRIORITY field specifies the priority of data transfers resulting from this EXTENDED COPY command relative to data transfers resulting from other commands being processed by the device server contained within the same logical unit as the copy manager. All commands other than third-party copy commands have a priority of 1h. Priority 0h is the highest priority, with increasing values in the PRIORITY field indicating lower priorities.

6.6.3.4 CSCD DESCRIPTOR LIST LENGTH field and CSCD descriptor list

The CSCD DESCRIPTOR LIST LENGTH field specifies the length in bytes of the CSCD descriptor list that follows the parameter list header (see 5.19.8.1). An EXTENDED COPY command may reference one or more CSCDs. Each CSCD is described by a CSCD descriptor (see 6.6.5).

The maximum number of CSCD descriptors permitted within a parameter list is indicated by the MAXIMUM CSCD DESCRIPTOR COUNT field in the Third-party Copy VPD page Parameter Data descriptor (see 7.7.18.5). If the number of CSCD descriptors exceeds the allowed number, the copy manager shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to TOO MANY TARGET DESCRIPTORS.

6.6.3.5 SEGMENT DESCRIPTOR LIST LENGTH field and segment descriptor list

The SEGMENT DESCRIPTOR LIST LENGTH field specifies the length in bytes of the segment descriptor list that follows the CSCD descriptors (see 5.19.8.1). See 6.6.6 for a detailed description of the segment descriptors.

The maximum number of segment descriptors permitted within a parameter list is indicated by the MAXIMUM SEGMENT DESCRIPTOR COUNT field in the Third-party Copy VPD page Parameter Data descriptor (see 7.7.18.5). If the number of segment descriptors exceeds the allowed number, the copy manager shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to TOO MANY SEGMENT DESCRIPTORS.

The maximum combined length of the CSCD descriptors and segment descriptors permitted within a parameter list is indicated by the MAXIMUM DESCRIPTOR LIST LENGTH field in the Third-party Copy VPD page Parameter Data descriptor (see 7.7.18.5). If the combined length of the CSCD descriptors and segment descriptors exceeds the allowed value, then the copy manager shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to PARAMETER LIST LENGTH ERROR.

6.6.3.6 INLINE DATA LENGTH field and inline data

The INLINE DATA LENGTH field specifies the number of bytes of inline data, following the last segment descriptor (see 5.19.8.1). A value of zero specifies that no inline data is present.

The inline data contains information that is available for:

    a) reference by CSCD descriptors; or
    b) transfer by the copy manager in response to segment descriptors.

6.6.4 Descriptor type codes

CSCD descriptors, the CSCD descriptor extension, and segment descriptors share a single set of code values (see table 102) that identify the type of descriptor.

Table 102 – EXTENDED COPY descriptor type codes

Descriptor type	Description	Reference
00h to BFh	Segment descriptors	6.6.6
C0h to DFh	Vendor specific descriptors	
E0h to FEh	CSCD descriptors	6.6.5
FFh [a]	CSCD descriptor extension	6.6.5.2
[a] Use of this descriptor type code is reserved except in byte 32 of a 64-byte CSCD descriptor (e.g., the IPv6 CSCD descriptor described in 7.6.3.8).		

6.6.5 CSCD descriptors

6.6.5.1 CSCD descriptors introduction

The descriptor type code (see table 102) values for CSCD descriptors are shown in table 103.

Table 103 – EXTENDED COPY CSCD descriptor type codes (part 1 of 2)

Descriptor type [a]	Name	Size (bytes)	Reference
E0h	Fibre Channel N_Port_Name CSCD descriptor	32	7.6.3.2
E1h	Fibre Channel N_Port_ID CSCD descriptor	32	7.6.3.3
E2h	Fibre Channel N_Port_ID With N_Port_Name Checking CSCD descriptor	32	7.6.3.4
E3h	Obsolete		
E4h	Identification Descriptor CSCD descriptor	32	6.6.5.6
E5h	IPv4 CSCD descriptor	32	7.6.3.7
E6h	Alias CSCD descriptor	32	6.6.5.7
E7h	RDMA CSCD descriptor	32	7.6.3.6

[a] A copy manager may not support all CSCD descriptor types; however, the copy manager shall list all supported CSCD descriptor types in the Third-party Copy VPD page Supported Descriptors descriptor (see 7.7.18.6).

[b] A copy manager that implements the ROD CSCD descriptor shall implement:
   a) the following third-party copy descriptors in the Third-party Copy VPD page:
      A) the ROD Features third-party copy descriptor (see 7.7.18.8); and
      B) the Supported ROD Types third-party copy descriptor (see 7.7.18.9);
     and
   b) at least one of the following segment descriptors:
      A) the Populate a ROD from one or more block device ranges (see 6.6.6.21); or
      B) the Populate a ROD from one block device range (see 6.6.6.22).

Table 103 – EXTENDED COPY CSCD descriptor type codes (part 2 of 2)

Descriptor type [a]	Name	Size (bytes)	Reference
E8h	IEEE 1394 EUI-64 CSCD descriptor	32	7.6.3.5
E9h	SAS Serial SCSI Protocol CSCD descriptor	32	7.6.3.9
EAh	IPv6 CSCD descriptor	64	7.6.3.8
EBh	IP Copy Service CSCD descriptor	64	6.6.5.8
ECh	Multiple Device CSCD descriptor	32	6.6.5.9
EDh to FDh	Reserved for CSCD descriptors		
FEh	ROD CSCD descriptor [b]	32	6.6.5.10

[a] A copy manager may not support all CSCD descriptor types; however, the copy manager shall list all supported CSCD descriptor types in the Third-party Copy VPD page Supported Descriptors descriptor (see 7.7.18.6).

[b] A copy manager that implements the ROD CSCD descriptor shall implement:
   a) the following third-party copy descriptors in the Third-party Copy VPD page:
      A) the ROD Features third-party copy descriptor (see 7.7.18.8); and
      B) the Supported ROD Types third-party copy descriptor (see 7.7.18.9);
      and
   b) at least one of the following segment descriptors:
      A) the Populate a ROD from one or more block device ranges (see 6.6.6.21); or
      B) the Populate a ROD from one block device range (see 6.6.6.22).

All CSCD descriptors (see table 104) are a multiple of 32 bytes in length and begin with a four-byte header containing the DESCRIPTOR TYPE CODE field that specifies the format of the descriptor. If a copy manager receives an unsupported descriptor type code in a CSCD descriptor, the copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to UNSUPPORTED TARGET DESCRIPTOR TYPE CODE.

Table 104 – CSCD descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE CODE (E0h to FEh)							
1	LU ID TYPE		Obsolete	PERIPHERAL DEVICE TYPE				
2	(MSB)			RELATIVE INITIATOR PORT IDENTIFIER				
3								(LSB)
4 ••• 27	CSCD descriptor parameters							
28 ••• 31	Device type specific parameters							
32 ••• n	Zero or more CSCD descriptor extensions (see 6.6.5.2)							

The DESCRIPTOR TYPE CODE field is described in 6.6.4.

The LU ID TYPE field (see table 105) specifies the interpretation of the LU IDENTIFIER field in CSCD descriptors that contain a LU IDENTIFIER field.

Table 105 – LU ID TYPE field

Code	LU IDENTIFIER **field contents**	Support	Reference
00b	Logical Unit Number	Mandatory	SAM-6
01b	Obsolete		SPC-4
10b to 11b	Reserved		

If a copy manager receives an unsupported value in the LU ID TYPE field, the copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

If the LU ID TYPE field specifies that the LU IDENTIFIER field contains a logical unit number, then the LU IDENTIFIER field specifies the logical unit within the SCSI target device specified by other fields in the CSCD descriptor that shall be the copy source or copy destination.

The PERIPHERAL DEVICE TYPE field is described in 6.7.2. The value in the PERIPHERAL DEVICE TYPE field (see table 104) specifies the format of the device type specific parameters. The device type specific parameters convey information specific to the type of device specified by the CSCD descriptor.

Table 106 lists the device type values defined for the device type specific parameters in a CSCD descriptor. Device type values not listed in table 106 are reserved in all PERIPHERAL DEVICE TYPE fields in the EXTENDED COPY parameter list.

Table 106 – Device type specific parameters in CSCD descriptors

Device Type	Reference	Description	Name
00h, 05h, and 0Eh	6.6.5.3	Block devices	Block
01h	6.6.5.4	Sequential access devices	Stream or Tape
03h	6.6.5.5	Processor devices [a]	Stream

[a] This standard defines the use of the processor device type (i.e., 03h) (see SPC-2) only for the interactions between copy managers.

The RELATIVE INITIATOR PORT IDENTIFIER field (see 4.3.4) specifies the relative port identifier of the SCSI initiator port within the SCSI device that the copy manager shall use to access the logical unit described by the CSCD descriptor, if such access requires use of a SCSI initiator port (i.e., if the logical unit is in the same SCSI device as the copy manager, the RELATIVE INITIATOR PORT IDENTIFIER field is ignored). A RELATIVE INITIATOR PORT IDENTIFIER field set to zero specifies that the copy manager may use any SCSI initiator port or ports within the SCSI device.

CSCD descriptor extensions increase the length of a CSCD descriptor as described in 6.6.5.2.

6.6.5.2 The CSCD descriptor extension

A CSCD descriptor (see 6.6.5.1) is extended by appending one or more CSCD descriptor extensions (see table 107) to it. A CSCD descriptor extension is 32 bytes in length and begins with a one-byte header containing the descriptor type code value that identifies the descriptor as a CSCD descriptor extension (i.e., FFh).

Table 107 – CSCD descriptor extension

Bit Byte	7	6	5	4	3	2	1	0
0	EXTENSION DESCRIPTOR TYPE CODE (FFh)							
1 ... 31	CSCD descriptor specific information							

The EXTENSION DESCRIPTOR TYPE CODE field is a descriptor type code value (see 6.6.4), and shall be set to the value shown in table 107 for each CSCD descriptor extension.

The CSCD descriptor specific information contains data that extends the CSCD descriptor or CSCD descriptor extension located adjacent to and preceding this CSCD descriptor extension.

If a SOURCE CSCD DESCRIPTOR ID field or a DESTINATION CSCD DESCRIPTOR ID field in a segment descriptor (see 6.6.6.1) references a CSCD descriptor extension (i.e., a descriptor with the descriptor type code set to FFh), then the copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to COPY ABORTED, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

6.6.5.3 Device type specific CSCD descriptor parameters for block device types

The format for the device type specific CSCD descriptor parameters for block device types (i.e., device type code values 00h, 05h, and 0Eh) is shown in table 108.

Table 108 – Device type specific CSCD descriptor parameters for block device types

Bit Byte	7	6	5	4	3	2	1	0
28	Reserved					PAD	Reserved	
29	(MSB)							
30	DISK BLOCK LENGTH							
31								(LSB)

The PAD bit is used in conjunction with the CAT bit (see 6.6.6.1) in the segment descriptor to determine what action should be taken if a segment of the copy does not fit exactly into an integer number of destination logical blocks (see 5.19.8.2).

The DISK BLOCK LENGTH field is set to the number of bytes in a logical block, excluding any protection information (see SBC-5), for the logical unit being addressed.

If the DISK BLOCK LENGTH field is set to zero and the PERIPHERAL DEVICE TYPE field (see 6.6.5.1) is set to 00h, then the copy manager shall determine the logical block length of the CSCD logical unit (e.g., by sending a READ CAPACITY command (see SBC-5)), and use the result wherever the use of the DISK BLOCK LENGTH field is required by this standard.

The copy manager may read ahead from copy sources of the block device type (i.e., the copy manager may perform reads from a copy source block device at any time and in any order during processing of an EXTENDED COPY command), provided that the relative order of writes and reads on the same logical blocks within the same CSCD descriptor does not differ from their order in the segment descriptor list (see 5.19.8.1).

6.6.5.4 Device type specific CSCD descriptor parameters for the sequential access device type

The format for the device type specific CSCD descriptor parameters for the sequential access device type (i.e., device type code value 01h) operating in the implicit address mode (see SSC-5) is shown in table 109.

Table 109 – Device type specific CSCD descriptor parameters for the sequential access device type

Bit Byte	7	6	5	4	3	2	1	0
28	Reserved					PAD	Reserved	FIXED
29	(MSB)							
30				STREAM BLOCK LENGTH				
31								(LSB)

The PAD bit is used in conjunction with the CAT bit (see 5.19.8.2) in the segment descriptor to determine what action should be taken if a segment of the copy does not fit exactly into an integer number of destination logical blocks (see 5.19.8.2).

The contents of the FIXED bit and STREAM BLOCK LENGTH field are combined with the STREAM DEVICE TRANSFER LENGTH FIELD in the segment descriptor to determine the length of the stream read or write as defined in table 110.

Table 110 – Stream device transfer lengths

FIXED bit	STREAM BLOCK LENGTH field	Description
0	000000h	Use variable length reads or writes. The number of bytes for each read or write is specified by the STREAM DEVICE TRANSFER LENGTH field in the segment descriptor.
	000001h to FFFFFFh	The copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.
1	000000h	The copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST
	000001h to FFFFFFh	Use fixed record length reads or writes. The number of bytes for each read or write shall be the product of the STREAM BLOCK LENGTH field and the STREAM DEVICE TRANSFER LENGTH field in the segment descriptor.

The copy manager may set the SILI bit to one (see SSC-5) in read commands sent to sequential access type devices.

The copy manager shall not read ahead from copy sources of the stream device type (i.e., the reads required by a segment descriptor for which the copy source is a stream device shall not be started until all writes for previous segment descriptors have completed).

6.6.5.5 Device type specific CSCD descriptor parameters for the processor device type

The format for the device type specific CSCD descriptor parameters for the processor device type (i.e., device type code value 03h) (see SPC-2) is shown in table 111.

Table 111 – Device type specific CSCD descriptor parameters for the processor device type

Bit Byte	7	6	5	4	3	2	1	0
28	Reserved					PAD	Reserved	
29 ••• 31	Reserved							

The PAD bit is used in conjunction with the CAT bit (see 5.19.8.2) in the segment descriptor to determine what action should be taken if a segment of the copy does not fit exactly into an integer number of EXTENDED COPY commands (see 6.6) or RECEIVE COPY DATA commands (see 6.22).

If the processor device is a copy source, the number of bytes to be transferred by an EXTENDED COPY command shall be specified by STREAM DEVICE TRANSFER LENGTH field in the segment descriptor. If the processor device is a copy destination, the number of bytes to be transferred by an EXTENDED COPY command and subsequent RECEIVE COPY DATA command shall be specified by STREAM DEVICE TRANSFER LENGTH field in the segment descriptor.

6.6.5.6 Identification Descriptor CSCD descriptor format

The CSCD descriptor format shown in table 112 requests the copy manager to locate a SCSI target device and logical unit that returns a Device Identification VPD page (see 7.7.6) containing an Identification descriptor having the specified values in the CODE SET field, ASSOCIATION field, DESIGNATOR TYPE field, IDENTIFIER LENGTH field, and DESIGNATOR field. The copy manager may use any SCSI transport protocol (see SAM-6), target port identifier (see SAM-6) and logical unit number (see SAM-6) values that result in matching VPD field values to address the logical unit. If multiple combinations of SCSI transport protocols, target port identifiers, and logical unit numbers access matching VPD field values, then the copy manager may use any combination to address the logical unit and shall try other combinations in the event that one combination becomes non-operational during the processing of an EXTENDED COPY command.

Table 112 – Identification Descriptor CSCD descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE CODE (E4h)							
1	LU ID TYPE		Obsolete	PERIPHERAL DEVICE TYPE				
2	(MSB)			RELATIVE INITIATOR PORT IDENTIFIER				
3								(LSB)
4	Reserved				CODE SET			
5	Reserved		ASSOCIATION		DESIGNATOR TYPE			
6	Reserved							
7	DESIGNATOR LENGTH							
8 ••• 27	DESIGNATOR							
28 ••• 31	Device type specific parameters							

The DESCRIPTOR TYPE CODE field, PERIPHERAL DEVICE TYPE field, RELATIVE INITIATOR PORT IDENTIFIER field, and the device type specific parameters are described in 6.6.5.1. The DESCRIPTOR TYPE CODE field shall be set as shown in table 112 for the Identification Descriptor CSCD descriptor.

The LU ID TYPE field shall be ignored in the Identification Descriptor CSCD descriptor.

The CODE SET field contains a code set enumeration (see table 25) that indicates the format of the DESIGNATOR field.

The contents of the ASSOCIATION field, DESIGNATOR TYPE field, and DESIGNATOR LENGTH field are described in 7.7.6.1. The designator length shall be 20 or less.

The DESIGNATOR field is a fixed-length zero-padded field that has the DESIGNATOR field format defined in 7.7.6.

Some combinations of code set, association, designator type, designator length and designator do not uniquely identify a logical unit to serve as a CSCD. The behavior of the copy manager if such combinations are specified is outside the scope of this standard.

6.6.5.7 Alias CSCD descriptor format

The CSCD descriptor format shown in table 113 requests the copy manager to locate a SCSI target port and logical unit using the alias list designation associated with the specified alias value. The alias list is maintained using the CHANGE ALIASES command (see 6.3).

Table 113 – Alias CSCD descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE CODE (E6h)							
1	LU ID TYPE		Obsolete	PERIPHERAL DEVICE TYPE				
2	(MSB)			RELATIVE INITIATOR PORT IDENTIFIER				
3								(LSB)
4 ••• 11				LU IDENTIFIER				
12 ••• 19				ALIAS VALUE				
20 ••• 27				Reserved				
28 ••• 31				Device type specific parameters				

The DESCRIPTOR TYPE CODE field, LU ID TYPE field, PERIPHERAL DEVICE TYPE field, RELATIVE INITIATOR PORT IDENTIFIER field, and the device type specific parameters are described in 6.6.5.1. The DESCRIPTOR TYPE CODE field shall be set as shown in table 113 for the Alias CSCD descriptor.

The ALIAS VALUE field specifies an alias value in the alias list as managed by the CHANGE ALIASES command (see 6.3) and maintained by the device server.

When the copy manager first processes an Alias CSCD descriptor, it shall check the value of the ALIAS VALUE field for a corresponding entry in the alias list. If the value is not in the alias list or the copy manager is unable to validate the designation (see 6.3.3) associated with the alias value, then the copy manager shall terminate the copy operation (see 5.19.4.3) because the CSCD is unreachable (see 5.19.8.4). An application client generating EXTENDED COPY commands that include Alias CSCD descriptors in the parameter list is responsible for providing a valid entry in the alias list using the CHANGE ALIASES command (see 6.3) prior to sending the EXTENDED COPY command.

6.6.5.8 IP Copy Service CSCD descriptor

The CSCD descriptor format shown in table 114 requests the copy manager to communicate with the copy service specified in the IP ADDRESS field to locate the CSCD that returns a Device Identification VPD page (see 7.7.6) containing an Identification descriptor having the specified CODE SET field, ASSOCIATION field, DESIGNATOR TYPE field, DESIGNATOR LENGTH field, and DESIGNATOR field values.

The protocol used by the copy manager to communicate with the copy service is vendor specific.

Table 114 – IP Copy Service CSCD descriptor

Bit / Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE CODE (EBh)							
1	LU ID TYPE		Obsolete	PERIPHERAL DEVICE TYPE				
2	Reserved							IPTYPE
3 ••• 11	Reserved							
12 ••• 27	(MSB) COPY SERVICE IP ADDRESS (LSB)							
28 — 31	Device type specific parameters							
32	EXTENSION DESCRIPTOR TYPE CODE (FFh)							
33 — 35	Reserved							
36 — 37	(MSB) COPY SERVICE PORT NUMBER (LSB)							
38 — 39	(MSB) COPY SERVICE INTERNET PROTOCOL NUMBER (LSB)							
40	Reserved				CODE SET			
41	Reserved		ASSOCIATION		DESIGNATOR TYPE			
42	Reserved							
43	DESIGNATOR LENGTH							
44 ••• 63	DESIGNATOR							

The DESCRIPTOR TYPE CODE field, PERIPHERAL DEVICE TYPE field, RELATIVE INITIATOR PORT IDENTIFIER field, and the device type specific parameters are described in 6.6.5.1. The DESCRIPTOR TYPE CODE field shall be set as shown in table 114 for the IP Copy Service CSCD descriptor.

The LU ID TYPE field shall be ignored in the IP Copy Service CSCD descriptor.

If the IPTYPE bit is set to zero, the COPY SERVICE IP ADDRESS field shall contain a zero-padded IPv4 address (see RFC 791). If the IPTYPE bit is set to one, the COPY SERVICE IP ADDRESS field shall contain a unicast IPv6 address (see RFC 4291).

The COPY SERVICE IP ADDRESS field is set to the IP address of the copy service in the format specified by the IPTYPE bit.

The EXTENSION DESCRIPTOR TYPE CODE field is described in 6.6.5.2. If the EXTENSION DESCRIPTOR TYPE CODE field does not contain the value shown in table 114, then the copy manager shall terminate the EXTENDED COPY command with CHECK CONDITION status, with the sense key set to COPY ABORTED, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

The COPY SERVICE PORT NUMBER field shall contain the TCP port number.

The COPY SERVICE INTERNET PROTOCOL NUMBER field shall contain an Internet protocol number.

The contents of the COPY SERVICE IP ADDRESS field, the COPY SERVICE PORT NUMBER field, and the COPY SERVICE INTERNET PROTOCOL NUMBER field may be obtained from the network service descriptor with the SERVICE TYPE field set to 06h (i.e., copy service) in the Management Network Addresses VPD page (see 7.7.8) returned by the logical unit that returns a Device Identification VPD page (see 7.7.6) containing an Identification descriptor having the specified CODE SET field, ASSOCIATION field, DESIGNATOR TYPE field, DESIGNATOR LENGTH field, and DESIGNATOR field values.

The CODE SET field contains a code set enumeration (see table 25) that indicates the format of the DESIGNATOR field.

The contents of the ASSOCIATION field, DESIGNATOR TYPE field, and DESIGNATOR LENGTH field are described in 7.7.6.1. The designator length shall be 20 or less.

The DESIGNATOR field is a fixed-length zero-padded field that has the DESIGNATOR field format defined in 7.7.6.

Some combinations of code set, association, designator type, designator length and designator do not uniquely identify a logical unit to serve as a CSCD. The behavior of the copy manager if such combinations are specified is outside the scope of this standard.

6.6.5.9 Multiple device CSCD descriptor format

The CSCD descriptor format shown in table 115 is used by an EXTENDED COPY command to specify multiple copy destination devices using CSCD descriptor IDs.

Table 115 – Multiple device CSCD descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE CODE (ECh)							
1	Reserved		Obsolete	Reserved				
2	Reserved							
3								
4	NUMBER OF VALID CSCD DESCRIPTOR IDS							
5	Reserved							
	CSCD descriptor ID list							
6	(MSB)	DEVICE 1 CSCD DESCRIPTOR ID						
7								(LSB)
8	(MSB)	DEVICE 2 CSCD DESCRIPTOR ID						
9								(LSB)
10	(MSB)	DEVICE 3 CSCD DESCRIPTOR ID						
11								(LSB)
12	(MSB)	DEVICE 4 CSCD DESCRIPTOR ID						
13								(LSB)
14	(MSB)	DEVICE 5 CSCD DESCRIPTOR ID						
15								(LSB)
16	(MSB)	DEVICE 6 CSCD DESCRIPTOR ID						
17								(LSB)
18	(MSB)	DEVICE 7 CSCD DESCRIPTOR ID						
19								(LSB)
20	(MSB)	DEVICE 8 CSCD DESCRIPTOR ID						
21								(LSB)
22	Reserved							
•••								
31								

The DESCRIPTOR TYPE CODE field is described in 6.6.5.5 and shall be set as shown in table 115 for the multiple device CSCD descriptor.

The NUMBER OF VALID CSCD DESCRIPTOR IDS field specifies the largest device number for a valid field in the CSCD descriptor ID list (e.g., a NUMBER OF VALID CSCD DESCRIPTOR IDS field set to 03h specifies that the DEVICE 1 CSCD DESCRIPTOR ID field, the DEVICE 2 CSCD DESCRIPTOR ID field, and the DEVICE 3 CSCD DESCRIPTOR ID field are valid).

For each field in the CSCD descriptor ID list that is specified to be valid by of NUMBER OF VALID CSCD DESCRIPTOR IDS field, the CSCD descriptor ID list field specifies the CSCD descriptor ID (see table 121) of a copy destination device.

The copy manager shall terminate the EXTENDED COPY command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN PARAMETER LIST if any CSCD descriptor specified by a valid field in the CSCD descriptor ID list contains:

a) a DESCRIPTOR TYPE CODE field set to ECh; or
b) a PERIPHERAL DEVICE TYPE field set to a value that is different than the peripheral device type in the CSCD descriptor specified by the DEVICE 1 CSCD DESCRIPTOR ID field.

If the SOURCE CSCD DESCRIPTOR ID field in a segment descriptor specifies a multiple device CSCD descriptor (i.e., a CSCD descriptor with the DESCRIPTOR TYPE CODE field set to ECh), then the copy manager shall terminate the EXTENDED COPY command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

6.6.5.10 ROD CSCD descriptor

The CSCD descriptor format shown in table 116 requests the copy manager to use the specified ROD as a copy source or copy destination. If the ROD represents no data when the copy manager begins processing the EXTENDED COPY command (e.g., the ROD TYPE field is not set to zero), then the copy manager shall allow the ROD to be populated as defined in 5.19.8.5.2. If a segment descriptor attempts to use an unpopulated ROD as a copy source or copy destination, then the copy manager shall terminate the copy operation (see 5.19.4.3) as if an unreachable CSCD had been encountered (see 5.19.8.4).

Table 116 – ROD CSCD descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE CODE (FEh)							
1	LU ID TYPE		Obsolete	PERIPHERAL DEVICE TYPE				
2	(MSB)			RELATIVE INITIATOR PORT IDENTIFIER				
3								(LSB)
4	(MSB)			ROD PRODUCER CSCD DESCRIPTOR ID				
5								(LSB)
6				Reserved				
7								
8	(MSB)			ROD TYPE				
•••								
11								(LSB)
12	(MSB)			REQUESTED ROD TOKEN LIFETIME				
•••								
15								(LSB)
16	(MSB)			REQUESTED ROD TOKEN INACTIVITY TIMEOUT				
•••								
19								(LSB)
20				Reserved				
21								
22	Reserved							R_TOKEN
23	Reserved							DEL_TKN
24	(MSB)			ROD TOKEN OFFSET				
•••								
27								(LSB)
28				Device type specific parameters				
•••								
31								

The DESCRIPTOR TYPE CODE field, PERIPHERAL DEVICE TYPE field, RELATIVE INITIATOR PORT IDENTIFIER field, and the device type specific parameters are described in 6.6.5.5. The DESCRIPTOR TYPE CODE field shall be set as shown in table 116 for the ROD CSCD descriptor.

The LU ID TYPE field shall be ignored in the ROD CSCD descriptor.

If the ROD TYPE field is set to zero, then:

a) the PERIPHERAL DEVICE TYPE field shall be ignored; and
b) the device type of the ROD CSCD descriptor shall be the device type specified by the ROD token that is specified by the ROD TOKEN OFFSET field.

The ROD PRODUCER CSCD DESCRIPTOR ID field specifies the CSCD device (see table 121 in 6.6.6.1) that contains the logical unit that contains the copy manager that:

a) created the ROD token that is specified by the ROD TOKEN OFFSET field, if the ROD TYPE field is set to zero; or
b) creates the ROD token that is created during processing of the EXTENDED COPY command, if the ROD TYPE field is not set to zero.

The ROD TYPE field (see table 79 in 5.19.6.2.1) specifies the type of ROD being populated or referenced by a ROD token.

For all ROD types (see 5.19.6.2), access to the bytes within a ROD is established by specifying:

a) the identifier of a ROD CSCD descriptor that describes the ROD for the duration of the copy operation (see 5.19.4.3) originated by an EXTENDED COPY command; or
b) that a ROD token be created that allows the copy manager that creates the ROD token creator to identify and access the bytes represented by the ROD across multiple third-party copy commands.

Methods are available to create a ROD token from a ROD identifier and create a ROD identifier from a ROD token (see 5.19.8.5.1).

Fields in the ROD CSCD descriptor and fields in the ROD Features third-party copy descriptor (see 7.7.18.8) in the Third-party Copy VPD page that affect the processing of the ROD PRODUCER CSCD DESCRIPTOR ID field are shown in table 117.

Table 117 – Inputs that affect the processing of the ROD PRODUCER CSCD DESCRIPTOR ID field

ROD PRODUCER CSCD DESCRIPTOR ID field	R_TOKEN bit	ROD TYPE field	REMOTE TOKENS field [a]	Description
n/a	1	zero	n/a	the command shall be terminated [b]
FFFFh	0	n/a	n/a	process the command
	1	not zero	n/a	process the command
F800h	0 or 1	not zero	n/a	the command shall be terminated [b]
	0	zero local [c]	n/a	process the command
		zero remote [c]	0h	remote ROD tokens not supported [d]
			4h	process the command
Others [e]	0	not zero	0h	remote ROD tokens not supported [d]
			4h	the command shall be terminated [b]
		zero	0h	remote ROD tokens not supported [d]
			4h	process the command
	1	not zero	0h	remote ROD tokens not supported [d]
			4h	remote ROD token creation not supported [f]
			6h	process the command

[a] Refers to the REMOTE TOKENS field in the ROD Features third-party copy descriptor (see 7.7.18.8). Remote tokens values not shown in this table are n/a.

[b] The copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

[c] Processing depends on the copy manager that created the ROD token specified by the ROD TOKEN OFFSET field as follows:
   a) **local:** a ROD token created by a copy manager that is contained within the same SCSI target device that is processing the copy operation originated by the EXTENDED COPY command; or
   b) **remote:** a ROD token created by a copy manager that is not contained within the same SCSI target device that is processing the copy operation originated by the EXTENDED COPY command.

[d] The copy manager shall terminate the copy operation with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID TOKEN OPERATION, REMOTE ROD TOKEN USAGE NOT SUPPORTED.

[e] Any other CSCD descriptor ID (i.e., not FFFFh and not F800h) that specifies a logical unit not contained within the same SCSI target device as the processing copy manager.

[f] The copy manager shall terminate the copy operation with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID TOKEN OPERATION, REMOTE ROD TOKEN CREATION NOT SUPPORTED.

If the copy manager is unable to process the requested activities with the remote copy manager specified by the ROD PRODUCER CSCD DESCRIPTOR ID field necessary to use or create a remote ROD token, then the copy manager shall terminate the copy operation (see 5.19.4.3) as if an unreachable CSCD device had been encountered (see 5.19.8.4).

If the R_TOKEN bit is set to one, the REQUESTED ROD TOKEN LIFETIME field specifies the number of seconds the ROD token should remain valid (see 5.19.6.7).

If the REQUESTED ROD TOKEN LIFETIME field specifies a number of seconds that is less than the value in the MINIMUM TOKEN LIFETIME field in the ROD Features third-party copy descriptor (see 7.7.18.8), then the copy manager shall use the value in the MINIMUM TOKEN LIFETIME field. If the REQUESTED ROD TOKEN LIFETIME field specifies a number of seconds that is greater than the value in the MAXIMUM TOKEN LIFETIME field in the ROD Features third-party copy descriptor, then the copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

If the R_TOKEN bit is set to zero and the REQUESTED ROD TOKEN LIFETIME field is not set to zero, then the copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

If the R_TOKEN bit is set to one, the REQUESTED ROD TOKEN INACTIVITY TIMEOUT field specifies number of seconds that the copy manager should wait for the next third-party copy command that specifies the ROD token, if any, before invalidating that ROD token (see 5.19.6.7).

If the REQUESTED ROD TOKEN INACTIVITY TIMEOUT field specifies zero seconds, then the copy manager shall not invalidate the ROD token due to the lack of its active use. If the REQUESTED ROD TOKEN INACTIVITY TIMEOUT field specifies a number of seconds that is greater than the value in the MAXIMUM TOKEN INACTIVITY TIMEOUT field in the ROD Features third-party copy descriptor (see 7.7.18.8), then the copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

If the R_TOKEN bit is set to zero and the REQUESTED ROD TOKEN INACTIVITY TIMEOUT field is not set to zero, then the copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

Processing of the R_TOKEN bit depends on the value in the ROD TYPE field as follows:

    a) if the ROD TYPE field is not set to zero, then the R_TOKEN bit specifies whether a ROD token is to be returned for the ROD created during processing of the EXTENDED COPY command as follows:
        A) if the R_TOKEN bit is set to zero, then a ROD token shall not be returned; and
        B) if the R_TOKEN bit is set to one and table 117 does not require termination of the EXTENDED COPY command with an error, then a ROD token shall be made available for retrieval using the RECEIVE ROD TOKEN INFORMATION command (see 6.25);
        and
    b) if the ROD TYPE field is set to zero, then the processing of the R_TOKEN bit shall be as shown in table 117.

If the LIST ID USAGE field (see 6.6.3.2) is set to a value other than 00b or 10b and the R_TOKEN bit is set to one, then the copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

The delete token (DEL_TKN) bit specifies whether the ROD token, if any, specified by the ROD CSCD descriptor should be deleted (see 5.19.6.7) when processing of the EXTENDED COPY command is complete as shown in table 118.

Table 118 – DEL_TKN bit processing

DEL_TKN bit	ROD TYPE field	ROD token created by	Description
0	n/a	n/a	Processing of the command shall not cause the ROD token, if any, to be deleted.
1	zero	processing copy manager or a copy manager in the same SCSI target device as the copy manager that created the ROD token	The copy manager should delete the ROD token after processing of the command has been completed.
		a copy manager in different SCSI target device from the copy manager that created the ROD token	The copy manager may communicate with the copy manager that created the ROD token to cause the ROD token to be deleted after processing of the command has been completed.
	not zero	n/a	The copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

If the ROD TYPE field is set to zero, the value in the ROD TOKEN OFFSET field is added to the location of the first byte of inline data in the EXTENDED COPY parameter list (see 5.19.8.1) to locate the ROD token (see 5.19.6) to be accessed via this ROD CSCD descriptor. If the ROD TYPE field is not set to zero and the ROD TOKEN OFFSET field is not set to zero, then the copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

6.6.6 Segment descriptors

6.6.6.1 Segment descriptors introduction

The descriptor type code (see table 102) values assigned to segment descriptors are shown in table 119.

Table 119 – EXTENDED COPY segment descriptor type codes (part 1 of 2)

Descriptor type code [a]	Reference	Description	Name
00h	6.6.6.2	Copy from block device to stream device	block→stream
01h	6.6.6.3	Copy from stream device to block device	stream→block
02h	6.6.6.4	Copy from block device to block device	block→block
03h	6.6.6.5	Copy from stream device to stream device	stream→stream
04h	6.6.6.6	Copy inline data to stream device	inline→stream
05h	6.6.6.7	Copy embedded data to stream device	embedded→stream
06h	6.6.6.8	Read from stream device and discard	stream→discard
07h	6.6.6.9	Verify CSCD	
08h	6.6.6.10	Copy block device with offset to stream device	block<o>→stream
09h	6.6.6.11	Copy stream device to block device with offset	stream→block<o>
0Ah	6.6.6.12	Copy block device with offset to block device with offset	block<o>→block<o>
0Bh	6.6.6.2	Copy from block device to stream device and hold a copy of processed data for the application client [a]	block→stream& application client
0Ch	6.6.6.3	Copy from stream device to block device and hold a copy of processed data for the application client [a]	stream→block& application client
0Dh	6.6.6.4	Copy from block device to block device and hold a copy of processed data for the application client [a]	block→block& application client
0Eh	6.6.6.5	Copy from stream device to stream device and hold a copy of processed data for the application client [b]	stream→stream& application client
0Fh	6.6.6.8	Read from stream device and hold a copy of processed data for the application client [a]	stream→discard& application client
10h	6.6.6.13	Write filemarks to sequential access device	filemark→tape
11h to 12h		Obsolete	
13h	6.6.6.14	Tape device image copy	<i>tape→<i>tape
14h	6.6.6.17	Register persistent reservation key	

[a] A copy manager may not support all segment descriptor types. However, the copy manager shall list all supported segment descriptor types in the Third-party Copy VPD page Supported Descriptors descriptor (see 7.7.18.6).

[b] The application client uses the RECEIVE COPY DATA command (see 6.22) to retrieve data held for it by the copy manager (see 5.19.4.5).

Table 119 – EXTENDED COPY segment descriptor type codes (part 2 of 2)

Descriptor type code [a]	Reference	Description	Name
15h	6.6.6.18	Third party persistent reservations source I_T nexus	
16h	6.6.6.19	Block device image copy	<i>block→<i>block
17h	6.6.6.15	Positioning on sequential access device	positioning→tape
18h	6.6.6.16	Copy logical objects from tape device to tape device	<loi>tape→<loi>tape
19h	6.6.6.20	Create a mirror of the data stream as the tape is written	<loi>tape→<loi>tape mirror
1Ah to BDh		Reserved	
BEh	6.6.6.21	Populate ROD from one or more block ranges	ROD←block ranges(n)
BFh	6.6.6.22	Populate ROD from one block range	ROD←block range(1)

[a] A copy manager may not support all segment descriptor types. However, the copy manager shall list all supported segment descriptor types in the Third-party Copy VPD page Supported Descriptors descriptor (see 7.7.18.6).

[b] The application client uses the RECEIVE COPY DATA command (see 6.22) to retrieve data held for it by the copy manager (see 5.19.4.5).

Segment descriptors (see table 120) begin with an eight-byte header.

Table 120 – Segment descriptor header

Bit / Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE CODE (00h to 3Fh)							
1	Reserved					FCO	DC	CAT
2	(MSB)			DESCRIPTOR LENGTH (n-3)				
3								(LSB)
4	(MSB)			SOURCE CSCD DESCRIPTOR ID				
5								(LSB)
6	(MSB)			DESTINATION CSCD DESCRIPTOR ID				
7								(LSB)
8 ··· n				Segment descriptor parameters				

The DESCRIPTOR TYPE CODE field is described in 6.6.4. If a copy manager receives an unsupported descriptor type code in a segment descriptor, the copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to UNSUPPORTED SEGMENT DESCRIPTOR TYPE CODE.

The fast copy only (FCO) bit is only applicable to segment descriptors with descriptor type code values of 02h, 0Ah, 0D, 16h, BEh, and BFh. The FCO bit shall be ignored for all other segment descriptors.

If the FCO bit is set to zero, then the copy manager shall process the segment descriptor.

If the FCO bit is set to one and the copy operation has:

    a) a high probability of being performed faster than an equivalent set of SCSI initiator read operations from the source CSCD and SCSI initiator write operations to the destination CSCD (e.g., the copy operation is able to be performed using a non-read/write method such as a copy on write snapshot method or a copy on write clone method), then the copy manager should process the segment descriptor; or

    b) a low probability of being performed faster than an equivalent set of SCSI initiator operations (e.g., the copy operation is performed using copy manager read operations from the source CSCD and copy manager write operations to the destination CSCD), then the EXTENDED COPY command should be terminated with CHECK CONDITION status, with the sense key set to COPY ABORTED, and the additional sense code set to FAST COPY NOT POSSIBLE.

The destination count (DC) bit is only applicable to segment descriptors with descriptor type code values of 02h and 0Dh (see 6.6.6.4). The DC bit shall be ignored for all other segment descriptors.

The CAT bit is described in 5.19.8.2.

The DESCRIPTOR LENGTH field is set to the length in bytes of the fields that follow the DESCRIPTOR LENGTH field in the segment descriptor.

The SOURCE CSCD DESCRIPTOR ID field (see table 121) specifies the copy source.

The DESTINATION CSCD DESCRIPTOR ID field (see table 121) specifies the copy destination.

Table 121 – CSCD descriptor ID values

Code	Description
0000h [a] 0001h to 07FFh [a]	The copy source or copy destination is specified by the contents of the CSCD descriptor whose location in the EXTENDED COPY command parameter list (see 5.19.8.1) is computed as follows: $$16 + (code \times 32)$$ where: code is 0000h to 07FFh as shown in this table.
C000h	The copy source or copy destination is a null logical unit [b] whose device type value is 00h (i.e., direct access block).
C001h	The copy source or copy destination is a null logical unit [b] whose device type value is 01h (i.e., sequential access).
F800h [c]	The copy source or copy destination is the logical unit specified by the ROD token specified in the ROD CSCD descriptor (see 6.6.5.10) that has this value in its ROD PRODUCER CSCD DESCRIPTOR ID field.
FFFFh	The copy source or copy destination is the logical unit that contains the copy manager (see SAM-6) that is processing the EXTENDED COPY command (i.e., the logical unit to which the EXTENDED COPY command was sent).
all others	Reserved

[a] If a SOURCE CSCD DESCRIPTOR ID field or a DESTINATION CSCD DESCRIPTOR ID field is set to this value, the copy manager may terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status (see 6.6.2).

[b] A null logical unit is a logical unit that has a specified device type to which the copy manager is not allowed to send any SCSI commands. If the processing of a segment descriptor requires sending a SCSI command to a source device or destination device specified to be a null logical unit, then the copy manager shall terminate the copy operation (see 5.19.4.3) as if an unreachable CSCD had been encountered (see 5.19.8.4). Null logical units are useful for processing the residual data from previous segment descriptors without affecting any media (e.g., a segment descriptor of type 06h (i.e., stream→discard) with the SOURCE CSCD DESCRIPTOR ID field set to C001h, the BYTE COUNT field set to zero, the CAT bit set to zero, and the PAD bit set to one may be used to discard all residual data).

[c] If this code appears in any field other than the ROD PRODUCER CSCD DESCRIPTOR ID field in the ROD CSCD descriptor, then the copy manager shall terminate the copy operation (see 5.19.4.3) as if an unreachable CSCD had been encountered (see 5.19.8.4).

If a segment descriptor format does not require a SOURCE CSCD DESCRIPTOR ID field or a DESTINATION CSCD DESCRIPTOR ID field, then that field is reserved.

If the CSCD specified by a SOURCE CSCD DESCRIPTOR ID field or a DESTINATION CSCD DESCRIPTOR ID field is not accessible to the copy manager, then the copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to COPY ABORTED, and the additional sense code set to UNREACHABLE COPY TARGET.

6.6.6.2 Block device to stream device functions

The segment descriptor format shown in table 122 is used by the copy functions that move data from a block device to a stream device.

Table 122 – Block device to stream device segment descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	\ DESCRIPTOR TYPE CODE (00h or 0Bh)							
1	Reserved							CAT
2	(MSB)			DESCRIPTOR LENGTH (0014h)				
3								(LSB)
4	(MSB)			SOURCE CSCD DESCRIPTOR ID				
5								(LSB)
6	(MSB)			DESTINATION CSCD DESCRIPTOR ID				
7								(LSB)
8	Reserved							
9	(MSB)							
10				STREAM DEVICE TRANSFER LENGTH				
11								(LSB)
12	Reserved							
13	Reserved							
14	(MSB)			BLOCK DEVICE NUMBER OF BLOCKS				
15								(LSB)
16	(MSB)							
•••				BLOCK DEVICE LOGICAL BLOCK ADDRESS				
23								(LSB)

The DESCRIPTOR TYPE CODE field is described in 6.6.4 and 6.6.6.1.

For descriptor type code 00h (i.e., block→stream) or descriptor type code 0Bh (i.e., block→stream&application client), the copy manager shall copy the data from the copy source block device specified by the SOURCE CSCD DESCRIPTOR ID field to the copy destination stream device specified by the DESTINATION CSCD DESCRIPTOR ID field using the logical blocks starting at the location specified by the BLOCK DEVICE LOGICAL BLOCK ADDRESS field. The copy manager shall read as many logical blocks as necessary to process (see 5.19.8.2) a number of bytes equal to the contents of the DISK BLOCK LENGTH field in the CSCD descriptor for the source device times the contents of the BLOCK DEVICE NUMBER OF BLOCKS field. The data shall be written to the stream device starting at the current position of the media.

For descriptor type code 0Bh (i.e., block→stream&application client), the copy manager also shall hold a copy of the processed data for delivery to the application client upon completion of the copy operation (see 5.19.4.3) originated by the EXTENDED COPY command as described in 5.19.4.5.

The CAT bit is described in 5.19.8.2.

The DESCRIPTOR LENGTH field is described in 6.6.6.1, and shall be set as shown in table 122 for descriptor type code 00h (i.e., block→stream) and descriptor type code 0Bh (i.e., block→stream&application client).

The SOURCE CSCD DESCRIPTOR ID field and DESTINATION CSCD DESCRIPTOR ID field are described in 6.6.6.1.

The STREAM DEVICE TRANSFER LENGTH field specifies the amount of data to be written by each write command sent to the copy destination stream device. See 6.6.5.4 for a description of how data in the STREAM DEVICE TRANSFER LENGTH field in the segment descriptor interacts with data in the STREAM BLOCK LENGTH field in the device type specific CSCD descriptor parameters for the copy destination sequential access device type.

The BLOCK DEVICE NUMBER OF BLOCKS field specifies the length, in copy source logical blocks, of data to be processed (see 5.19.8.2) in the segment. A value of zero shall not be considered an error. No data shall be processed, but any residual destination data retained from a previous segment shall be written if possible to the destination in whole block transfers. A value of zero shall not modify the handling of residual data.

The BLOCK DEVICE LOGICAL BLOCK ADDRESS field specifies the starting logical block address on the copy source block device for this segment.

6.6.6.3 Stream device to block device functions

The segment descriptor format shown in table 123 is used by the copy functions that move data from a stream device to a block device.

Table 123 – Stream device to block device segment descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE CODE (01h or 0Ch)							
1	Reserved							CAT
2	(MSB)			DESCRIPTOR LENGTH (0014h)				
3								(LSB)
4	(MSB)			SOURCE CSCD DESCRIPTOR ID				
5								(LSB)
6	(MSB)			DESTINATION CSCD DESCRIPTOR ID				
7								(LSB)
8	Reserved							
9	(MSB)							
10				STREAM DEVICE TRANSFER LENGTH				
11								(LSB)
12	Reserved							
13	Reserved							
14	(MSB)			BLOCK DEVICE NUMBER OF BLOCKS				
15								(LSB)
16	(MSB)							
•••				BLOCK DEVICE LOGICAL BLOCK ADDRESS				
23								(LSB)

The DESCRIPTOR TYPE CODE field is described in 6.6.4 and 6.6.6.1.

For descriptor type code 01h (i.e., stream→block) or descriptor type code 0Ch (i.e., stream→block&application client), the copy manager shall copy the data from the copy source stream device specified by the SOURCE CSCD DESCRIPTOR ID field to the copy destination block device specified by the DESTINATION CSCD DESCRIPTOR ID field using the stream data starting at the current position of the stream device. The data shall be written to logical blocks starting at the location specified by the BLOCK DEVICE LOGICAL BLOCK ADDRESS field and continuing for the number of logical blocks specified in the BLOCK DEVICE NUMBER OF BLOCKS field.

For descriptor type code 0Ch (i.e., stream→block&application client), the copy manager also shall hold a copy of the processed data for delivery to the application client upon completion of the copy operation (see 5.19.4.3) originated by the EXTENDED COPY command as described in 5.19.4.5.

The CAT bit is described in 5.19.8.2.

The DESCRIPTOR LENGTH field is described in 6.6.6.1, and shall be set as shown in table 123 for descriptor type code 01h (i.e., stream→block) and descriptor type code 0Ch (i.e., stream→block&application client).

The SOURCE CSCD DESCRIPTOR ID field and DESTINATION CSCD DESCRIPTOR ID field are described in 6.6.6.1.

The STREAM DEVICE TRANSFER LENGTH field specifies the amount of data to be read from the copy source stream device by each read command. See 6.6.5.4 for a description of how data in the STREAM DEVICE TRANSFER LENGTH field in the segment descriptor interacts with data in the STREAM BLOCK LENGTH field in the device type specific CSCD descriptor parameters for the copy source sequential access device type.

The BLOCK DEVICE NUMBER OF BLOCKS field specifies the number logical blocks to be written by the segment. A value of zero specifies that no logical blocks shall be written in this segment. This shall not be considered an error.

The BLOCK DEVICE LOGICAL BLOCK ADDRESS field specifies the starting logical block address on the copy destination block device for this segment.

6.6.6.4 Block device to block device functions

The segment descriptor format shown in table 124 is used by the copy functions that move data from a block device to a block device.

Table 124 – Block device to block device segment descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE CODE (02h or 0Dh)							
1	Reserved					FCO	DC	CAT
2	(MSB)							
3	DESCRIPTOR LENGTH (0018h)							(LSB)
4	(MSB)							
5	SOURCE CSCD DESCRIPTOR ID							(LSB)
6	(MSB)							
7	DESTINATION CSCD DESCRIPTOR ID							(LSB)
8	Reserved							
9	Reserved							
10	(MSB)							
11	BLOCK DEVICE NUMBER OF BLOCKS							(LSB)
12	(MSB)							
•••	SOURCE BLOCK DEVICE LOGICAL BLOCK ADDRESS							
19								(LSB)
20	(MSB)							
•••	DESTINATION BLOCK DEVICE LOGICAL BLOCK ADDRESS							
27								(LSB)

The DESCRIPTOR TYPE CODE field is described in 6.6.4 and 6.6.6.1.

For descriptor type code 02h (i.e., block→block) or descriptor type code 0Dh (i.e., block→block&application client), the copy manager shall copy the data from the copy source block device specified by the SOURCE CSCD DESCRIPTOR ID field to the copy destination block device specified by the DESTINATION CSCD DESCRIPTOR ID field using the logical blocks starting at the location specified by the SOURCE BLOCK DEVICE LOGICAL BLOCK ADDRESS field. The data shall be written to logical blocks starting at the location specified by the DESTINATION BLOCK DEVICE LOGICAL BLOCK ADDRESS field.

The fast copy only (FCO) bit is described in 6.6.6.1.

If the destination count (DC) bit is set to zero, then the copy manager shall:

 a) read as many logical blocks as necessary to process (see 5.19.8.2) a number of bytes equal to the contents of the DISK BLOCK LENGTH field in the CSCD descriptor for the copy source device times the contents of the BLOCK DEVICE NUMBER OF BLOCKS field; and
 b) perform as many writes as possible using any residual destination data from the previous segment and the data processed in this segment.

If the DC bit is set to one, then:

    a) the number of logical blocks specified by the BLOCK DEVICE NUMBER OF BLOCKS field shall be written to the copy destination block device;

    b) as many bytes shall be processed (see 5.19.8.2) as necessary for these writes to be performed; and

    c) as many logical blocks shall be read as necessary to supply the data to be processed.

For descriptor type code 0Dh (i.e., block→block&application client), the copy manager also shall hold a copy of the processed data for delivery to the application client upon completion of the copy operation (see 5.19.4.3) originated by the EXTENDED COPY command as described in 5.19.4.5.

The CAT bit is described in 5.19.8.2.

The DC bit specifies whether the BLOCK DEVICE NUMBER OF BLOCKS field refers to the copy source or copy destination. A DC bit set to zero specifies that the BLOCK DEVICE NUMBER OF BLOCKS field refers to the copy source. A DC bit set to one specifies that the BLOCK DEVICE NUMBER OF BLOCKS field refers to the copy destination.

The DESCRIPTOR LENGTH field is described in 6.6.6.1, and shall be set as shown in table 124 for descriptor type code 02h (i.e., block→block) and descriptor type code 0Dh (i.e., block→block&application client).

The SOURCE CSCD DESCRIPTOR ID field and DESTINATION CSCD DESCRIPTOR ID field are described in 6.6.6.1.

If the DC bit is set to zero, the BLOCK DEVICE NUMBER OF BLOCKS field specifies the number of logical blocks to be processed. If the DC bit is set to one, the BLOCK DEVICE NUMBER OF BLOCKS field specifies the number of logical blocks to be written to the copy destination.

If the DC bit is set to zero, a BLOCK DEVICE NUMBER OF BLOCKS field set to zero specifies that:

    a) no source logical blocks shall be read and no source data shall be processed;

    b) any residual destination data from a previous segment shall be written if possible to the destination in whole logical block transfers; and

    c) any residual data shall be processed as described in 5.19.8.2.

If the DC bit set to one, a BLOCK DEVICE NUMBER OF BLOCKS field set to zero specifies that:

    a) no destination logical blocks shall be written; and

    b) the only processing to be performed is that any residual source data or destination data from the previous segment shall be processed as residual data as described in 5.19.8.2.

The SOURCE BLOCK DEVICE LOGICAL BLOCK ADDRESS field specifies the copy source logical block address from which the reading of data shall start.

The DESTINATION BLOCK DEVICE LOGICAL BLOCK ADDRESS field specifies the copy destination logical block address to which the writing of data shall begin.

6.6.6.5 Stream device to stream device functions

The segment descriptor format shown in table 125 is used by the copy functions that move data from a stream device to a stream device.

Table 125 – Stream device to stream device segment descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE CODE (03h or 0Eh)							
1	Reserved							CAT
2	(MSB)			DESCRIPTOR LENGTH (0010h)				
3								(LSB)
4	(MSB)			SOURCE CSCD DESCRIPTOR ID				
5								(LSB)
6	(MSB)			DESTINATION CSCD DESCRIPTOR ID				
7								(LSB)
8	Reserved							
9	(MSB)							
10				SOURCE STREAM DEVICE TRANSFER LENGTH				
11								(LSB)
12	Reserved							
13	(MSB)							
14				DESTINATION STREAM DEVICE TRANSFER LENGTH				
15								(LSB)
16	(MSB)							
•••				BYTE COUNT				
19								(LSB)

The DESCRIPTOR TYPE CODE field is described in 6.6.4 and 6.6.6.1.

For descriptor type code 03h (i.e., stream→stream) or descriptor type code 0Eh (i.e., stream→stream&application client), the copy manager shall copy the data from the copy source stream device specified by the SOURCE CSCD DESCRIPTOR ID field to the destination copy stream device specified by the DESTINATION CSCD DESCRIPTOR ID field. Data shall be read from the copy source stream device starting at the current position of the copy source stream device. Data shall be written to the copy destination stream device starting at the current position of the copy destination stream device. The BYTE COUNT field defines the number of bytes to be processed (see 5.19.8.2) by the copy manager. The copy manager shall perform reads as necessary to supply the source data, and as many writes as possible using the destination data.

For descriptor type code 0Eh (i.e., stream→stream&application client), the copy manager also shall hold a copy of the processed data for delivery to the application client upon completion of the copy operation (see 5.19.4.3) originated by the EXTENDED COPY command as described in 5.19.4.5.

The CAT bit is described in 5.19.8.2.

The DESCRIPTOR LENGTH field is described in 6.6.6.1, and shall be set as shown in table 125 for descriptor type code 03h (i.e., stream→stream) and descriptor type code 0Eh (i.e., stream→stream&application client).

The SOURCE CSCD DESCRIPTOR ID field and DESTINATION CSCD DESCRIPTOR ID field are described in 6.6.6.1.

The SOURCE STREAM DEVICE TRANSFER LENGTH field specifies the amount of data to be read from the copy source stream device by each read command. See 6.6.5.4 for a description of how data in the SOURCE STREAM DEVICE TRANSFER LENGTH field in the segment descriptor interacts with data in the STREAM BLOCK LENGTH field in the device type specific CSCD descriptor parameters for the copy source sequential access device type.

The DESTINATION STREAM DEVICE TRANSFER LENGTH field specifies the amount of data to be written to the copy destination stream device by each write command. See 6.6.5.4 for a description of how data in the DESTINATION STREAM DEVICE TRANSFER LENGTH field in the segment descriptor interacts with data in the STREAM BLOCK LENGTH field in the device type specific CSCD descriptor parameters for the copy destination sequential access device type.

The BYTE COUNT field specifies the number of bytes that shall be processed (see 5.19.8.2) for this segment descriptor. A value of zero shall not be considered an error, and specifies that no source data shall be read and no source data shall be processed. However, a value of zero specifies that any residual destination data from a previous segment shall be written if possible to the copy destination in whole-block transfers, and any residual data shall be processed as described in 5.19.8.2.

6.6.6.6 Inline data to stream device function

The segment descriptor format shown in table 126 requests the copy manager to write inline data from the EXTENDED COPY parameter list to a stream device.

Table 126 – Inline data to stream device segment descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE CODE (04h)							
1	Reserved							CAT
2	(MSB)			DESCRIPTOR LENGTH (0010h)				
3								(LSB)
4	Reserved							
5	Reserved							
6	(MSB)			DESTINATION CSCD DESCRIPTOR ID				
7								(LSB)
8	Reserved							
9	(MSB)							
10				STREAM DEVICE TRANSFER LENGTH				
11								(LSB)
12	(MSB)							
•••				INLINE DATA OFFSET				
15								(LSB)
16	(MSB)							
•••				INLINE DATA NUMBER OF BYTES				
19								(LSB)

The DESCRIPTOR TYPE CODE field is described in 6.6.4 and 6.6.6.1, and shall be set as shown in table 126 for the inline data to stream device segment descriptor.

Descriptor type code 04h (i.e., inline→stream) requests the copy manager to write inline data to a copy destination stream device. The inline data shall be read from the inline data in the EXTENDED COPY parameter list (see 5.19.8.1). The data shall be written to the copy destination stream device specified by the DESTINATION CSCD DESCRIPTOR ID field starting at the current position of the stream device. Any residual destination data from a previous segment descriptor shall be written before the data of the current segment descriptor. Any residual source data from a previous segment descriptor shall not be processed (see 5.19.8.2), and shall be processed as residual source data.

The CAT bit is described in 5.19.8.2.

The DESCRIPTOR LENGTH field is described in 6.6.6.1, and shall be set as shown in table 126 for descriptor type code 04h (i.e., inline→stream).

The DESTINATION CSCD DESCRIPTOR ID field is described in 6.6.6.1.

The STREAM DEVICE TRANSFER LENGTH field specifies the amount of data to be written to the copy destination stream device by each write command. See 6.6.5.4 for a description of how data in the STREAM DEVICE TRANSFER LENGTH field in the segment descriptor interacts with data in the STREAM BLOCK LENGTH field in the device type specific CSCD descriptor parameters for the copy destination sequential access device type.

The value in the INLINE DATA OFFSET field is added to the location of the first byte of inline data in the EXTENDED COPY parameter list (see 5.19.8.1) to locate the first byte of inline data to be written to the copy destination stream device. The INLINE DATA OFFSET value shall be a multiple of 4.

The INLINE DATA NUMBER OF BYTES field specifies the number of bytes of inline data that are to be transferred to the copy destination stream device. A value of zero shall not be considered an error.

If the sum of the INLINE DATA OFFSET and the INLINE DATA NUMBER OF BYTES values exceeds the value in the INLINE DATA LENGTH field (see 6.6.3.6), then the copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to COPY ABORTED, and the additional sense code set to INLINE DATA LENGTH EXCEEDED.

6.6.6.7 Embedded data to stream device function

The segment descriptor format shown in table 127 requests the copy manager to write embedded data from the segment descriptor to a stream device.

Table 127 – Embedded data to stream device segment descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE CODE (05h)							
1	Reserved							CAT
2	(MSB)			DESCRIPTOR LENGTH (n-3)				
3								(LSB)
4	Reserved							
5	Reserved							
6	(MSB)			DESTINATION CSCD DESCRIPTOR ID				
7								(LSB)
8	Reserved							
9	(MSB)							
10				STREAM DEVICE TRANSFER LENGTH				
11								(LSB)
12	(MSB)			EMBEDDED DATA NUMBER OF BYTES				
13								(LSB)
14				Reserved				
15								
16								
•••				EMBEDDED DATA				
n								

The DESCRIPTOR TYPE CODE field is described in 6.6.4 and 6.6.6.1, and shall be set as shown in table 127 for the embedded data to stream device segment descriptor.

Descriptor type code 05h (i.e., embedded→stream) requests the copy manager to write embedded data from the segment descriptor to a copy destination stream device. The embedded data shall be read from the segment descriptor. The data shall be written to the copy destination stream device specified by the DESTINATION CSCD DESCRIPTOR ID field starting at the current position of the copy destination stream device. Any residual destination data from a previous segment descriptor shall be written before the data of the current segment descriptor. Any residual source data from a previous segment descriptor shall not be processed (see 5.19.8.2), and shall be processed as residual source data.

The CAT bit is described in 5.19.8.2.

The DESCRIPTOR LENGTH field is described in 6.6.6.1. The value in the DESCRIPTOR LENGTH field shall be a multiple of 4.

The DESTINATION CSCD DESCRIPTOR ID field is described in 6.6.6.1.

The STREAM DEVICE TRANSFER LENGTH field specifies the amount of data to be written to the copy destination stream device by each write command. See 6.6.5.4 for a description of how data in the STREAM DEVICE TRANSFER LENGTH field in the segment descriptor interacts with data in the STREAM BLOCK LENGTH field in the device type specific CSCD descriptor parameters for the copy destination sequential access device type.

The EMBEDDED DATA NUMBER OF BYTES field specifies the number of bytes of embedded data that are to be transferred to the copy destination stream device. A value of zero shall not be considered an error. If the value in the EMBEDDED DATA NUMBER OF BYTES field is greater than the value in the DESCRIPTOR LENGTH field minus 12, then the copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

The EMBEDDED DATA field is a zero-padded field whose length is a multiple of 4 that specifies the embedded data to be copied to the copy destination stream device.

6.6.6.8 Stream device to discard functions

The segment descriptor format shown in table 128 requests the copy manager to read data from a stream device and not transfer it to any copy destination.

Table 128 – Stream device to discard segment descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE CODE (06h or 0Fh)							
1	Reserved							CAT
2	(MSB)			DESCRIPTOR LENGTH (000Ch)				
3								(LSB)
4	(MSB)			SOURCE CSCD DESCRIPTOR ID				
5								(LSB)
6	Reserved							
7	Reserved							
8	Reserved							
9	(MSB)							
10				STREAM DEVICE TRANSFER LENGTH				
11								(LSB)
12	(MSB)							
•••				NUMBER OF BYTES				
15								(LSB)

The DESCRIPTOR TYPE CODE field is described in 6.6.4 and 6.6.6.1.

For descriptor type code 06h (i.e., stream→discard) or descriptor type code 0Fh (i.e., stream→discard&application client), the copy manager shall read data as necessary from the copy source stream device specified by the SOURCE CSCD DESCRIPTOR ID field starting at the current position of the copy source stream device. The number of bytes specified by the NUMBER OF BYTES field shall be removed from the source data, starting with any residual source data from the previous segment.

For descriptor type code 06h (i.e., stream→discard) the removed data shall be discarded and not written to any copy destination.

For descriptor type code 0Fh (i.e., stream→discard&application client) the removed data shall be held for delivery to the application client upon completion of the copy operation (see 5.19.4.3) originated by the EXTENDED COPY command as described in 5.19.4.5.

The CAT bit is described in 5.19.8.2.

The DESCRIPTOR LENGTH field is described in 6.6.6.1, shall be set as shown in table 128 for descriptor type code 06h (i.e., stream→discard) and descriptor type code 0Fh (i.e., stream→discard&application client).

The DESTINATION CSCD DESCRIPTOR ID field is described in 6.6.6.1.

The SOURCE STREAM DEVICE TRANSFER LENGTH field specifies the amount of data to be read from the copy source stream device on each read command. See 6.6.5.4 for a description of how data in the SOURCE STREAM DEVICE TRANSFER LENGTH field in the segment descriptor interacts with data in the STREAM BLOCK LENGTH field in the device type specific CSCD descriptor parameters for the copy source sequential access device type.

The NUMBER OF BYTES field specifies the number of bytes to be removed from the source data.

6.6.6.9 Verify CSCD function

The segment descriptor format shown in table 129 requests the copy manager to verify the accessibility of a CSCD.

Table 129 – Verify CSCD segment descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE CODE (07h)							
1	Reserved							
2	(MSB)			DESCRIPTOR LENGTH (0008h)				
3								(LSB)
4	(MSB)			SOURCE CSCD DESCRIPTOR ID				
5								(LSB)
6	Reserved							
7								
8	Reserved							TUR
9	Reserved							
•••								
11								

The DESCRIPTOR TYPE CODE field is described in 6.6.4 and 6.6.6.1, and shall be set as shown in table 129 for the verify CSCD segment descriptor.

Descriptor type code 07h requests the copy manager to verify the accessibility of the CSCD specified by the SOURCE CSCD DESCRIPTOR ID field.

The DESCRIPTOR LENGTH field is described in 6.6.6.1, and shall be set as shown in table 129 for the verify CSCD segment descriptor.

The SOURCE CSCD DESCRIPTOR ID field is described in 6.6.6.1.

Support for a value of one in the test unit ready (TUR) bit is optional. If setting the TUR bit to one is supported and the TUR bit is set to one, then a TEST UNIT READY command (see 6.46) shall be used to determine the readiness of the CSCD. If setting the TUR to one is not supported and the TUR bit is set to one, the copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to COPY ABORTED, and the additional sense code set to INVALID FIELD IN PARAMETER LIST. The sense key specific information shall be set as described in 5.19.8.4. If the TUR bit is set to zero, then the accessibility should be verified without disturbing established unit attention conditions or ACA conditions (e.g., using the INQUIRY command (see 6.7)).

If the SOURCE CSCD DESCRIPTOR ID field specifies a ROD CSCD descriptor (see 6.6.5.10), the copy manager shall ignore the TUR bit and shall process the Verify CSCD segment descriptor based on the contents of ROD TYPE field as follows:

- a) if the ROD TYPE field is set to zero, then the copy manager shall verify the accessibility as follows:
    - A) if the ROD token was created by the copy manager that is processing the Verify CSCD segment descriptor, then the ROD token shall be validated as described in 5.19.6.5.2;
    - B) if the ROD token was created by a copy manager in the same SCSI target device as the copy manager that is processing the Verify CSCD segment descriptor, then the creating copy manager shall be requested to validate the ROD token as described in 5.19.6.5.2; and
    - C) if the ROD token was created by a copy manager in a SCSI target device other than the SCSI target device that contains the copy manager that is processing the Verify CSCD segment descriptor, then the validation of the ROD token depends on the contents of the REMOTE TOKENS field in the ROD Features third-party copy descriptor (see 7.7.18.8) as follows:
        - a) if the REMOTE TOKENS field is set to 0h, then the copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID TOKEN OPERATION, REMOTE TOKEN USAGE NOT SUPPORTED; and
        - b) if the REMOTE TOKENS field is not set to 0h, then the processing copy manager shall request the copy manager that created the ROD token to validate it;

        and
- b) if the ROD TYPE field is not set to zero, then the processing copy manager shall ignore the Verify CSCD segment descriptor. This shall not be considered an error.

6.6.6.10 Block device with offset to stream device function

The segment descriptor format shown in table 130 requests the copy manager to move data from a block device with a byte offset to a stream device.

Table 130 – Block device with offset to stream device segment descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE CODE (08h)							
1	Reserved							CAT
2	(MSB)			DESCRIPTOR LENGTH (0018h)				
3								(LSB)
4	(MSB)			SOURCE CSCD DESCRIPTOR ID				
5								(LSB)
6	(MSB)			DESTINATION CSCD DESCRIPTOR ID				
7								(LSB)
8	Reserved							
9	(MSB)							
10				STREAM DEVICE TRANSFER LENGTH				
11								(LSB)
12	(MSB)							
•••				NUMBER OF BYTES				
15								(LSB)
16	(MSB)							
•••				BLOCK DEVICE LOGICAL BLOCK ADDRESS				
23								(LSB)
24	Reserved							
25	Reserved							
26	(MSB)			BLOCK DEVICE BYTE OFFSET				
27								(LSB)

The DESCRIPTOR TYPE CODE field is described in 6.6.4 and 6.6.6.1, and shall be set as shown in table 130 for the block device with offset to stream device segment descriptor.

Descriptor type code 08h (i.e., block<o>→stream) requests the copy manager to copy the data from the copy source block device specified by the SOURCE CSCD DESCRIPTOR ID field to the copy destination stream device specified by the DESTINATION CSCD DESCRIPTOR ID field using data starting at the location specified by the BLOCK DEVICE BYTE OFFSET field in the logical block specified by the BLOCK DEVICE LOGICAL BLOCK ADDRESS field and continuing for the number of bytes specified in the NUMBER OF BYTES field. The data shall be written to the copy destination stream device starting at the current position of the media.

The CAT bit is described in 5.19.8.2.

The DESCRIPTOR LENGTH field is described in 6.6.6.1, and shall be set as shown in table 130 for the block device with offset to stream device segment descriptor.

The SOURCE CSCD DESCRIPTOR ID field and DESTINATION CSCD DESCRIPTOR ID field are described in 6.6.6.1.

The STREAM DEVICE TRANSFER LENGTH field specifies the amount of data to be written by each write command sent to the copy destination stream device. See 6.6.5.4 for a description of how data in the STREAM DEVICE TRANSFER LENGTH field in the segment descriptor interacts with data in the STREAM BLOCK LENGTH field in the device type specific CSCD descriptor parameters for the copy destination sequential access device type.

The NUMBER OF BYTES field specifies the number bytes to be read. A value of zero specifies that no bytes shall be transferred in this segment. This shall not be considered an error.

The BLOCK DEVICE LOGICAL BLOCK ADDRESS field specifies the starting logical block address on the copy source block device for this segment.

The BLOCK DEVICE BYTE OFFSET field specifies the offset into the first copy source logical block at which to begin reading bytes.

6.6.6.11 Stream device to block device with offset function

The segment descriptor format shown in table 131 requests the copy manager to move data from a stream device to a block device with a byte offset.

Table 131 – Stream device with offset to block device segment descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE CODE (09h)							
1	Reserved							CAT
2	(MSB)							
3	DESCRIPTOR LENGTH (0018h)							(LSB)
4	(MSB)							
5	SOURCE CSCD DESCRIPTOR ID							(LSB)
6	(MSB)							
7	DESTINATION CSCD DESCRIPTOR ID							(LSB)
8	Reserved							
9	(MSB)							
10	STREAM DEVICE TRANSFER LENGTH							
11								(LSB)
12	(MSB)							
•••	NUMBER OF BYTES							
15								(LSB)
16	(MSB)							
•••	BLOCK DEVICE LOGICAL BLOCK ADDRESS							
23								(LSB)
24	Reserved							
25	Reserved							
26	(MSB)							
27	BLOCK DEVICE BYTE OFFSET							(LSB)

The DESCRIPTOR TYPE CODE field is described in 6.6.4 and 6.6.6.1, and shall be set as shown in table 131 for the stream device with offset to block device segment descriptor.

Descriptor type code 09h (i.e., stream→block<o>) requests the copy manager to copy the data from the copy source stream device specified by the SOURCE CSCD DESCRIPTOR ID field to the copy destination block device specified by the DESTINATION CSCD DESCRIPTOR ID field using the stream data starting at the current position of the copy source stream device. The data shall be written starting at the location specified by the BLOCK DEVICE BYTE OFFSET field in the logical block specified by the BLOCK DEVICE LOGICAL BLOCK ADDRESS field and continuing for the number of bytes specified in the NUMBER OF BYTES field.

The content of the starting logical block on the copy destination block device before the starting offset shall be preserved. The content on the ending logical block on the copy destination block device beyond the end of the transfer shall be preserved. The copy manager may implement this function by reading the starting and ending logical blocks, modifying a portion of the logical blocks as required, and writing the full logical blocks to the copy destination block device.

The CAT bit is described in 5.19.8.2.

The DESCRIPTOR LENGTH field is described in 6.6.6.1, and shall be set as shown in table 131 for the stream device with offset to block device segment descriptor.

The SOURCE CSCD DESCRIPTOR ID field and DESTINATION CSCD DESCRIPTOR ID field are described in 6.6.6.1.

The STREAM DEVICE TRANSFER LENGTH field specifies the amount of data to be read from the copy source stream device by each read command. See 6.6.5.4 for a description of how data in the STREAM DEVICE TRANSFER LENGTH field in the segment descriptor interacts with data in the STREAM BLOCK LENGTH field in the device type specific CSCD descriptor parameters for the copy source sequential access device type.

The NUMBER OF BYTES field specifies the number bytes to be read. A value of zero specifies that no bytes shall be transferred in this segment. This shall not be considered an error.

The BLOCK DEVICE LOGICAL BLOCK ADDRESS field specifies the starting logical block address on the copy destination block device for this segment.

The BLOCK DEVICE BYTE OFFSET field specifies the offset into the first destination logical block at which to begin writing data to the copy destination block device.

6.6.6.12 Block device with offset to block device with offset function

The segment descriptor format shown in table 132 requests the copy manager to move data from a block device with a byte offset to a block device with a byte offset.

Table 132 – Block device with offset to block device with offset segment descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE CODE (0Ah)							
1	Reserved					FCO	Reserved	CAT
2	(MSB)			DESCRIPTOR LENGTH (001Ch)				
3								(LSB)
4	(MSB)			SOURCE CSCD DESCRIPTOR ID				
5								(LSB)
6	(MSB)			DESTINATION CSCD DESCRIPTOR ID				
7								(LSB)
8	(MSB)			NUMBER OF BYTES				
•••								
11								(LSB)
12	(MSB)			SOURCE BLOCK DEVICE LOGICAL BLOCK ADDRESS				
•••								
19								(LSB)
20	(MSB)			DESTINATION BLOCK DEVICE LOGICAL BLOCK ADDRESS				
•••								
27								(LSB)
28	(MSB)			SOURCE BLOCK DEVICE BYTE OFFSET				
29								(LSB)
30	(MSB)			DESTINATION BLOCK DEVICE BYTE OFFSET				
31								(LSB)

The DESCRIPTOR TYPE CODE field is described in 6.6.4 and 6.6.6.1, and shall be set as shown in table 132 for the block device with offset to block device with offset segment descriptor.

Descriptor type code 0Ah (i.e., block<o>→block<o>) requests the copy manager to copy the data from the copy source block device specified by the SOURCE CSCD DESCRIPTOR ID field to the copy destination block device specified by the DESTINATION CSCD DESCRIPTOR ID field using data starting at the location specified by the source BLOCK DEVICE BYTE OFFSET field in the logical block specified by the SOURCE BLOCK DEVICE LOGICAL BLOCK ADDRESS field and continuing for the number of bytes specified in the NUMBER OF BYTES field. The data shall be written to the copy destination block device starting at the location specified by the DESTINATION BLOCK DEVICE BYTE OFFSET field in the logical block specified by the DESTINATION BLOCK DEVICE LOGICAL BLOCK ADDRESS field.

The content of the starting logical block on the copy destination block device before the starting offset shall be preserved. The content on the ending logical block on the copy destination block device beyond the end of the transfer shall be preserved. The copy manager may implement this operation by reading the starting and

ending logical blocks, modifying a portion of the logical blocks as required, and writing the full logical blocks on the copy destination block device.

The fast copy only (FCO) bit is described in 6.6.6.1.

The CAT bit is described in 5.19.8.2.

The DESCRIPTOR LENGTH field is described in 6.6.6.1, and shall be set as shown in table 132 for the block device with offset to block device with offset segment descriptor.

The SOURCE CSCD DESCRIPTOR ID field and DESTINATION CSCD DESCRIPTOR ID field are described in 6.6.6.1.

The NUMBER OF BYTES field specifies the number bytes to be read. A value of zero specifies that no bytes shall be transferred in this segment. This shall not be considered an error.

The SOURCE BLOCK DEVICE LOGICAL BLOCK ADDRESS field specifies the starting address on the copy source block device for this segment.

The DESTINATION BLOCK DEVICE LOGICAL BLOCK ADDRESS field specifies the starting logical block address on the copy destination block device for this segment.

The SOURCE BLOCK DEVICE BYTE OFFSET field specifies the offset into the first copy source logical block at which to begin reading bytes.

The DESTINATION BLOCK DEVICE BYTE OFFSET field specifies the offset into the first copy destination logical block at which to begin writing data to the copy destination block device.

6.6.6.13 Write filemarks function

The segment descriptor format shown in table 133 requests the copy manager to write filemarks on the destination tape device.

Table 133 – Write filemarks segment descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE CODE (10h)							
1	Reserved							
2	(MSB)			DESCRIPTOR LENGTH (0008h)				
3								(LSB)
4	Reserved							
5	Reserved							
6	(MSB)			DESTINATION CSCD DESCRIPTOR ID				
7								(LSB)
8	Reserved						Obsolete	W_IMMED
9	(MSB)							
10	FILEMARK COUNT							
11								(LSB)

The DESCRIPTOR TYPE CODE field is described in 6.6.4 and 6.6.6.1, and shall be set as shown in table 133 for the write filemarks segment descriptor.

Descriptor type code 10h (i.e., filemark→tape) requests the copy manager to write filemarks to the copy destination tape device specified by the DESTINATION CSCD DESCRIPTOR ID field starting at the current position of the copy destination tape device. If the PERIPHERAL DEVICE TYPE field in the CSCD descriptor specified by the DESTINATION CSCD DESCRIPTOR ID field does not contain 01h, then the copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to COPY ABORTED, and the additional sense code set to INVALID OPERATION FOR COPY SOURCE OR DESTINATION.

The DESCRIPTOR LENGTH field is described in 6.6.6.1, and shall be set as shown in table 133 for the write filemarks segment descriptor.

The DESTINATION CSCD DESCRIPTOR ID field is described in 6.6.6.1.

If the write immediate (W_IMMED) bit in the segment descriptor is set to one, the copy manager shall send a WRITE FILEMARKS command to the copy destination tape device with the IMMED bit set to one. If the W_IMMED bit is set to zero, the copy manager shall send a WRITE FILEMARKS command to the copy destination tape device with the IMMED bit set to zero.

The FILEMARK COUNT field contents in the WRITE FILEMARKS command sent to the copy destination tape device shall be set to the value in the FILEMARK COUNT field in the segment descriptor.

6.6.6.14 Tape device image copy function

The segment descriptor format shown in table 134 requests the copy manager to perform an image copy from the copy source tape device to the copy destination tape device.

Table 134 – Tape device image copy segment descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE CODE (13h)							
1	Reserved							
2	(MSB)			DESCRIPTOR LENGTH (0008h)				
3								(LSB)
4	(MSB)			SOURCE CSCD DESCRIPTOR ID				
5								(LSB)
6	(MSB)			DESTINATION CSCD DESCRIPTOR ID				
7								(LSB)
8	(MSB)			COUNT				
•••								
11								(LSB)

The DESCRIPTOR TYPE CODE field is described in 6.6.4 and 6.6.6.1 and shall be set as shown in table 134 for the tape device image copy segment descriptor.

Descriptor type code 13h (i.e., <i>tape→<i>tape) requests the copy manager to create a compatible image of the copy source specified by the SOURCE CSCD DESCRIPTOR ID field on the copy destination specified by the DESTINATION CSCD DESCRIPTOR ID field beginning at the current positions of the copy source and the copy

destination. If the PERIPHERAL DEVICE TYPE field in the CSCD descriptor specified by the SOURCE CSCD DESCRIPTOR ID field or the DESTINATION CSCD DESCRIPTOR ID field does not contain 01h, then the copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to COPY ABORTED, and the additional sense code set to INVALID OPERATION FOR COPY SOURCE OR DESTINATION.

The DESCRIPTOR LENGTH field is described in 6.6.6.1 and shall be set as shown in table 134 for descriptor type code 13h (i.e., <i>tape→<i>tape).

The SOURCE CSCD DESCRIPTOR ID field and DESTINATION CSCD DESCRIPTOR ID field are described in 6.6.6.1.

A COUNT field set to zero specifies that the tape image copy function shall not terminate due to any number of consecutive filemarks. Other error or exception conditions (e.g., early-warning, end of partition on the copy destination) may cause the copy manager to terminate the copy operation (see 5.19.4.3) prior to completion. If this occurs, the residue shall not be calculated and the INFORMATION field in the sense data shall be set to zero.

A COUNT field not set to zero specifies that the tape image copy function shall be terminated if the specified number of consecutive filemarks are copied.

The tape image copy operation terminates when:

   a) the copy source encounters an end of partition as defined by the copy source;
   b) the copy source encounters an end of data as defined by the copy source (i.e., BLANK CHECK sense key); or
   c) the copy manager has copied the number of consecutive filemarks specified in the COUNT field from the copy source to the copy destination.

6.6.6.15 Tape device positioning function

The segment descriptor format shown in table 135 requests the copy manager to position the destination tape device by sending appropriate commands (e.g., SPACE(6), SPACE(16), LOCATE(10), LOCATE(16)) as described in SSC-5.

Table 135 – Positioning segment descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE CODE (17h)							
1	Reserved							
2	(MSB)							
3	DESCRIPTOR LENGTH (0010h)							(LSB)
4	Reserved							
5								
6	(MSB)							
7	DESTINATION CSCD DESCRIPTOR ID							(LSB)
8	CP	Reserved			POSITIONING TYPE			
9	PARTITION							
10	Reserved							
11								
12	(MSB)							
•••	LOGICAL IDENTIFIER							
19								(LSB)

The DESCRIPTOR TYPE CODE field is described in 6.6.4 and 6.6.6.1, and shall be set as shown in table 135 for the positioning segment descriptor.

Descriptor type code 17h (i.e., positioning→tape) requests the copy manager to send sequential access device positioning commands (e.g., SPACE(6), SPACE(16), LOCATE(10), LOCATE(16)) to the copy destination tape device specified by the DESTINATION CSCD DESCRIPTOR ID field. If the PERIPHERAL DEVICE TYPE field in the CSCD descriptor specified by the DESTINATION CSCD DESCRIPTOR ID field does not contain 01h, the copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to COPY ABORTED, and the additional sense code set to INVALID OPERATION FOR COPY SOURCE OR DESTINATION.

The DESCRIPTOR LENGTH field is described in 6.6.6.1, and shall be set as shown in table 135 for the positioning segment descriptor.

The DESTINATION CSCD DESCRIPTOR ID field is described in 6.6.6.1.

A change partition (CP) bit set to one specifies a change to the partition specified in the PARTITION field shall occur prior to positioning to the logical object or logical file, as specified in the LOGICAL IDENTIFIER field. A CP bit set to zero specifies that:

a) no change to a different partition shall occur; and
b) the contents of the PARTITION field shall be ignored.

If the CP bit is set to one and the POSITIONING TYPE field is set to 0h or 1h, then the copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to COPY ABORTED, and the additional sense code set to INVALID OPERATION FOR COPY SOURCE OR DESTI-NATION.

The POSITIONING TYPE field (see table 136) shall be used in conjunction with the LOGICAL IDENTIFIER field to specify the requested position of the medium.

<p align="center">**Table 136 – POSITIONING TYPE field**</p>

Code	Description	Logical position upon successful completion
0h	Relative by logical block	EOP side of the number of logical blocks specified in the LOGICAL IDENTIFIER field
1h	Relative by logical file	EOP side of the number of logical files specified in the LOGICAL IDENTIFIER field
2h	Absolute logical object	BOP side of the logical object specified in the LOGICAL IDENTIFIER field
3h	Absolute logical file	BOP side of the logical file specified in the LOGICAL IDENTIFIER field
4h	EOD	EOD
5h to Fh	Reserved	

The PARTITION field specifies the partition (see SSC-5) to select if the CP bit is set to one.

The LOGICAL IDENTIFIER field is used in conjunction with the POSITIONING TYPE field and shall specify how to position the medium. If the POSITIONING TYPE field is set to:

a) 0h or 1h, then the LOGICAL IDENTIFIER field specifies the transfer count, in two's complement notation, of the number of logical objects (i.e., logical blocks if the POSITIONING TYPE field is set to 0h or logical files if the POSITIONING TYPE field is set to 1h) to be spaced over and the direction of movement (see SSC-5);

b) 2h or 3h, then the LOGICAL IDENTIFIER field specifies the absolute logical object identifier (see SSC-5) of the location to which the medium shall be positioned; or

c) 4h (i.e., EOD), then the LOGICAL IDENTIFIER field shall be ignored.

6.6.6.16 Tape device logical object copy function

The segment descriptor format shown in table 137 requests the copy manager to copy logical objects from the source tape device to the destination tape device.

Table 137 – Tape logical object copy segment descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE CODE (18h)							
1	Reserved							
2	(MSB)			DESCRIPTOR LENGTH (0010h)				
3								(LSB)
4	(MSB)			SOURCE CSCD DESCRIPTOR ID				
5								(LSB)
6	(MSB)			DESTINATION CSCD DESCRIPTOR ID				
7								(LSB)
8	CTEOM	EOEOD	Reserved		COPY TYPE			
9	Reserved							
•••								
11								
12	(MSB)			NUMBER OF OBJECTS				
•••								
19								(LSB)

The DESCRIPTOR TYPE CODE field is described in 6.6.4 and 6.6.6.1, and shall be set as shown in table 137 for the tape logical object copy segment descriptor.

Descriptor type code 18h (i.e., <loi>tape→<loi>tape) requests the copy manager to copy logical objects from the copy source tape device specified by the SOURCE CSCD DESCRIPTOR ID field to the copy destination tape device specified by the DESTINATION CSCD DESCRIPTOR ID field beginning at the current position of the copy source and the current position of the copy destination. If the PERIPHERAL DEVICE TYPE field in the CSCD descriptor specified by the SOURCE CSCD DESCRIPTOR ID field or the DESTINATION CSCD DESCRIPTOR ID field does not contain 01h, then the copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to COPY ABORTED, and the additional sense code set to INVALID OPERATION FOR COPY SOURCE OR DESTINATION.

The DESCRIPTOR LENGTH field is described in 6.6.6.1, and shall be set as shown in table 137 for the tape logical object copy segment descriptor.

The SOURCE CSCD DESCRIPTOR ID field and the DESTINATION CSCD DESCRIPTOR ID field are described in 6.6.6.1.

A continue through EOM (CTEOM) bit set to one specifies that the processing of this segment descriptor shall not be terminated as a result of the copy destination device returning:

a) an EOM bit set to one (see SSC-5); and
b) the SENSE KEY field set to NO SENSE or BLANK CHECK.

A CTEOM bit set to zero specifies that the processing of this segment descriptor shall be terminated as a result of the copy destination device returning an EOM bit set to one.

An error on EOD (EOEOD) bit set to one specifies that the processing of this segment descriptor shall terminate with the exception condition returned by the copy source device if EOD is encountered while reading from the copy source device (e.g., READ(6) command (see SSC-5)). An EOEOD bit set to zero specifies that the processing of this segment descriptor shall not be terminated with an exception condition as a result of encountering EOD and segment descriptor processing shall continue with the next segment descriptor.

The COPY TYPE field (see table 138) shall be used in conjunction with the NUMBER OF OBJECTS field to specify the number of objects to be copied.

Table 138 – COPY TYPE field

Code	Type of objects	Description
0h	Logical objects	The NUMBER OF OBJECTS field specifies the number of logical objects (see SSC-5) to copy. If the NUMBER OF OBJECTS field is set to zero, then no logical objects are copied. This shall not be considered an error.
1h	Logical blocks	The NUMBER OF OBJECTS field specifies the number of logical blocks (see SSC-5) to copy. If a filemark is encountered, then the filemark is copied and the processing of this segment descriptor terminates with a filemark encountered indication. If the NUMBER OF OBJECTS field is set to zero, then no logical blocks are copied. This shall not be considered an error.
2h	Logical files	The NUMBER OF OBJECTS field specifies the number of logical files (see SSC-5) to copy. If the NUMBER OF OBJECTS field is set to zero, then no logical files are copied. This shall not be considered an error.
3h	All logical objects to EOD	All logical objects starting at the current position of the copy source device and ending at EOD on the copy source device are copied to the destination device. The contents of the NUMBER OF OBJECTS field shall be ignored.
4h to Fh		Reserved

The NUMBER OF OBJECTS field is used in conjunction with the COPY TYPE field and specifies the number of objects to be copied.

6.6.6.17 Register persistent reservation key function

The segment descriptor format shown in table 139 requests the copy manager to register an I_T nexus using the reservation key (see 5.14.7) specified by the RESERVATION KEY field with the logical unit specified by the DESTINATION CSCD DESCRIPTOR ID field.

Table 139 – Register persistent reservation key segment descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE CODE (14h)							
1	Reserved							
2	(MSB)			DESCRIPTOR LENGTH (0018h)				
3								(LSB)
4	Reserved							
5	Reserved							
6	(MSB)			DESTINATION CSCD DESCRIPTOR ID				
7								(LSB)
8	(MSB)							
•••				RESERVATION KEY				
15								(LSB)
16	(MSB)							
•••				SERVICE ACTION RESERVATION KEY				
23								(LSB)
24								
•••				Reserved				
27								

The DESCRIPTOR TYPE CODE field is described in 6.6.4 and 6.6.6.1, and shall be set as shown in table 139 for the register persistent reservation key segment descriptor.

Descriptor type code 14h requests the copy manager to register an I_T nexus using the reservation key specified by the RESERVATION KEY field with the logical unit specified by the DESTINATION CSCD DESCRIPTOR ID field using a PERSISTENT RESERVE OUT command with a REGISTER service action (see 6.15.2).

The DESCRIPTOR LENGTH field is described in 6.6.6.1, and shall be set as shown in table 139 for the register persistent reservation key segment descriptor.

The DESTINATION CSCD DESCRIPTOR ID field is described in 6.6.6.1.

The RESERVATION KEY field and SERVICE ACTION RESERVATION KEY field contents in the PERSISTENT RESERVE OUT command sent to the copy destination shall be copied from the RESERVATION KEY field and SERVICE ACTION RESERVATION KEY field in the segment descriptor.

The application client sending an EXTENDED COPY command that contains a register persistent reservation key segment descriptor may be required to remove the reservation key held by the copy manager as described in 5.14.11 prior to sending the EXTENDED COPY command.

6.6.6.18 Third party persistent reservations source I_T nexus function

The segment descriptor format shown in table 140 requests the copy manager to send a PERSISTENT RESERVE OUT command with REGISTER AND MOVE service action (see 5.14.8) with the specified I_T nexus after all other segment descriptors have been processed. If an error is detected any time after receiving

a third party persistent source reservation I_T nexus segment descriptor, then the PERSISTENT RESERVE OUT command REGISTER AND MOVE service action shall be processed before the copy operation (see 5.19.4.3) originated by the EXTENDED COPY command is completed.

This segment descriptor should be placed at or near the beginning of the list of segment descriptors to assure the copy manager processes the PERSISTENT RESERVE OUT command with REGISTER AND MOVE service action in the event of an error that terminates the processing of segment descriptors. If an error is detected in a segment descriptor and third party persistent reservations source I_T nexus segment descriptor has not been processed, then the copy manager shall not send a PERSISTENT RESERVE OUT command with REGISTER AND MOVE service action.

Placing more than one source third party persistent reservations source I_T nexus segment descriptor in the list of descriptors is not an error. All source third party persistent reservations source I_T nexus segment descriptors known to the copy manager shall be processed after all other segment descriptors have been processed.

Table 140 – Third party persistent reservations source I_T nexus segment descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE CODE (15h)							
1	Reserved							
2	(MSB)			DESCRIPTOR LENGTH (n-3)				
3								(LSB)
4	Reserved							
5	Reserved							
6	(MSB)			DESTINATION CSCD DESCRIPTOR ID				
7								(LSB)
8	(MSB)			RESERVATION KEY				
•••								
15								(LSB)
16	(MSB)			SERVICE ACTION RESERVATION KEY				
•••								
23								(LSB)
24	Reserved							
25	Reserved						UNREG	APTPL
26	(MSB)			RELATIVE TARGET PORT IDENTIFIER				
27								(LSB)
28	(MSB)			TRANSPORTID LENGTH (n-31)				
•••								
31								(LSB)
32				TransportID				
•••								
n								

The DESCRIPTOR TYPE CODE field is described in 6.6.4 and 6.6.6.1, and shall be set as shown in table 140 for the third party persistent reservations source I_T nexus segment descriptor.

Descriptor type code 15h requests the copy manager to send PERSISTENT RESERVE OUT command with REGISTER AND MOVE service action (see 6.15) to the target port specified by the DESTINATION CSCD DESCRIPTOR ID field.

The DESCRIPTOR LENGTH field is described in 6.6.6.1. The value in the DESCRIPTOR LENGTH field shall be a multiple of 4.

The DESTINATION CSCD DESCRIPTOR ID field is described in 6.6.6.1.

If the PERIPHERAL DEVICE TYPE field in the CSCD descriptor specified by the DESTINATION CSCD DESCRIPTOR ID field does not contain 01h, then the copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to COPY ABORTED, and the additional sense code set to INVALID OPERATION FOR COPY SOURCE OR DESTINATION.

Bytes eight to n of the third party persistent reservations source I_T nexus segment descriptor shall be sent as the parameter list (see 6.15.4) for the PERSISTENT RESERVE OUT command with REGISTER AND MOVE service action.

For a description of the RESERVATION KEY field, SERVICE ACTION RESERVATION KEY field, UNREG bit, APTPL bit, RELATIVE TARGET PORT IDENTIFIER field, TRANSPORTID LENGTH field, and TransportID, see 6.15.4.

6.6.6.19 Block device image copy function

The segment descriptor format shown in table 141 requests the copy manager to perform an image copy from the copy source block device to the copy destination block device.

Table 141 – Block device image copy segment descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE CODE (16h)							
1	Reserved					FCO	Reserved	
2	(MSB)							
3	DESCRIPTOR LENGTH (0018h)							(LSB)
4	(MSB)							
5	SOURCE CSCD DESCRIPTOR ID							(LSB)
6	(MSB)							
7	DESTINATION CSCD DESCRIPTOR ID							(LSB)
8	(MSB)							
•••	STARTING SOURCE LOGICAL BLOCK ADDRESS							
15								(LSB)
16	(MSB)							
•••	STARTING DESTINATION LOGICAL BLOCK ADDRESS							
23								(LSB)
24	(MSB)							
•••	NUMBER OF LOGICAL BLOCKS							
27								(LSB)

The DESCRIPTOR TYPE CODE field is described in 6.6.4 and 6.6.6.1 and shall be set as shown in table 141 for the block device image copy segment descriptor.

Descriptor type code 16h (i.e., <i>block→<i>block) requests the copy manager to copy logical blocks from the copy source block device specified by the SOURCE CSCD DESCRIPTOR ID field to the copy destination block device specified by the DESTINATION CSCD DESCRIPTOR ID field while preserving the characteristics (e.g., logical block length protection information) associated with each logical block.

The fast copy only (FCO) bit is described in 6.6.6.1.

The copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to COPY ABORTED, and the additional sense code set to INCORRECT COPY TARGET DEVICE TYPE if:

a) the DISK BLOCK LENGTH field in the device type specific CSCD descriptor parameters (see 6.6.5.3) for the copy source is not equal to DISK BLOCK LENGTH field in the device type specific CSCD descriptor parameters for the copy destination; or
b) the protection information characteristics for the copy source are not the same as the protection information characteristics for the copy destination.

While copying logical blocks from the copy source to the copy destination, the copy manager shall preserve the protection information.

While copying logical blocks from the copy source to the copy destination, the copy manager should preserve the logical block provisioning information, if any. If the copy manager detects differences between the logical block provisioning characteristics for the copy source and the logical block provisioning characteristics for the copy destination that prevent the preservation of logical block provisioning information (see SBC-5), then the copy manager may terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to COPY ABORTED, and the additional sense code set to INCORRECT COPY TARGET DEVICE TYPE.

The DESCRIPTOR LENGTH field is described in 6.6.6.1, and shall be set as shown in table 141 for descriptor type code 16h (i.e., <i>block→<i>block).

The SOURCE CSCD DESCRIPTOR ID field and DESTINATION CSCD DESCRIPTOR ID field are described in 6.6.6.1.

The STARTING SOURCE LOGICAL BLOCK ADDRESS field specifies the first logical block to read from the copy source block device.

The STARTING DESTINATION LOGICAL BLOCK ADDRESS field specifies the first logical block to write on the copy destination block device.

The NUMBER OF LOGICAL BLOCKS field specifies the number of logical blocks to copy. If the NUMBER OF LOGICAL BLOCKS field is set to zero, the copy manager shall use FFFF FFFF FFFF FFFFh as the number of logical blocks to copy.

The copy manager shall copy logical blocks from the copy source to the copy destination beginning at the specified logical block addresses until:

   a) the specified number of logical blocks are copied;
   b) the maximum logical block address on the copy source is reached; or
   c) the maximum logical block address on the copy destination is reached.

The <i>block→<i>block copy function shall be considered a success regardless of which limit on the number of logical blocks copied caused the function to end.

6.6.6.20 Tape stream mirroring function

The segment descriptor format shown in table 142 requests the copy manager to perform a tape stream mirroring copy operation (see 5.19.7) to mirror the effects of operations on a tape copy source to a tape copy destination.

Table 142 – Tape stream mirroring segment descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE CODE (19h)							
1	Reserved							
2	(MSB)			DESCRIPTOR LENGTH (0008h)				
3								(LSB)
4	(MSB)			SOURCE CSCD DESCRIPTOR ID				
5								(LSB)
6	(MSB)			DESTINATION CSCD DESCRIPTOR ID				
7								(LSB)
8	CTEOM	Reserved	SCOTI	Reserved				
9	(MSB)			Reserved				
•••								
11								(LSB)

The DESCRIPTOR TYPE CODE field is described in 6.6.4 and 6.6.6.1 and shall be set as shown in table 142 for the tape stream mirroring segment descriptor.

Descriptor type code 19h (i.e., <loi>tape->→<loi>tape mirror) requests the copy manager to create equivalent effects on the copy destination specified by the DESTINATION CSCD DESCRIPTOR ID field as those that occur on the copy source specified by the SOURCE CSCD DESCRIPTOR ID field due to the receipt of data transfer commands and positioning operations from an application client.

If the PERIPHERAL DEVICE TYPE field in the CSCD descriptor specified by the SOURCE CSCD DESCRIPTOR ID field or the DESTINATION CSCD DESCRIPTOR ID field does not contain 01h, then the copy manager shall terminate the copy operation (see 5.19.4.3) originated by the command with CHECK CONDITION status, with the sense key set to COPY ABORTED, and the additional sense code set to INVALID OPERATION FOR COPY SOURCE OR DESTINATION.

If a copy manager that processes a segment descriptor with descriptor type 19h is not contained in the same logical unit as the copy source device server, then the copy manager shall terminate the EXTENDED COPY command requesting a tape stream mirroring function with CHECK CONDITION status, with the sense key set to COPY ABORTED, and the additional sense code set to INVALID OPERATION FOR COPY SOURCE OR DESTINATION.

If segment descriptor with descriptor type 19h is followed by another segment descriptor in the segment descriptor list (see 6.6.2), the copy manager shall terminate the EXTENDED COPY command requesting a tape stream mirroring function with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

The DESCRIPTOR LENGTH field is described in 6.6.6.1, and shall be set as shown in table 142 for descriptor type code 19h (i.e., <loi>tape->→<loi>tape mirror).

The SOURCE CSCD DESCRIPTOR ID field and DESTINATION CSCD DESCRIPTOR ID field are described in 6.6.6.1.

The continue through EOM (CTEOM) bit is defined in 6.6.6.16.

A suppress copy operation termination indication (SCOTI) bit set to zero specifies that, if while performing operations to the copy destination an exception condition is detected by the copy manager that terminates the tape stream mirroring copy operation, then the copy manager and device server shall establish a deferred error condition with CHECK CONDITION status, the response code set to 71h or 73h (i.e., deferred error), the sense key set to COPY ABORTED and the additional sense code set to THIRD PARTY DEVICE FAILURE. A SCOTI bit set to one specifies that, if while performing operations to the copy destination an exception condition is detected by the copy manager that terminates the tape stream mirroring copy operation, then the copy manager and device server shall not establish a deferred error condition.

If there is a tape stream mirroring copy operation in progress, the EXTENDED COPY command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to OPERATION IN PROGRESS.

If the sequential access device is not capable of performing a tape stream mirroring copy operation (see SSC-5), then the copy manager shall terminate the EXTENDED COPY command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

If a tape stream mirroring copy operation has been prevented (see SSC-5 and ADC-4), the copy manager shall terminate the EXTENDED COPY command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST and the additional sense code set to TAPE STREAM MIRRORING PREVENTED.

If there is a copy destination specified by the DESTINATION CSCD DESCRIPTOR ID that is not in the tape stream mirroring authorization list (see SSC-5), then the EXTENDED COPY command shall be terminated with CHECK CONDITION status, with sense key set to ILLEGAL REQUEST, and the additional sense code set to COPY SOURCE OR COPY DESTINATION NOT AUTHORIZED.

The copy manager uses commands supported by sequential access devices (see SSC-5) to perform operations on the copy destination that result in equivalent data on the medium and the equivalent resulting position on the medium. If the copy manager is unable to maintain a consistent relative position between the copy source and copy destination, then the copy manager shall terminate the tape stream mirroring copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to COPY ABORTED, and the additional sense code set to INVALID OPERATION FOR COPY SOURCE OR DESTINATION.

EXAMPLE – The copy manager is unable to maintain a consistent relative position between the copy source and copy destination if:

   a) the copy source receives a SPACE(6) command, LOCATE(10) command, LOCATE(16) command, REWIND command or READ REVERSE(6) command that positions the copy source or copy destination to a logical position that is before (i.e., BOP side) the logical position at the start of the processing of this segment descriptor;
   b) the copy source receives a LOCATE(10) command with the CP bit set to one (i.e., change partition);
   c) the copy source receives a LOCATE(16) command with the CP bit set to one (i.e., change partition), the BAM bit set to one (i.e., explicit address) or the DEST_TYPE field set to 001b (i.e., locate logical file);
   d) the copy source receives a LOCATE(10) command and the logical position of the copy source is not equal to the logical position of the copy destination;
   e) the copy source receives a LOCATE(16) command with the DEST_TYPE field set to 000b (i.e., locate logical object) and the logical position of the copy source is not equal to the logical position of the copy destination;

f)   the copy source receives a LOAD/UNLOAD command with the EOT bit set to one, the RET bit set to one, or the LOAD bit set to one; or

g)   the copy source receives a command that changes logical unit parameters (e.g., MODE SELECT command).

If an exception condition is detected by the copy source (e.g., a command performed by the copy source encounters a filemark, BOP, or EOD) and the command forwarded to the copy destination does not encounter the same exception condition, then the copy manager shall terminate the tape stream mirroring copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to COPY ABORTED and the additional sense code set to THIRD PARTY DEVICE FAILURE.

If the tape mounted on the copy source is demounted (see SSC-5), the copy manager shall complete the tape stream mirroring copy operation.

6.6.6.21 Populate a ROD from one or more block ranges function

The segment descriptor format shown in table 143 requests the copy manager to add one or more ranges from the copy source block device to the end of the ROD that is specified as the copy destination. The copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST if:

a) the PERIPHERAL DEVICE TYPE field in the specified copy source CSCD descriptor is not set to 00h (i.e., block device);
b) the PERIPHERAL DEVICE TYPE field in the specified copy destination CSCD descriptor is not set to 00h (i.e., block device);
c) the SOURCE CSCD DESCRIPTOR ID field is not set to FFFFh (i.e., the logical unit that contains the copy manager);
d) the copy destination CSCD descriptor is not a ROD CSCD descriptor (see 6.6.5.10);
e) the ROD TYPE field in the copy destination CSCD descriptor is set to zero; or
f) the same LBA is specified in more than one range descriptor (see 5.19.6.3).

Table 143 – Populate a ROD from one or more block ranges segment descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE CODE (BEh)							
1	Reserved					FCO	Reserved	
2	(MSB)			DESCRIPTOR LENGTH (n-3)				
3								(LSB)
4	(MSB)			SOURCE CSCD DESCRIPTOR ID				
5								(LSB)
6	(MSB)			DESTINATION CSCD DESCRIPTOR ID				
7								(LSB)
8 ••• 12	Reserved							
13	RANGE DESCRIPTOR TYPE							
14	(MSB)			RANGE DESCRIPTORS LENGTH (n-15)				
15								(LSB)
	Range descriptor list							
16 •••	Range descriptor [first]							
	⋮							
••• n	Range descriptor [last]							

The DESCRIPTOR TYPE CODE field is described in 6.6.4 and 6.6.6.1 and shall be set as shown in table 143 for the Populate a ROD from one or more block ranges segment descriptor.

Descriptor type code BEh (i.e., ROD←block ranges(n)) requests the copy manager to add the ranges specified in the segment descriptor from the copy source specified by the SOURCE CSCD DESCRIPTOR ID field to the end of the ROD specified by the DESTINATION CSCD DESCRIPTOR ID field.

The fast copy only (FCO) bit and the DESCRIPTOR LENGTH field are described in 6.6.6.1.

The SOURCE CSCD DESCRIPTOR ID field and DESTINATION CSCD DESCRIPTOR ID field are described in 6.6.6.1.

The RANGE DESCRIPTOR TYPE field (see table 144) specifies the format of all range descriptors.

Table 144 – RANGE DESCRIPTOR TYPE field

Code	Description	Reference
01h	Four gibi-block range descriptor	table 145
all others	Reserved	

The RANGE DESCRIPTORS LENGTH field specifies the number of bytes of range descriptors that follow.

If the RANGE DESCRIPTOR TYPE field is set to 01h, each range descriptor (see table 145) has the format specified by the RANGE DESCRIPTOR TYPE field.

Table 145 – Populate a ROD four gibi-block range descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
•••				LOGICAL BLOCK ADDRESS				
7								(LSB)
8	(MSB)							
•••				NUMBER OF LOGICAL BLOCKS				
11								(LSB)
12								
•••				Reserved				
15								

The LOGICAL BLOCK ADDRESS field specifies the first LBA from the copy source to be added to the copy destination ROD.

The NUMBER OF LOGICAL BLOCKS field specifies the number of consecutive LBAs from the copy source to be added to the copy destination ROD.

6.6.6.22 Populate a ROD from one block range function

The segment descriptor format shown in table 146 requests the copy manager to add one range from the copy source block device to the end of the ROD that is specified as the copy destination. The copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST if:

   a) the PERIPHERAL DEVICE TYPE field in the specified copy source CSCD descriptor is not set to 00h (i.e., block device);
   b) the PERIPHERAL DEVICE TYPE field in the specified copy destination CSCD descriptor is not set to 00h (i.e., block device);
   c) the SOURCE CSCD DESCRIPTOR ID field is not set to FFFFh (i.e., the logical unit that contains the copy manager);
   d) the copy destination CSCD descriptor is not a ROD CSCD descriptor (see 6.6.5.10); or
   e) the ROD TYPE field in the copy destination CSCD descriptor is set to zero.

Table 146 – Populate a ROD from one block range segment descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE CODE (BFh)							
1	Reserved					FCO	Reserved	
2	(MSB)			DESCRIPTOR LENGTH (0010h)				
3								(LSB)
4	(MSB)			SOURCE CSCD DESCRIPTOR ID				
5								(LSB)
6	(MSB)			DESTINATION CSCD DESCRIPTOR ID				
7								(LSB)
8	(MSB)			LOGICAL BLOCK ADDRESS				
•••								
15								(LSB)
16	(MSB)			NUMBER OF LOGICAL BLOCKS				
•••								
19								(LSB)

The DESCRIPTOR TYPE CODE field is described in 6.6.4 and 6.6.6.1 and shall be set as shown in table 146 for the Populate a ROD from one block range segment descriptor.

Descriptor type code BFh (i.e., ROD←block range(1)) requests the copy manager to add the range specified in the segment descriptor from the copy source specified by the SOURCE CSCD DESCRIPTOR ID field to the end of the ROD specified by the DESTINATION CSCD DESCRIPTOR ID field.

The fast copy only (FCO) bit is described in 6.6.6.1.

The DESCRIPTOR LENGTH field is described in 6.6.6.1, and shall be set as shown in table 146 for descriptor type code BEh (i.e., ROD←block range(1)).

The SOURCE CSCD DESCRIPTOR ID field and DESTINATION CSCD DESCRIPTOR ID field are described in 6.6.6.1.

The LOGICAL BLOCK ADDRESS field specifies the first LBA from the copy source to be added to the copy desti-nation ROD.

The NUMBER OF LOGICAL BLOCKS field specifies the number of consecutive LBAs from the copy source to be added to the copy destination ROD.

6.7 INQUIRY command

6.7.1 INQUIRY command introduction

The INQUIRY command (see table 147) requests the device server to return information regarding the logical unit and SCSI target device.

Table 147 – INQUIRY command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (12h)							
1	Reserved						Obsolete	EVPD
2	PAGE CODE							
3	(MSB)			ALLOCATION LENGTH				
4								(LSB)
5	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 147 for the INQUIRY command.

An enable vital product data (EVPD) bit set to one specifies that the device server shall return the vital product data specified by the PAGE CODE field (see 7.7). If the device server does not support (see 7.7.17) the requested vital product data page, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

An EVPD bit set to zero specifies that the device server shall return the standard INQUIRY data (see 6.7.2). If the PAGE CODE field is not set to zero and the EVPD bit is set to zero, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

If the EVPD bit is set to one, the PAGE CODE field specifies which page of vital product data information the device server shall return (see 7.7).

The ALLOCATION LENGTH field is defined in 4.2.5.6.

The CONTROL byte is defined in SAM-6.

In response to an INQUIRY command received by an incorrect logical unit, the SCSI target device shall return the INQUIRY data with the peripheral qualifier set to the value defined in 6.7.2. The device server or task router (see SAM-6) shall terminate an INQUIRY command with CHECK CONDITION status only if the device server or task router is unable to return the requested INQUIRY data.

If an INQUIRY command is received from a SCSI initiator port for which the device server has a pending unit attention condition (i.e., before the device server reports CHECK CONDITION status), then the device server shall perform the INQUIRY command and shall not clear the unit attention condition (see SAM-6).

The device server should be able to process the INQUIRY command even when an error occurs that prohibits normal command completion.

INQUIRY data (i.e., standard INQUIRY data (see 6.7.2) and all VPD pages (see 7.7)) should be returned even though the device server is not ready for other commands. Standard INQUIRY data, the Extended INQUIRY Data VPD page (see 7.7.7), and the Device Identification VPD page (see 7.7.6) should be available without incurring any media access delays. If reporting INQUIRY data requires a delay (e.g., the device server stores some of the standard INQUIRY data or VPD data on the media), then the device server may return ASCII spaces (20h) in ASCII data fields (see 4.3.1) and zeros in other fields until the data is available from the media.

INQUIRY data may change as the SCSI target device and its logical units perform their initialization sequence.

EXAMPLE – Logical units may provide a minimum command set from nonvolatile memory until they load the final firmware from the media. After the firmware has been loaded, more options may be supported and therefore different INQUIRY data may be returned.

If INQUIRY data changes for any reason, the device server shall establish a unit attention condition for the SCSI initiator port associated with every I_T nexus (see SAM-6), with the additional sense code set to INQUIRY DATA HAS CHANGED.

> NOTE 14 - The INQUIRY command may be used by an application client after a hard reset or power on condition to determine the device types for system configuration.

6.7.2 Standard INQUIRY data

The standard INQUIRY data (see table 148) shall contain at least 36 bytes.

Table 148 – Standard INQUIRY data (part 1 of 2)

Bit Byte	7	6	5	4	3	2	1	0
0	PERIPHERAL QUALIFIER			PERIPHERAL DEVICE TYPE				
1	RMB	LU_CONG	HOT PLUGGABLE		Reserved			
2	VERSION							
3	Reserved	Reserved	NORMACA	HISUP	RESPONSE DATA FORMAT (2h)			
4	ADDITIONAL LENGTH (n-4)							
5	SCCS	Obsolete	TPGS		3PC	Reserved		PROTECT
6	Obsolete	ENCSERV	VS	MULTIP	Obsolete	Reserved	Reserved	Obsolete
7	Obsolete	Reserved	Obsolete		Obsolete	Reserved	CMDQUE	VS
8	(MSB)							
•••			T10 VENDOR IDENTIFICATION					
15								(LSB)
16	(MSB)							
•••			PRODUCT IDENTIFICATION					
31								(LSB)
32	(MSB)							
•••			PRODUCT REVISION LEVEL					
35								(LSB)

Table 148 – Standard INQUIRY data (part 2 of 2)

Bit Byte	7	6	5	4	3	2	1	0
36 ••• 55	Vendor specific							
56	Reserved				Obsolete			
57	Reserved							
58	(MSB)			VERSION DESCRIPTOR 1				
59								(LSB)
	⋮							
72	(MSB)			VERSION DESCRIPTOR 8				
73								(LSB)
74 ••• 95	Reserved							
	Vendor specific parameters							
96 ••• n	Vendor specific							

The PERIPHERAL QUALIFIER field and PERIPHERAL DEVICE TYPE field identify the logical unit accessible by the task router (see SAM-6) contained in the SCSI target port that received this INQUIRY command. If the SCSI target device is not capable of accessing the addressed logical unit from the addressed SCSI target port, then the device server shall set these fields to 7Fh (i.e., PERIPHERAL QUALIFIER field set to 011b and PERIPHERAL DEVICE TYPE field set to 1Fh).

The PERIPHERAL QUALIFIER field is defined in table 149.

Table 149 – PERIPHERAL QUALIFIER field

Qualifier	Description

000b	An addressed logical unit having the indicated peripheral device type is:
	    a) accessible to the task router (see SAM-6) contained in the SCSI target port that received this INQUIRY command; or
	    b) the task router is unable to determine whether or not the addressed logical unit is accessible from this SCSI target port.
	This peripheral qualifier value does not indicate that a logical unit accessible by this task router is ready for access.

001b	An addressed logical unit having the indicated device type is not accessible, at this time, to the task router (see SAM-6) contained in the SCSI target port that received this INQUIRY command. However, the task router is capable of accessing the addressed logical unit from this SCSI target port
010b	Reserved
011b	An addressed logical unit is not accessible to the task router (see SAM-6) contained in the SCSI target port that received this INQUIRY command. If the task router sets the PERIPHERAL QUALIFIER field to 011b, the task router shall set the PERIPHERAL DEVICE TYPE field to 1Fh.
100b to 111b	Vendor specific

The PERIPHERAL DEVICE TYPE field is defined in table 150.

Table 150 – PERIPHERAL DEVICE TYPE field (part 1 of 2)

Code	Reference [a]	Device type
00h	SBC-5	Direct access block device (e.g., magnetic disk)
01h	SSC-5	Sequential access device (e.g., magnetic tape)
02h		Obsolete
03h	SPC-2	Processor device
04h		Obsolete
05h	MMC-6	CD/DVD device
06h		Reserved
07h	SBC	Optical memory device (e.g., some optical disks)
08h	SMC-3	Media changer device (e.g., jukeboxes)
09h to 0Bh		Reserved
0Ch	SCC-2	Storage array controller device (e.g., RAID)
0Dh	SES-2	Enclosure services device

[a] All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the listed standards.
[b] See ISO/IEC 14776-381, *Information Technology - Small Computer System Interface (SCSI) - Part 381: Optical Memory Card Device Commands (OMC)* in clause 2.
[c] All well known logical units use the same device type.

Table 150 – PERIPHERAL DEVICE TYPE field (part 2 of 2)

Code	Reference [a]	Device type
0Eh	RBC	Simplified direct access device (e.g., magnetic disk)
0Fh	OCRW	Optical card reader/writer device [b]
10h		Reserved
11h	OSD-2	Object-based Storage Device
12h	ADC-3	Automation/Drive Interface
13h		Obsolete
14h	ZBC-3	Host managed zoned block device
15h to 1Dh		Reserved
1Eh	clause 8	Well known logical unit [c]
1Fh		Unknown or no device type

[a] All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the listed standards.

[b] See ISO/IEC 14776-381, *Information Technology - Small Computer System Interface (SCSI) - Part 381: Optical Memory Card Device Commands (OMC)* in clause 2.

[c] All well known logical units use the same device type.

A removable medium (RMB) bit set to zero indicates that the medium is not removable or is able to be removed only if that removal is accompanied by an I_T nexus loss event (see SAM-6) that affects the application client. A RMB bit set to one indicates that the medium is able to be removed without an accompanying I_T nexus loss event.

A logical unit conglomerate (LU_CONG) bit set to zero indicates that the logical unit is not part of a logical unit conglomerate (see SAM-6). A LU_CONG bit set to one indicates that the logical unit is part of a logical unit conglomerate.

The HOT PLUGGABLE field (see table 151) indicates the effects of removing the SCSI target device that contains the logical unit from a SCSI domain.

Table 151 – HOT PLUGGABLE field

Code	Description
00b	No information is provided regarding whether SCSI target device is hot pluggable.
01b	The SCSI target device is designed to be removed from a SCSI domain as a single object (i.e., concurrent removal of the SCSI target ports, logical units, and all other objects contained in that SCSI target device (see SAM-6)) while that SCSI domain continues to operate for all other SCSI target devices, if any, in that SCSI domain.
10b	The SCSI target device is not designed to be removed from a SCSI domain while that SCSI domain continues to operate.
11b	Reserved

The VERSION field indicates the implemented version of this standard and is defined in table 152.

Table 152 – VERSION field

Code	Description
00h	The device server does not claim conformance to any standard.
01h to 02h	Obsolete
03h	The device server complies to ANSI INCITS 301-1997 (a withdrawn standard).
04h	The device server complies to ANSI INCITS 351-2001 (SPC-2).
05h	The device server complies to ANSI INCITS 408-2005 (SPC-3).
06h	The device server complies to ANSI INCITS 513-2015 (SPC-4).
07h	The device server complies to ANSI INCITS 502-2019 (SPC-5).
08h to 0Ch	Obsolete
0Dh	The device server complies to this standard.
0Eh to 3Fh	Reserved
40h to 44h	Obsolete
45h to 47h	Reserved
48h to 4Ch	Obsolete
4Dh to 7Fh	Reserved
80h to 84h	Obsolete
85h to 87h	Reserved
88h to 8Ch	Obsolete
8Dh to FFh	Reserved

The Normal ACA Supported (NORMACA) bit set to one indicates that the device server supports a NACA bit set to one in the CDB CONTROL byte and supports the ACA task attribute (see SAM-6). A NORMACA bit set to zero indicates that the device server does not support a NACA bit set to one and does not support the ACA task attribute.

A historical support (HISUP) bit set to zero indicates the SCSI target device does not use the LUN structures described in SAM-6. A HISUP bit set to one indicates the SCSI target device uses the LUN structures described in SAM-6.

The RESPONSE DATA FORMAT field (see table 153) indicates the format of the standard INQUIRY data and shall be set as shown in table 148.

Table 153 – RESPONSE DATA FORMAT field

Code	Description
00h to 01h	Obsolete
02h	The response data format complies to this standard.
all other values	Reserved

The ADDITIONAL LENGTH field indicates the length in bytes of the remaining standard INQUIRY data. The contents of the ADDITIONAL LENGTH field are not altered based on the allocation length (see 4.2.5.6).

An SCC Supported (SCCS) bit set to one indicates that the SCSI target device contains an embedded storage array controller component that is addressable through this logical unit. See SCC-2 for details about storage array controller devices. An SCCS bit set to zero indicates that no embedded storage array controller component is addressable through this logical unit.

The contents of the target port group support (TPGS) field (see table 154) indicate the support for asymmetric logical unit access (see 5.18).

Table 154 – TPGS field

Code	Description
00b	The logical unit does not support asymmetric logical unit access or supports a form of asymmetric access that is vendor specific. Neither the REPORT TARGET GROUPS command nor the SET TARGET PORT GROUPS command is supported.
01b	The logical unit supports only implicit asymmetric logical unit access (see 5.18.2.9). The logical unit is capable of changing target port asymmetric access states without a SET TARGET PORT GROUPS command. The REPORT TARGET PORT GROUPS command is supported and the SET TARGET PORT GROUPS command is not supported.
10b	The logical unit supports only explicit asymmetric logical unit access (see 5.18.2.10). The logical unit only changes target port asymmetric access states as requested with the SET TARGET PORT GROUPS command. Both the REPORT TARGET PORT GROUPS command and the SET TARGET PORT GROUPS command are supported.
11b	The logical unit supports both explicit and implicit asymmetric logical unit access. Both the REPORT TARGET PORT GROUPS command and the SET TARGET PORT GROUPS commands are supported.

A third-party copy (3PC) bit set to one indicates that the logical unit supports third-party copy commands (see 5.19.3). A 3PC bit set to zero indicates that the logical unit does not support third-party copy commands.

A PROTECT bit set to zero indicates that the logical unit does not support protection information. A PROTECT bit set to one indicates that the logical unit supports:

  a) type 1 protection, type 2 protection, or type 3 protection (see SBC-5); or
  b) logical block protection (see SSC-5).

More information about the type of protection the logical unit supports is available in the SPT field (see 7.7.7).

An Enclosure Services (ENCSERV) bit set to one indicates that the SCSI target device contains an embedded enclosure services component that is addressable through this logical unit. See SES-3 for details about enclosure services. An ENCSERV bit set to zero indicates that no embedded enclosure services component is addressable through this logical unit.

A multiple SCSI port (MULTIP) bit set to one indicates that the logical unit is in a SCSI target device with multiple SCSI target ports (see SAM-6). A MULTIP bit set to zero indicates that the logical unit is in a SCSI target device with a single SCSI target port.

The CMDQUE bit shall be set to one indicating that the logical unit supports the command management model defined in SAM-6.

The T10 VENDOR IDENTIFICATION field contains eight bytes of left-aligned ASCII data (see 4.3.1) identifying the manufacturer of the logical unit. The T10 vendor identification shall be one assigned by INCITS. A list of assigned T10 vendor identifications is in Annex F and on the T10 web site (http://www.t10.org).

NOTE 15 - The T10 web site (http://www.t10.org) provides a convenient means to request an identification code.

The PRODUCT IDENTIFICATION field contains 16 bytes of left-aligned ASCII data (see 4.3.1) that identifies the product and is defined by the manufacturer.

The PRODUCT REVISION LEVEL field contains four bytes of left-aligned ASCII data that identifies the product revision and is defined by the manufacturer.

The VERSION DESCRIPTOR fields provide for identifying up to eight standards to which the SCSI target device and/or logical unit claim conformance. The value in each VERSION DESCRIPTOR field shall be selected from table 155. All version descriptor values not listed in table 155 are reserved. Technical Committee T10 of INCITS maintains an electronic copy of the information in table 155 on its website (http://www.t10.org/). In the event that the T10 website is no longer active, the information may be accessible on the INCITS website (http://www.incits.org), the ANSI website (http://www.ansi.org), the IEC website (http://www.iec.ch/), the ISO website (http://www.iso.ch/), or the ISO/IEC JTC 1 website (http://www.jtc1.org/). It is recommended that the first version descriptor be used for the SCSI architecture standard, followed by the physical transport standard if any, followed by the SCSI transport protocol standard, followed by the SPC-x version, followed by the device type command set, followed by a secondary command set, if any.

Table 155 – Version descriptor values (part 1 of 16)

Standard	Version Descriptor Value
ACS-2 (no version claimed)	1761h
ACS-2 INCITS 482-2013	1762h
ACS-3 (no version claimed)	1765h
ACS-3 INCITS 522-2014	1766h
ACS-4 (no version claimed)	1768h
ACS-4 INCITS 529-2018	1767h
ACS-5 (no version claimed)	1769h
ACS-5 INCITS 558-2021	176Ah
ACS-6 (no version claimed)	176Eh
ACS-2 ISO/IEC 17760-102	1778h
ACS-3 ISO/IEC 17760-103	1779h
ACS-5 ISO/IEC 17760-105	177Bh
ADC (no version claimed)	03C0h
ADC INCITS 403-2005	03D7h
ADC T10/1558-D revision 7	03D6h
ADC T10/1558-D revision 6	03D5h
ADC-2 (no version claimed)	04A0h
ADC-2 INCITS 441-2008	04ACh
ADC-2 T10/1741-D revision 7	04A7h
ADC-2 T10/1741-D revision 8	04AAh
ADC-3 (no version claimed)	0500h
ADC-3 INCITS 497-2012	050Ah
A numeric ordered listing of the version descriptor value assignments is provided in clause E.9.	

Table 155 – Version descriptor values (part 2 of 16)

Standard	Version Descriptor Value
ADC-3 T10/1895-D revision 04	0502h
ADC-3 T10/1895-D revision 05	0504h
ADC-3 T10/1895-D revision 05a	0506h
ADC-4 (no version claimed)	0640h
ADC-4 INCITS 541-2023	0642h
ADC-4 BSR INCITS 541 revision 05	064Ch
ADC-4 BSR INCITS 541 revision 04	064Bh
ADP (no version claimed)	09C0h
ADT (no version claimed)	09E0h
ADT INCITS 406-2005	09FDh
ADT T10/1557-D revision 14	09FAh
ADT T10/1557-D revision 11	09F9h
ADT-2 (no version claimed)	0A20h
ADT-2 INCITS 472-2011	0A2Bh
ADT-2 T10/1742-D revision 06	0A22h
ADT-2 T10/1742-D revision 08	0A27h
ADT-2 T10/1742-D revision 09	0A28h
ADT-3 (no version claimed)	0A60h
ADT-3 INCITS 542-2022	0A62h
ADT-3 BSR INCITS 542 revision 03	0A6Bh
ADT-4 (no version claimed)	2460h
ADT-4 INCITS 541-2023	246Bh
ATA/ATAPI-6 (no version claimed)	15E0h
ATA/ATAPI-6 INCITS 361-2002	15FDh
ATA/ATAPI-7 (no version claimed)	1600h
ATA/ATAPI-7 ISO/IEC 24739	161Eh
ATA/ATAPI-7 INCITS 397-2005	161Ch
ATA/ATAPI-7 T13/1532-D revision 3	1602h
ATA/ATAPI-8 ATA8-AAM (no version claimed)	1620h
ATA/ATAPI-8 ATA8-ACS ATA/ATAPI Command Set ISO/IEC 17760-101	1630h
ATA/ATAPI-8 ATA8-AAM INCITS 451-2008	1628h
ATA/ATAPI-8 ATA8-APT Parallel Transport (no version claimed)	1621h
ATA/ATAPI-8 ATA8-AST Serial Transport (no version claimed)	1622h
ATA/ATAPI-8 ATA8-ACS ATA/ATAPI Command Set (no version claimed)	1623h
ATA/ATAPI-8 ATA8-ACS INCITS 452-2009 w/ Amendment 1	162Ah
BCC (no version claimed)	0380h
EPI (no version claimed)	0B20h
EPI INCITS TR-23 1999	0B3Ch
A numeric ordered listing of the version descriptor value assignments is provided in clause E.9.	

Table 155 – Version descriptor values (part 3 of 16)

Standard	Version Descriptor Value
EPI T10/1134 revision 16	0B3Bh
Fast-20 (no version claimed)	0AC0h
Fast-20 INCITS 277-1996	0ADCh
Fast-20 T10/1071 revision 06	0ADBh
FC 10GFC (no version claimed)	0EA0h
FC 10GFC ISO/IEC 14165-116	0EA3h
FC 10GFC INCITS 364-2003	0EA2h
FC 10GFC ISO/IEC 14165-116 with AM1	0EA5h
FC 10GFC INCITS 364-2003 with AM1 INCITS 364/AM1-2007	0EA6h
FC-AL (no version claimed)	0D40h
FC-AL INCITS 272-1996	0D5Ch
FC-AL-2 (no version claimed)	0D60h
FC-AL-2 ISO/IEC 14165-122 with AM1 & AM2	0D65h
FC-AL-2 INCITS 332-1999 with AM1-2003 & AM2-2006	0D63h
FC-AL-2 INCITS 332-1999 with Amnd 2 AM2-2006	0D64h
FC-AL-2 INCITS 332-1999 with Amnd 1 AM1-2003	0D7Dh
FC-AL-2 INCITS 332-1999	0D7Ch
FC-AL-2 T11/1133-D revision 7.0	0D61h
FC-DA (no version claimed)	12E0h
FC-DA ISO/IEC 14165-341	12E9h
FC-DA INCITS TR-36 2004	12E8h
FC-DA T11/1513-DT revision 3.1	12E2h
FC-DA-2 (no version claimed)	12C0h
FC-DA-2 INCITS TR-49 2012	12C9h
FC-DA-2 T11/1870DT revision 1.04	12C3h
FC-DA-2 T11/1870DT revision 1.06	12C5h
FC-FLA (no version claimed)	1320h
FC-FLA INCITS TR-20 1998	133Ch
FC-FLA T11/1235 revision 7	133Bh
FC-FS (no version claimed)	0DA0h
FC-FS ISO/IEC 14165-251	0DBDh
FC-FS INCITS 373-2003	0DBCh
FC-FS T11/1331-D revision 1.2	0DB7h
FC-FS T11/1331-D revision 1.7	0DB8h
FC-FS-2 (no version claimed)	0E00h
FC-FS-2 INCITS 242-2007 with AM1 INCITS 242/AM1-2007	0E03h
FC-FS-2 INCITS 242-2007	0E02h
FC-FS-3 (no version claimed)	0EE0h
A numeric ordered listing of the version descriptor value assignments is provided in clause E.9.	

Table 155 – Version descriptor values (part 4 of 16)

Standard	Version Descriptor Value
FC-FS-3 INCITS 470-2011	0EEBh
FC-FS-3 T11/1861-D revision 0.9	0EE2h
FC-FS-3 T11/1861-D revision 1.0	0EE7h
FC-FS-3 T11/1861-D revision 1.10	0EE9h
FC-FS-4 (no version claimed)	0F60h
FC-LS (no version claimed)	0E20h
FC-LS INCITS 433-2007	0E29h
FC-LS T11/1620-D revision 1.62	0E21h
FC-LS-2 (no version claimed)	0F00h
FC-LS-2 INCITS 477-2011	0F07h
FC-LS-2 T11/2103-D revision 2.11	0F03h
FC-LS-2 T11/2103-D revision 2.21	0F05h
FC-LS-3 (no version claimed)	0F80h
FC-PH (no version claimed)	0D20h
FC-PH INCITS 230-1994	0D3Bh
FC-PH INCITS 230-1994 with Amnd 1 INCITS 230/AM1-1996	0D3Ch
FC-PH-3 (no version claimed)	0D80h
FC-PH-3 INCITS 303-1998	0D9Ch
FC-PI (no version claimed)	0DC0h
FC-PI INCITS 352-2002	0DDCh
FC-PI-2 (no version claimed)	0DE0h
FC-PI-2 INCITS 404-2006	0DE4h
FC-PI-2 T11/1506-D revision 5.0	0DE2h
FC-PI-3 (no version claimed)	0E60h
FC-PI-3 INCITS 460-2011	0E6Eh
FC-PI-3 T11/1625-D revision 2.0	0E62h
FC-PI-3 T11/1625-D revision 2.1	0E68h
FC-PI-3 T11/1625-D revision 4.0	0E6Ah
FC-PI-4 (no version claimed)	0E80h
FC-PI-4 INCITS 450-2009	0E88h
FC-PI-4 T11/1647-D revision 8.0	0E82h
FC-PI-5 (no version claimed)	0F20h
FC-PI-5 INCITS 479-2011	0F2Eh
FC-PI-5 T11/2118-D revision 2.00	0F27h
FC-PI-5 T11/2118-D revision 3.00	0F28h
FC-PI-5 T11/2118-D revision 6.00	0F2Ah
FC-PI-5 T11/2118-D revision 6.10	0F2Bh
FC-PI-6 (no version claimed)	0F40h
A numeric ordered listing of the version descriptor value assignments is provided in clause E.9.	

Table 155 – Version descriptor values (part 5 of 16)

Standard	Version Descriptor Value
FC-PLDA (no version claimed)	1340h
FC-PLDA INCITS TR-19 1998	135Ch
FC-PLDA T11/1162 revision 2.1	135Bh
FC-SCM (no version claimed)	12A0h
FC-SCM INCITS TR-47 2012	12AAh
FC-SCM T11/1824DT revision 1.0	12A3h
FC-SCM T11/1824DT revision 1.1	12A5h
FC-SCM T11/1824DT revision 1.4	12A7h
FC-SP (no version claimed)	0E40h
FC-SP INCITS 426-2007	0E45h
FC-SP T11/1570-D revision 1.6	0E42h
FC-SP-2 (no version claimed)	0EC0h
FC-Tape (no version claimed)	1300h
FC-Tape INCITS TR-24 1999	131Ch
FC-Tape T11/1315 revision 1.17	131Bh
FC-Tape T11/1315 revision 1.16	1301h
FCP (no version claimed)	08C0h
FCP INCITS 269-1996	08DCh
FCP T10/0993-D revision 12	08DBh
FCP-2 (no version claimed)	0900h
FCP-2 ISO/IEC 14776-222	091Ah
FCP-2 INCITS 350-2003	0917h
FCP-2 T10/1144-D revision 8	0918h
FCP-2 T10/1144-D revision 4	0901h
FCP-2 T10/1144-D revision 7	0915h
FCP-2 T10/1144-D revision 7a	0916h
FCP-3 (no version claimed)	0A00h
FCP-3 ISO/IEC 14776-223	0A1Ch
FCP-3 INCITS 416-2006	0A11h
FCP-3 T10/1560-D revision 4	0A0Fh
FCP-3 T10/1560-D revision 3f	0A07h
FCP-4 (no version claimed)	0A40h
FCP-4 ISO/IEC 14776-224	0A50h
FCP-4 INCITS 481-2011	0A46h
FCP-4 AM1 INCITS 481-2011/AM1-2018	0A52h
FCP-4 T10/1828-D revision 01	0A42h
FCP-4 T10/1828-D revision 02	0A44h
FCP-4 T10/1828-D revision 02b	0A45h
A numeric ordered listing of the version descriptor value assignments is provided in clause E.9.	

Table 155 – Version descriptor values (part 6 of 16)

Standard	Version Descriptor Value
FCP-5 (no version claimed)	0A80h
FCP-5 INCITS 563-2023	0A82h
FCP-5 BSR INCITS 563 revision 04	0A8Bh
IEEE 1394 (no version claimed)	14A0h
IEEE 1394-1995	14BDh
IEEE 1394a (no version claimed)	14C0h
IEEE 1394b (no version claimed)	14E0h
IEEE 1667 (no version claimed)	FFC0h
IEEE 1667-2006	FFC1h
IEEE 1667-2009	FFC2h
IEEE 1667-2015	FFC3h
IEEE 1667-2018	FFC4h
iSCSI (no version claimed)	0960h
iSCSI (versions as described via RFC 7144)	0961h to 097Fh
MMC (no version claimed)	0140h
MMC INCITS 304-1997	015Ch
MMC T10/1048-D revision 10a	015Bh
MMC-2 (no version claimed)	0240h
MMC-2 INCITS 333-2000	025Ch
MMC-2 T10/1228-D revision 11a	025Bh
MMC-2 T10/1228-D revision 11	0255h
MMC-3 (no version claimed)	02A0h
MMC-3 INCITS 360-2002	02B8h
MMC-3 T10/1363-D revision 10g	02B6h
MMC-3 T10/1363-D revision 9	02B5h
MMC-4 (no version claimed)	03A0h
MMC-4 INCITS 401-2005	03BFh
MMC-4 T10/1545-D revision 3	03BDh
MMC-4 T10/1545-D revision 3d	03BEh
MMC-4 T10/1545-D revision 5	03B0h
MMC-4 T10/1545-D revision 5a	03B1h
MMC-5 (no version claimed)	0420h
MMC-5 INCITS 430-2007	0434h
MMC-5 T10/1675-D revision 04	0432h
MMC-5 T10/1675-D revision 03	042Fh
MMC-5 T10/1675-D revision 03b	0431h
MMC-6 (no version claimed)	04E0h
A numeric ordered listing of the version descriptor value assignments is provided in clause E.9.	

Table 155 – Version descriptor values (part 7 of 16)

Standard	Version Descriptor Value
MMC-6 INCITS 468-2010 + MMC-6/AM1 INCITS 468-2010/AM 1	04E7h
MMC-6 INCITS 468-2010	04E6h
MMC-6 T10/1836-D revision 02b	04E3h
MMC-6 T10/1836-D revision 02g	04E5h
OCRW (no version claimed)	0280h
OCRW ISO/IEC 14776-381	029Eh
OSD (no version claimed)	0340h
OSD INCITS 400-2004	0356h
OSD T10/1355-D revision 10	0355h
OSD T10/1355-D revision 0	0341h
OSD T10/1355-D revision 7a	0342h
OSD T10/1355-D revision 8	0343h
OSD T10/1355-D revision 9	0344h
OSD-2 (no version claimed)	0440h
OSD-2 INCITS 458-2011	0448h
OSD-2 T10/1729-D revision 4	0444h
OSD-2 T10/1729-D revision 5	0446h
OSD-3 (no version claimed)	0560h
PQI (no version claimed)	2200h
PQI INCITS 490-2014	2208h
PQI T10/BSR INCITS 490 revision 6	2204h
PQI T10/BSR INCITS 490 revision 7	2206h
PQI-2 (no version claimed)	2240h
PQI-2 INCITS 507-2016	2244h
PQI-2 T10/BSR INCITS 507 revision 01	2242h
RBC (no version claimed)	0220h
RBC ISO/IEC 14776-326	023Eh
RBC INCITS 330-2000	023Ch
RBC T10/1240-D revision 10a	0238h
SAM (no version claimed)	0020h
SAM ISO/IEC 14776-411	003Dh
SAM INCITS 270-1996	003Ch
SAM T10/0994-D revision 18	003Bh
SAM-2 (no version claimed)	0040h
SAM-2 ISO/IEC 14776-412	005Eh
SAM-2 INCITS 366-2003	005Ch
SAM-2 T10/1157-D revision 24	0055h
SAM-2 T10/1157-D revision 23	0054h
A numeric ordered listing of the version descriptor value assignments is provided in clause E.9.	

Table 155 – Version descriptor values (part 8 of 16)

Standard	Version Descriptor Value
SAM-3 (no version claimed)	0060h
SAM-3 ISO/IEC 14776-413	0079h
SAM-3 INCITS 402-2005	0077h
SAM-3 T10/1561-D revision 14	0076h
SAM-3 T10/1561-D revision 7	0062h
SAM-3 T10/1561-D revision 13	0075h
SAM-4 (no version claimed)	0080h
SAM-4 ISO/IEC 14776-414	0092h
SAM-4 INCITS 447-2008	0090h
SAM-4 T10/1683-D revision 13	0087h
SAM-4 T10/1683-D revision 14	008Bh
SAM-5 (no version claimed)	00A0h
SAM-5 ISO/IEC 14776-415	00AAh
SAM-5 INCITS 515-2016	00A8h
SAM-5 T10/2104-D revision 4	00A2h
SAM-5 T10/2104-D revision 20	00A4h
SAM-5 T10/2104-D revision 21	00A6h
SAM-6 (no version claimed)	00C0h
SAM-6 INCITS 546-2021	00C2h
SAM-6 BSR INCITS 546 revision 10	00D4h
SAS (no version claimed)	0BE0h
SAS ISO/IEC 14776-150	0BFEh
SAS INCITS 376-2003	0BFDh
SAS T10/1562-D revision 05	0BFCh
SAS T10/1562-D revision 01	0BE1h
SAS T10/1562-D revision 03	0BF5h
SAS T10/1562-D revision 4	0BFAh
SAS T10/1562-D revision 04	0BFBh
SAS-1.1 (no version claimed)	0C00h
SAS-1.1 ISO/IEC 14776-151	0C12h
SAS-1.1 INCITS 417-2006	0C11h
SAS-1.1 T10/1601-D revision 9	0C07h
SAS-1.1 T10/1601-D revision 10	0C0Fh
SAS-2 (no version claimed)	0C20h
SAS-2 INCITS 457-2010	0C2Ah
SAS-2 T10/1760-D revision 14	0C23h
SAS-2 T10/1760-D revision 15	0C27h
SAS-2 T10/1760-D revision 16	0C28h
A numeric ordered listing of the version descriptor value assignments is provided in clause E.9.	

Table 155 – Version descriptor values (part 9 of 16)

Standard	Version Descriptor Value
SAS-2.1 (no version claimed)	0C40h
SAS-2.1 ISO/IEC 14776-153	0C52h
SAS-2.1 INCITS 478-2011	0C4Eh
SAS-2.1 INCITS 478-2011 w/ Amnd 1 INCITS 478/AM1-2014	0C4Fh
SAS-2.1 T10/2125-D revision 04	0C48h
SAS-2.1 T10/2125-D revision 06	0C4Ah
SAS-2.1 T10/2125-D revision 07	0C4Bh
SAS-3 (no version claimed)	0C60h
SAS-3 ISO/IEC 14776-154	0C6Ah
SAS-3 INCITS 519-2014	0C68h
SAS-3 T10/BSR INCITS 519 revision 05a	0C63h
SAS-3 T10/BSR INCITS 519 revision 06	0C65h
SAS-4 (no version claimed)	0C80h
SAS-4 INCITS 534-2019	0C92h
SAS-4 T10/BSR INCITS 534 revision 09	0C84h
SAS-4 T10/BSR INCITS 534 revision 08a	0C82h
SAS-4.1 (no version claimed)	0CA0h
SAS-4.1 INCITS 567-2023	0CA2h
SAS-4.1 BSR INCITS 567 revision 04	0CB0h
SAS-4.1 BSR INCITS 567 revision 03	0CAFh
SAT (no version claimed)	1EA0h
SAT INCITS 431-2007	1EADh
SAT T10/1711-D revision 9	1EABh
SAT T10/1711-D revision 8	1EA7h
SAT-2 (no version claimed)	1EC0h
SAT-2 INCITS 465-2010	1ECAh
SAT-2 T10/1826-D revision 06	1EC4h
SAT-2 T10/1826-D revision 09	1EC8h
SAT-3 (no version claimed)	1EE0h
SAT-3 INCITS 517-2015	1EE8h
SAT-3 T10/BSR INCITS 517 revision 4	1EE2h
SAT-3 T10/BSR INCITS 517 revision 7	1EE4h
SAT-4 (no version claimed)	1F00h
SAT-4 INCITS 491-2018	1F0Ch
SAT-4 T10/BSR INCITS 491 revision 5	1F02h
SAT-4 T10/BSR INCITS 491 revision 6	1F04h
SAT-5 (no version claimed)	1F20h
SAT-5 INCITS 557-2023	1F22h
A numeric ordered listing of the version descriptor value assignments is provided in clause E.9.	

Table 155 – Version descriptor values (part 10 of 16)

Standard	Version Descriptor Value
SAT-5 BSR INCITS 577 revision 10	1F25h
SAT-6 (no version claimed)	1F40h
SBC (no version claimed)	0180h
SBC ISO/IEC 14776-321	019Eh
SBC INCITS 306-1998	019Ch
SBC T10/0996-D revision 08c	019Bh
SBC-2 (no version claimed)	0320h
SBC-2 ISO/IEC 14776-322	033Eh
SBC-2 INCITS 405-2005	033Dh
SBC-2 T10/1417-D revision 16	033Bh
SBC-2 T10/1417-D revision 5a	0322h
SBC-2 T10/1417-D revision 15	0324h
SBC-3 (no version claimed)	04C0h
SBC-3 ISO/IEC 14776-323	04CAh
SBC-3 INCITS 514-2014	04C8h
SBC-3 T10/BSR INCITS 514 revision 35	04C3h
SBC-3 T10/BSR INCITS 514 revision 36	04C5h
SBC-4 (no version claimed)	0600h
SBC-4 INCITS 506-2021	0602h
SBC-4 BSR INCITS 506 revision 22	0610h
SBC-4 BSR INCITS 506 revision 20a	060Fh
SBC-5 (no version claimed)	06C0h
SBC-5 SCSI/INCITS 571 revision 07	06C8h
SBC-6 (no version claimed)	0720h
SBP-2 (no version claimed)	08E0h
SBP-2 INCITS 325-1998	08FCh
SBP-2 T10/1155-D revision 04	08FBh
SBP-3 (no version claimed)	0980h
SBP-3 INCITS 375-2004	099Ch
SBP-3 T10/1467-D revision 5	099Bh
SBP-3 T10/1467-D revision 1f	0982h
SBP-3 T10/1467-D revision 3	0994h
SBP-3 T10/1467-D revision 4	099Ah
SCC (no version claimed)	0160h
SCC INCITS 276-1997	017Ch
SCC T10/1047-D revision 06c	017Bh
SCC-2 (no version claimed)	01E0h
SCC-2 INCITS 318-1998	01FCh
A numeric ordered listing of the version descriptor value assignments is provided in clause E.9.	

Table 155 – Version descriptor values (part 11 of 16)

Standard	Version Descriptor Value
SCC-2 T10/1125-D revision 04	01FBh
SES (no version claimed)	01C0h
SES INCITS 305-1998 w/ Amendment INCITS 305/AM1-2000	01DEh
SES INCITS 305-1998	01DCh
SES T10/1212-D revision 08b	01DBh
SES T10/1212 revision 08b w/ Amendment INCITS 305/AM1-2000	01DDh
SES-2 (no version claimed)	03E0h
SES-2 ISO/IEC 14776-372	03F2h
SES-2 INCITS 448-2008	03F0h
SES-2 T10/1559-D revision 16	03E1h
SES-2 T10/1559-D revision 19	03E7h
SES-2 T10/1559-D revision 20	03EBh
SES-3 (no version claimed)	0580h
SES-3 INCITS 518-2017	0591h
SES-3 T10/BSR INCITS 518 revision 14	0584h
SES-3 T10/BSR INCITS 518 revision 13	0582h
SES-4 (no version claimed)	0680h
SES-4 INCITS 555-2020	0682h
SES-4 BSR INCITS 555 revision 05	0690h
SES-4 BSR INCITS 555 revision 03	068Fh
SFSC (no version claimed)	05E0h
SFSC ISO/IEC 14776-481	05EAh
SFSC INCITS 501-2016	05E8h
SFSC BSR INCITS 501 revision 01	05E3h
SFSC BSR INCITS 501 revision 02	05E5h
SIP (no version claimed)	08A0h
SIP INCITS 292-1997	08BCh
SIP T10/0856-D revision 10	08BBh
SMC (no version claimed)	01A0h
SMC ISO/IEC 14776-351	01BEh
SMC INCITS 314-1998	01BCh
SMC T10/0999-D revision 10a	01BBh
SMC-2 (no version claimed)	02E0h
SMC-2 INCITS 382-2004	02FEh
SMC-2 T10/1383-D revision 7	02FDh
SMC-2 T10/1383-D revision 5	02F5h
SMC-2 T10/1383-D revision 6	02FCh
SMC-3 (no version claimed)	0480h
A numeric ordered listing of the version descriptor value assignments is provided in clause E.9.	

Table 155 – Version descriptor values (part 12 of 16)

Standard	Version Descriptor Value
SMC-3 INCITS 484-2012	0486h
SMC-3 T10/1730-D revision 15	0482h
SMC-3 T10/1730-D revision 16	0484h
SNT (no version claimed)	1F60h
SOP (no version claimed)	21E0h
SOP INCITS 489-2014	21E8h
SOP T10/BSR INCITS 489 revision 4	21E4h
SOP T10/BSR INCITS 489 revision 5	21E6h
SOP-2 (no draft published)	2220h
SPC (no version claimed)	0120h
SPC INCITS 301-1997	013Ch
SPC T10/0995-D revision 11a	013Bh
SPC-2 (no version claimed)	0260h
SPC-2 ISO/IEC 14776-452	0278h
SPC-2 INCITS 351-2001	0277h
SPC-2 T10/1236-D revision 20	0276h
SPC-2 T10/1236-D revision 12	0267h
SPC-2 T10/1236-D revision 18	0269h
SPC-2 T10/1236-D revision 19	0275h
SPC-3 (no version claimed)	0300h
SPC-3 ISO/IEC 14776-453	0316h
SPC-3 INCITS 408-2005	0314h
SPC-3 T10/1416-D revision 7	0301h
SPC-3 T10/1416-D revision 21	0307h
SPC-3 T10/1416-D revision 22	030Fh
SPC-3 T10/1416-D revision 23	0312h
SPC-4 (no version claimed)	0460h
SPC-4 ISO/IEC 14776-454	046Eh
SPC-4 INCITS 513-2015	046Ch
SPC-4 T10/BSR INCITS 513 revision 16	0461h
SPC-4 T10/BSR INCITS 513 revision 18	0462h
SPC-4 T10/BSR INCITS 513 revision 23	0463h
SPC-4 T10/BSR INCITS 513 revision 36	0466h
SPC-4 T10/BSR INCITS 513 revision 37	0468h
SPC-4 T10/BSR INCITS 513 revision 37a	0469h
SPC-5 (no version claimed)	05C0h
SPC-5 INCITS 502-2019	05C2h
SPC-5 BSR INCITS 502 revision 22	05CBh
A numeric ordered listing of the version descriptor value assignments is provided in clause E.9.	

Table 155 – Version descriptor values (part 13 of 16)

Standard	Version Descriptor Value
SPC-6 (no version claimed)	06E0h
SPC-6 SCSI/INCITS 566 revision 13	06E5h
SPC-6 SCSI/INCITS 566 revision 12	06E8h
SPC-7 (no version claimed)	0700h
SPI (no version claimed)	0AA0h
SPI INCITS 253-1995	0ABAh
SPI T10/0855-D revision 15a	0AB9h
SPI INCITS 253-1995 with SPI Amnd INCITS 253/AM1-1998	0ABCh
SPI T10/0855-D revision 15a with SPI Amnd revision 3a	0ABBh
SPI-2 (no version claimed)	0AE0h
SPI-2 INCITS 302-1999	0AFCh
SPI-2 T10/1142-D revision 20b	0AFBh
SPI-3 (no version claimed)	0B00h
SPI-3 INCITS 336-2000	0B1Ch
SPI-3 T10/1302-D revision 14	0B1Ah
SPI-3 T10/1302-D revision 10	0B18h
SPI-3 T10/1302-D revision 13a	0B19h
SPI-4 (no version claimed)	0B40h
SPI-4 INCITS 362-2002	0B56h
SPI-4 T10/1365-D revision 7	0B54h
SPI-4 T10/1365-D revision 9	0B55h
SPI-4 T10/1365-D revision 10	0B59h
SPI-5 (no version claimed)	0B60h
SPI-5 INCITS 367-2003	0B7Ch
SPI-5 T10/1525-D revision 6	0B7Bh
SPI-5 T10/1525-D revision 3	0B79h
SPI-5 T10/1525-D revision 5	0B7Ah
SPL (no version claimed)	20A0h
SPL ISO/IEC 14776-261	20AAh
SPL INCITS 476-2011	20A7h
SPL INCITS 476-2011 + SPL AM1 INCITS 476/AM1 2012	20A8h
SPL T10/2124-D revision 6a	20A3h
SPL T10/2124-D revision 7	20A5h
SPL-2 (no version claimed)	20C0h
SPL-2 ISO/IEC 14776-262	20C9h
SPL-2 INCITS 505-2013	20C8h
SPL-2 T10/BSR INCITS 505 revision 4	20C2h
SPL-2 T10/BSR INCITS 505 revision 5	20C4h
A numeric ordered listing of the version descriptor value assignments is provided in clause E.9.	

Table 155 – Version descriptor values (part 14 of 16)

Standard	Version Descriptor Value
SPL-3 (no version claimed)	20E0h
SPL-3 ISO/IEC 14776-263	20E9h
SPL-3 INCITS 492-2015	20E8h
SPL-3 T10/BSR INCITS 492 revision 6	20E4h
SPL-3 T10/BSR INCITS 492 revision 7	20E6h
SPL-4 (no version claimed)	2100h
SPL-4 INCITS 538-2018	2110h
SPL-4 T10/BSR INCITS 538 revision 13	2107h
SPL-4 T10/BSR INCITS 538 revision 08a	2102h
SPL-4 T10/BSR INCITS 538 revision 10	2104h
SPL-4 T10/BSR INCITS 538 revision 11	2105h
SPL-5 (no version claimed)	2120h
SPL-5 INCITS 554-2023	2122h
SPL-5 BSR INCITS 554 revision 15	212Fh
SPL-5 BSR INCITS 554 revision 14	212Eh
SRP (no version claimed)	0940h
SRP INCITS 365-2002	095Ch
SRP T10/1415-D revision 16a	0955h
SRP T10/1415-D revision 10	0954h
SRP-2 (no version claimed)	09A0h
SRP-2 INCITS 551-2019	09BCh
SSA-PH2 (no version claimed)	1360h
SSA-PH2 INCITS 293-1996	137Ch
SSA-PH2 T10.1/1145-D revision 09c	137Bh
SSA-PH3 (no version claimed)	1380h
SSA-PH3 INCITS 307-1998	139Ch
SSA-PH3 T10.1/1146-D revision 05b	139Bh
SSA-S2P (no version claimed)	0880h
SSA-S2P INCITS 294-1996	089Ch
SSA-S2P T10.1/1121-D revision 07b	089Bh
SSA-S3P (no version claimed)	0860h
SSA-S3P INCITS 309-1998	087Ch
SSA-S3P T10.1/1051-D revision 05b	087Bh
SSA-TL1 (no version claimed)	0840h
SSA-TL1 INCITS 295-1996	085Ch
SSA-TL1 T10.1/0989-D revision 10b	085Bh
SSA-TL2 (no version claimed)	0820h
SSA-TL2 INCITS 308-1998	083Ch
A numeric ordered listing of the version descriptor value assignments is provided in clause E.9.	

Table 155 – Version descriptor values (part 15 of 16)

Standard	Version Descriptor Value
SSA-TL2 T10.1/1147-D revision 05b	083Bh
SSC (no version claimed)	0200h
SSC ISO/IEC 14776-331	021Eh
SSC INCITS 335-2000	021Ch
SSC T10/0997-D revision 22	0207h
SSC T10/0997-D revision 17	0201h
SSC-2 (no version claimed)	0360h
SSC-2 ISO/IEC 14776-342	037Eh
SSC-2 INCITS 380-2003	037Dh
SSC-2 T10/1434-D revision 9	0375h
SSC-2 T10/1434-D revision 7	0374h
SSC-3 (no version claimed)	0400h
SSC-3 ISO/IEC 14776-333	040Bh
SSC-3 INCITS 467-2011	0409h
SSC-3 T10/1611-D revision 04a	0403h
SSC-3 T10/1611-D revision 05	0407h
SSC-4 (no version claimed)	0520h
SSC-4 INCITS 516-2013	0527h
SSC-4 T10/BSR INCITS 516 revision 2	0523h
SSC-4 T10/BSR INCITS 516 revision 3	0525h
SSC-5 (no version claimed)	05A0h
SSC-5 BSR INCITS 503-2022	05A2h
SSC-5 BSR INCITS 503 revision 06	05ABh
SSC-5 AM1 (no version claimed)	05AFh
SST (no version claimed)	0920h
SST T10/1380-D revision 8b	0935h
UAS (no version claimed)	1740h
UAS ISO/IEC 14776-251	1749h
UAS INCITS 471-2010	1748h
UAS T10/2095-D revision 02	1743h
UAS T10/2095-D revision 04	1747h
UAS-2 (no version claimed)	1780h
UAS-3 (no version claimed)	17C0h
UAS-3 INCITS 572-2021	17C2h
UAS-3 BSR INCITS 572 revision 05	17C5h
UAS-3 ISO/IEC 14776-253	1807h
Universal Serial Bus Specification, Revision 1.1	1728h
Universal Serial Bus Specification, Revision 2.0	1729h
A numeric ordered listing of the version descriptor value assignments is provided in clause E.9.	

Table 155 – Version descriptor values (part 16 of 16)

Standard	Version Descriptor Value
Universal Serial Bus 3.2 Specification Revision 1.0	172Ah
Universal Serial Bus 4 Specification Version 1.0	172Bh
Universal Serial Bus 4 Specification Version 2.0	172Ch
USB Mass Storage Class Bulk-Only Transport, Revision 1.0	1730h
ZAC (no version claimed)	17A3h
ZAC INCITS 537-2016	17A4h
ZAC AM1 INCITS 537-2016/AM1-2019	17BCh
ZAC-2 (no version claimed)	17A6h
ZAC-2 INCITS 549-2022	17A5h
ZAC-3 (no version claimed)	17A7h
ZBC (no version claimed)	0620h
ZBC INCITS 536-2016	0628h
ZBC AM1 INCITS 536-2016/AM1-2019	0629h
ZBC BSR INCITS 536 revision 02	0622h
ZBC BSR INCITS 536 revision 05	0624h
ZBC-2 (no version claimed)	0660h
ZBC-2 INCITS 550-2023	0662h
ZBC-2 BSR INCITS 550 revision 13	066Bh
ZBC-3 (no version claimed)	06A0h
Version Descriptor Not Supported or No Standard Identified	0000h
Reserved	All others
A numeric ordered listing of the version descriptor value assignments is provided in clause E.9.	

6.8 LOG SELECT command

6.8.1 LOG SELECT command introduction

The LOG SELECT command (see table 156) requests the device server to manage the specified statistical information about the SCSI target device or its logical units. Device servers that implement the LOG SELECT command shall also implement the LOG SENSE command. Structures in the form of log parameters within log pages (see 7.3) are defined to manage the log data. The LOG SELECT command provides a method for sending zero or more log pages in the command's parameter list.

Table 156 – LOG SELECT command

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

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 156 for the LOG SELECT command.

The parameter code reset (PCR) bit specifies whether the device server shall set parameters to their vendor specific default values (e.g., zero) as described in table 159.

The save parameters (SP) bit specifies whether the device server shall save parameters to nonvolatile memory as described in table 159.

The page control (PC) field specifies which values the device server shall process for bounded data counter log parameters (see 7.3.2.2.2.2) and unbounded data counter log parameters (see 7.3.2.2.2.3) in response to a LOG SELECT command as described in table 157. The PC field shall be ignored for ASCII format list log parameters (see 7.3.2.2.2.4) and binary format list log parameters (see 7.3.2.2.2.5).

Table 157 – Page control (PC) field

Value	Description
00b	Obsolete
01b	Cumulative values [a]
10b	Obsolete
11b	Default cumulative values

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

When evaluated together, the combination of the values in the PCR bit, the SP bit, and the PC field specify the actions that a device server performs while processing a LOG SELECT command.

If the PARAMETER LIST LENGTH field is set to zero, the PAGE CODE field and SUBPAGE CODE field specify the log page or log pages to which the other CDB fields apply (see 6.8.2).

If the PARAMETER LIST LENGTH field is set to a value other than zero, and:

    a) the PAGE CODE field is set to a value other than zero; or
    b) the SUBPAGE CODE field is set to a value other than zero,

then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

The PARAMETER LIST LENGTH field specifies the length in bytes of the parameter list that shall be located in the Data-Out Buffer.

If the PARAMETER LIST LENGTH field is set to a value other than zero, the actions that a device server performs after receiving a LOG SELECT command are determined by the values in the PCR bit, the SP bit, and the PC field as described in table 321 (see 7.3.2.1).

If the PARAMETER LIST LENGTH field is set to zero, no log pages shall be transferred. This condition shall not be considered an error. The LOG SELECT command shall be processed as described in 6.8.2.

The CONTROL byte is defined in SAM-6.

6.8.2 Processing LOG SELECT when the parameter list length is zero

If the PARAMETER LIST LENGTH field is set to zero (i.e., when there is no parameter data being sent with a LOG SELECT command), then the device server processes the log parameter values as described in this subclause.

The PAGE CODE field and SUBPAGE CODE field (see table 158) specify the log page or log pages to which the other CDB fields apply (see table 159).

Table 158 – PAGE CODE field and SUBPAGE CODE field

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

Table 159 defines the meaning of the combinations of values for the PCR bit, the SP bit, and the PC field.

Table 159 – PCR bit, SP bit, and PC field meanings when parameter list length is zero (part 1 of 3)

PCR bit	SP bit	PC field	Description
0b	0b	0xb	This is not an error. The device server shall make no changes to any log parameter values and shall not save any values to nonvolatile media.
0b	1b	00b	The device server shall make no changes to any log parameter values and shall process the saving of current list parameters as follows: a) if the device server implements saving of the current list parameters, then the device server shall save all current list parameters to nonvolatile media; or b) if the device server does not implement saving of the current list parameters, then the device server shall terminate the command [a].
[a] The device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.			
[b] Vendor specific default cumulative values may be zero.			
[c] Device servers compliant with SPC-3 may save the log parameter values to nonvolatile media after setting the log parameter values instead of before setting the log parameter values.			

Table 159 – PCR bit, SP bit, and PC field meanings when parameter list length is zero (part 2 of 3)

PCR bit	SP bit	PC field	Description
0b	1b	01b	The device server shall make no change to any log parameter values and shall process the saving of current parameter values as follows: a) if the values are current cumulative data counter parameters, then: A) if the device server implements saving of the current cumulative values, then the device server shall save all current cumulative values to nonvolatile media; and B) if the device server does not implement saving of the current cumulative values, then the device server shall terminate the command [a]; and b) if the values are current list parameters, then: A) if the device server implements saving of the current list parameters, then the device server shall save all current list parameters to nonvolatile media; and B) if the device server does not implement saving of the current list parameters, then the device server shall terminate the command [a].
0b	xb	10b	Obsolete
0b	xb	11b	The device server shall set all current cumulative values to the vendor specific default cumulative values [b] and shall not save any values to nonvolatile media.
1b	0b	xxb	The device server shall: 1) set all current cumulative values to the vendor specific default cumulative values [b]; 2) set all list parameters to their vendor specific default values; and 3) not save any values to nonvolatile media.
1b	1b	00b	The device server shall: 1) set all current cumulative values to the vendor specific default cumulative values [b]; and 2) set all list parameters to their vendor specific default values.
1b	1b	01b	The device server shall process the saving of current cumulative values as follows: a) if the device server implements saving of the current cumulative values, then the device server shall: 1) save all current cumulative values to nonvolatile media [c]; 2) set all current cumulative values to the vendor specific default cumulative values [b]; and 3) set all list parameters to their vendor specific default values; and b) if the device server does not implement saving of the current cumulative values, then the device server shall terminate the command [a].

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

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

[c] Device servers compliant with SPC-3 may save the log parameter values to nonvolatile media after setting the log parameter values instead of before setting the log parameter values.

Table 159 – PCR bit, SP bit, and PC field meanings when parameter list length is zero (part 3 of 3)

PCR bit	SP bit	PC field	Description
1b	1b	1xb	The device server shall: 1) set all current cumulative values to the vendor specific default cumulative values [b]; 2) set all list parameters to their vendor specific default values; and 3) not save any values to nonvolatile media.

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

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

[c] Device servers compliant with SPC-3 may save the log parameter values to nonvolatile media after setting the log parameter values instead of before setting the log parameter values.

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

> NOTE 16 - Log pages or log parameters that are not available may become available at some later time (e.g., after the logical unit has become ready).

6.9 LOG SENSE command

The LOG SENSE command (see table 160) requests the device server to return statistical or other operational information about the SCSI target device or its logical units. It is a complementary command to the LOG SELECT command.

Table 160 – LOG SENSE command

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

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 160 for the LOG SENSE command.

A save parameters (SP) bit set to zero specifies the device server shall perform the specified LOG SENSE command and shall not save any log parameters.

An SP bit set to one specifies that the device server shall perform the specified LOG SENSE command and shall save all log parameters identified as saveable by the DS bit (see 7.3) to a nonvolatile, vendor specific location. If the SP bit is set to one and the logical unit does not implement saving log parameters, the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

The PC field shall be ignored for ASCII format list log parameters (see 7.3.2.2.2.4) and binary format list log parameters (see 7.3.2.2.2.5).

For bounded data counter log parameters (see 7.3.2.2.2.2) and unbounded data counter log parameters (see 7.3.2.2.2.3), the page control (PC) field (see table 157 in 6.8.1) specifies which log parameter values are to be returned by a device server in response to a LOG SENSE command.

For ASCII format list log parameters (see 7.3.2.2.2.4) and binary format list log parameters (see 7.3.2.2.2.5), the PC field shall be ignored. If the parameters specified by the PAGE CODE field and SUBPAGE CODE field in the CDB are list parameters, then the parameter values returned by a device server in response to a LOG SENSE command are determined as follows in order of preference:

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

The PAGE CODE field and SUBPAGE CODE field specify which log page of data is being requested (see 7.3). If the log page specified by the page code and subpage code combination is reserved or not supported, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

The PARAMETER POINTER field allows the application client to request parameter data beginning from a specific parameter code to the maximum allocation length or the maximum parameter code supported by the logical unit, whichever is less. If the PARAMETER POINTER field is set to:

a) 0000h, then the device server shall begin the transfer of the parameter data with the log parameter having the lowest parameter code that is implemented by the device server for the specified log page;
b) a value specifying the parameter code of a log parameter implemented by the device server for the specified log page, then the device server shall begin the transfer of the parameter data with the log parameter having the specified code;
c) a value that does not specify a parameter code implemented by the device server for the specified log page but is less than the largest parameter code implemented by the device server, then the device server shall begin the transfer of the parameter data with the log parameter implemented by the device server that has the next largest parameter code after the specified value; or
d) a value greater than the largest parameter code implemented by the device server for the specified log page, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

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

The ALLOCATION LENGTH field is defined in 4.2.5.6.

The CONTROL byte is defined in SAM-6.

6.10 MANAGEMENT PROTOCOL IN command

6.10.1 MANAGEMENT PROTOCOL IN command description

The MANAGEMENT PROTOCOL IN command (see table 161) requests the device server to return management protocol information (see 6.10.2) or the results of one or more MANAGEMENT PROTOCOL OUT commands (see 6.11).

Table 161 – MANAGEMENT PROTOCOL IN command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (A3h)							
1	Reserved			SERVICE ACTION (10h)				
2	MANAGEMENT PROTOCOL							
3 ••• 5	MANAGEMENT PROTOCOL SPECIFIC1							
6 ••• 9	(MSB) ALLOCATION LENGTH (LSB)							
10	MANAGEMENT PROTOCOL SPECIFIC2							
11	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 161 for the MANAGEMENT PROTOCOL IN command.

The MANAGEMENT PROTOCOL field (see table 162) specifies which management protocol is being used.

Table 162 – MANAGEMENT PROTOCOL field in MANAGEMENT PROTOCOL IN command

Code	Description	Reference
00h	Management protocol information	6.10.2
01h to 2Fh	Reserved	
30h to 35h	Defined by the SNIA	3.1.120
36h to EFh	Reserved	
F0h to FFh	Vendor Specific	

The contents of the MANAGEMENT PROTOCOL SPECIFIC1 field and MANAGEMENT PROTOCOL SPECIFIC2 field depend on the protocol specified by the MANAGEMENT PROTOCOL field (see table 162).

The ALLOCATION LENGTH field is defined in 4.2.5.6.

The CONTROL byte is defined in SAM-6.

Indications of data overrun or underrun and the mechanism, if any, for processing retries depend on the protocol specified by the MANAGEMENT PROTOCOL field (see table 162).

Any association between a previous MANAGEMENT PROTOCOL OUT command and the data transferred by a MANAGEMENT PROTOCOL IN command depends on the protocol specified by the MANAGEMENT PROTOCOL field (see table 162). If the device server has no data to transfer (e.g., the results for any previous MANAGEMENT PROTOCOL OUT commands are not yet available), then the device server may transfer data indicating it has no other data to transfer.

The format of the data transferred depends on the protocol specified by the MANAGEMENT PROTOCOL field (see table 162).

The device server shall retain data resulting from a MANAGEMENT PROTOCOL OUT command, if any, until one of the following events is processed:

a) transfer of the data via a MANAGEMENT PROTOCOL IN command from the same I_T_L nexus as defined by the protocol specified by the MANAGEMENT PROTOCOL field (see table 162);
b) logical unit reset (see SAM-6); or
c) I_T nexus loss (see SAM-6) associated with the I_T nexus that sent the MANAGEMENT PROTOCOL OUT command.

6.10.2 Management protocol information description

6.10.2.1 Overview

The management protocol information management protocol (i.e., the MANAGEMENT PROTOCOL field set to 00h in a MANAGEMENT PROTOCOL IN command) returns management protocol related information from the logical unit. A MANAGEMENT PROTOCOL IN command in which the MANAGEMENT PROTOCOL field is set to 00h is not associated with any previous MANAGEMENT PROTOCOL OUT command and shall be processed without regard for whether a MANAGEMENT PROTOCOL OUT command has been processed.

If the MANAGEMENT PROTOCOL IN command is supported, the MANAGEMENT PROTOCOL value of 00h shall be supported as defined in this standard.

6.10.2.2 CDB description

If the MANAGEMENT PROTOCOL field is set to 00h in a MANAGEMENT PROTOCOL IN command, the MANAGEMENT PROTOCOL SPECIFIC1 field is reserved and the MANAGEMENT PROTOCOL SPECIFIC2 field (see table 163) contains a single numeric value as defined in 3.6.

Table 163 – MANAGEMENT PROTOCOL SPECIFIC2 field for MANAGEMENT PROTOCOL IN protocol 00h

Code	Description	Support	Reference
00h	Supported management protocol list	Mandatory	6.10.2.3
01h to FFh	Reserved		

All other CDB fields for MANAGEMENT PROTOCOL IN command shall meet the requirements stated in 6.10.1.

Each time a MANAGEMENT PROTOCOL IN command with the MANAGEMENT PROTOCOL field set to 00h is received, the device server shall transfer the data defined 6.10.2.3 starting with byte 0.

6.10.2.3 Supported management protocols list description

If the MANAGEMENT PROTOCOL field is set to 00h and the MANAGEMENT PROTOCOL SPECIFIC2 field is set to 00h in a MANAGEMENT PROTOCOL IN command, then the parameter data shall have the format shown in table 164.

Table 164 – Supported management protocols MANAGEMENT PROTOCOL IN parameter data

Bit Byte	7	6	5	4	3	2	1	0
0 ••• 5				Reserved				
6	(MSB)			SUPPORTED MANAGEMENT PROTOCOL LIST LENGTH				
7				(n-7)				(LSB)
Supported management protocol list								
8				SUPPORTED MANAGEMENT PROTOCOL (00h) [first]				
				⋮				
n				SUPPORTED MANAGEMENT PROTOCOL [last]				

The SUPPORTED MANAGEMENT PROTOCOL LIST LENGTH field indicates the total length, in bytes, of the supported management protocol list that follows.

Each SUPPORTED MANAGEMENT PROTOCOL field in the supported management protocols list shall contain one of the management protocol values supported by the logical unit. The values shall be listed in ascending order starting with 00h.

6.11 MANAGEMENT PROTOCOL OUT command

The MANAGEMENT PROTOCOL OUT command (see table 165) is used to send data to the logical unit. The data sent specifies one or more operations to be performed by the logical unit. The format and function of the operations depends on the contents of the MANAGEMENT PROTOCOL field (see table 165). Depending on the protocol specified by the MANAGEMENT PROTOCOL field, the application client may use the MANAGEMENT PROTOCOL IN command (see 6.10) to retrieve data derived from these operations.

Table 165 – MANAGEMENT PROTOCOL OUT command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (A4h)							
1	Reserved			SERVICE ACTION (10h)				
2	MANAGEMENT PROTOCOL							
3 ••• 5	MANAGEMENT PROTOCOL SPECIFIC1							
6 ••• 9	(MSB) PARAMETER LIST LENGTH (LSB)							
10	MANAGEMENT PROTOCOL SPECIFIC2							
11	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 165 for the MANAGEMENT PROTOCOL OUT command.

The MANAGEMENT PROTOCOL field (see table 166) specifies which management protocol is being used.

Table 166 – MANAGEMENT PROTOCOL field in MANAGEMENT PROTOCOL OUT command

Code	Description
00h to 2Fh	Reserved
30h to 35h	Defined by the SNIA
36h to EFh	Reserved
F0h to FFh	Vendor Specific

The contents of the MANAGEMENT PROTOCOL SPECIFIC1 field and MANAGEMENT PROTOCOL SPECIFIC2 field depend on the protocol specified by the MANAGEMENT PROTOCOL field (see table 166).

The PARAMETER LIST LENGTH field is defined in 4.2.5.5.

The CONTROL byte is defined in SAM-6.

Any association between a MANAGEMENT PROTOCOL OUT command and a subsequent MANAGEMENT PROTOCOL IN command depends on the protocol specified by the MANAGEMENT PROTOCOL field (see table 166). Each management protocol shall define whether:

    a) the device server shall complete the command with GOOD status as soon as it determines the data has been correctly received. An indication that the data has been processed is obtained by sending a MANAGEMENT PROTOCOL IN command and processing the parameter data that is returned; or

    b) the device server shall complete the command with GOOD status only after the data has been successfully processed and an associated MANAGEMENT PROTOCOL IN command is not required.

The format of the data transferred depends on the protocol specified by the MANAGEMENT PROTOCOL field (see table 166).

6.12 MODE SELECT(10) command

The MODE SELECT(10) command (see table 167) requests the device server to set the specified medium or logical unit mode parameters. Application clients should send MODE SENSE(10) prior to each MODE SELECT(10) to determine supported mode pages, page lengths, and other mode parameters. Device servers that implement the MODE SELECT(10) command shall also implement the MODE SENSE(10) command.

Table 167 – MODE SELECT(10) command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (55h)							
1	Reserved			PF	Reserved		RTD	SP
2 ••• 6	Reserved							
7	(MSB)	PARAMETER LIST LENGTH						
8								(LSB)
9	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 167 for the MODE SELECT(10) command.

If an application client sends a MODE SELECT(10) command that changes any mode parameters applying to other I_T nexuses, then the device server shall establish a unit attention condition (see SAM-6) for the SCSI initiator port associated with every I_T nexus except the I_T nexus on which the MODE SELECT(10) command was received, with the additional sense code set to MODE PARAMETERS CHANGED.

A page format (PF) bit set to zero specifies that all parameter data following the block descriptors is vendor specific. A PF bit set to one specifies that all parameters following the header and block descriptors are structured as pages of related mode parameters (see 7.5). If the RTD bit is set to one, the PF bit is ignored.

A revert to defaults (RTD) bit set to zero specifies that the device server shall process the MODE SELECT(10) command based on the contents of the parameter data and other fields in the CDB. A RTD bit set to one specifies that the device server shall revert mode page values as described in this subclause (i.e., 6.12).

If:

    a) the RTD bit is set to one;
    b) the RTD_SUP bit is set to one (see 7.7.7);
    c) the PARAMETER LIST LENGTH field is set to a zero value; and
    d) there is no other reason to return CHECK CONDITION status (e.g., the SP bit is set to zero and the device server does not support a distinction between current mode pages and saved mode pages),

then the device server shall set:

    a) the current values for all mode parameters in all mode pages to their default values, if the SP bit is set to zero; or
    b) the current values and the saved values for all mode parameters in all mode pages to their default values, if the SP bit is set to one.

The device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB, if the RTD bit is set to one and:

    a) the RTD_SUP bit is set to zero; or
    b) the PARAMETER LIST LENGTH field is set to a non-zero value.

A save pages (SP) bit set to zero specifies that the device server shall perform the specified MODE SELECT(10) operation and shall not save any mode pages. If the device server supports only saved mode pages (i.e., the device server does not support a distinction between current mode pages and saved mode pages) and the SP bit is set to zero, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

An SP bit set to one specifies that the device server shall perform the specified MODE SELECT(10) operation and shall save to a nonvolatile vendor specific location all the saveable mode pages including any sent in the parameter list. Mode pages that are saved are specified by the parameter saveable (PS) bit in each mode page (see 7.5). If the PS bit is set to one in the MODE SENSE(10) data, the mode page shall be saveable by issuing a MODE SELECT(10) command with the SP bit set to one. If the logical unit does not implement saved mode pages and the SP bit is set to one, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

The PARAMETER LIST LENGTH field specifies the length in bytes of the mode parameter list that shall be contained in the Data-Out Buffer. A parameter list length of zero specifies that the Data-Out Buffer shall be empty. This condition shall not be considered an error.

If the parameter list length results in the truncation of any mode parameter header, mode parameter block descriptor(s), or mode page, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to PARAMETER LIST LENGTH ERROR.

The CONTROL byte is defined in SAM-6.

The mode parameter list for the MODE SELECT command and MODE SENSE command is defined in 7.5. Parts of each mode parameter list are defined in a device type dependent manner. Definitions for the parts of each mode parameter list that are unique for each device type may be found in the applicable command standards.

The device server shall terminate the MODE SELECT command with CHECK CONDITION status, set the sense key to ILLEGAL REQUEST, set the additional sense code to INVALID FIELD IN PARAMETER LIST, and shall not change any mode parameters in response to any of the following conditions:

 a) if the application client sets any field that is reported as not changeable by the device server to a value other than the current value of the mode parameter;

 b) if the application client sets any field in the mode parameter header or block descriptor(s) to an unsupported value;

 c) if an application client sends a mode page with a page length not equal to the page length returned by the MODE SENSE command for that mode page;

 d) if the application client sends an unsupported value for a mode parameter and rounding is not performed for that mode parameter; or

 e) if the application client sets any reserved field in the mode parameter list to a non-zero value and the device server checks reserved fields.

If the application client sends a value for a mode parameter that is outside the range supported by the device server and rounding is performed for that mode parameter, then the device server handles the condition by either:

 a) rounding the parameter to an acceptable value and terminating the command as described in 5.10; or

 b) terminating the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

A device server may alter any mode parameter in any mode page, even those reported as non-changeable, as a result of changes to other mode parameters.

The device server validates the non-changeable mode parameters against the current values that existed for those mode parameters prior to the MODE SELECT command.

The current values calculated by the device server may affect the application client's operation. The application client may send a MODE SENSE command after each MODE SELECT command, to determine the current values.

6.13 MODE SENSE(10) command

6.13.1 MODE SENSE(10) command introduction

The MODE SENSE(10) command (see table 168) requests the device server to return the specified medium or logical unit parameters. It is a complementary command to the MODE SELECT(10) command. Device servers that implement the MODE SENSE(10) command shall also implement the MODE SELECT(10) command.

Table 168 – MODE SENSE(10) command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (5Ah)							
1	Reserved			LLBAA	DBD	Reserved		
2	PC		PAGE CODE					
3	SUBPAGE CODE							
4 ••• 6	Reserved							
7	(MSB)			ALLOCATION LENGTH				
8								(LSB)
9	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 168 for the MODE SENSE(10) command.

If the Long LBA Accepted (LLBAA) bit is set to one, the device server should return mode parameter header data with the LONGLBA bit equal to one (see 7.5.6). If LLBAA bit is set to zero, the LONGLBA bit shall be set to zero in the mode parameter header data returned by the device server.

A disable block descriptors (DBD) bit set to zero specifies that the device server may return zero or more block descriptors in the MODE SENSE(10) parameter data (see 7.5). A DBD bit set to one specifies that the device server shall not return any block descriptors in the MODE SENSE(10) parameter data.

The page control (PC) field specifies the type of mode parameter values to be returned in the mode pages. The PC field is defined in table 169.

Table 169 – Page control (PC) field

Code	Type of parameter	Reference
00b	Current values	6.13.2
01b	Changeable values	6.13.3
10b	Default values	6.13.4
11b	Saved values	6.13.5

The PC field only affects the mode parameters within the mode pages. The PS bit, SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field should return current values (i.e., as if PC is set to 00b). The mode parameter header and mode parameter block descriptor should return current values.

Some device servers may not distinguish between current mode parameters and saved mode parameters and report identical values in response to a PC field of either 00b or 11b. See also the description of the SP bit in the MODE SELECT command (see 6.12).

The PAGE CODE field and SUBPAGE CODE field (see table 170) specify which mode pages and subpages to return.

Table 170 – Mode page code usage in MODE SENSE(10) commands for all devices

Page Code	Subpage Code	Description
00h	vendor specific	Vendor specific
01h to 3Eh	00h	See specific device types (i.e., page_0 mode page format (see 7.5.8))
	01h to FEh	See specific device types (i.e., sub_page mode page format (see 7.5.8))
	FFh	Return all supported subpages for the specified device specific mode page in the page_0 mode page format for subpage 00h and in the sub_page mode page format for subpages 01h to FEh
3Fh	00h	Return all subpage 00h mode pages in page_0 mode page format
	01h to FEh	Reserved
	FFh	Return all subpages for all mode pages in the page_0 mode page format for subpage 00h and in the sub_page mode page format for subpages 01h to FEh

The ALLOCATION LENGTH field is defined in 4.2.5.6.

The CONTROL byte is defined in SAM-6.

An application client may request any one or all of the supported mode pages from the device server. If the device server receives a MODE SENSE command with a page code value or subpage code value that is not implemented by the logical unit, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

If an application client requests all supported mode pages, the device server shall return the supported pages in ascending page code order beginning with mode page 01h. If mode page 00h is implemented, the device server shall return mode page 00h after all other mode pages have been returned.

If the PC field and the PAGE CODE field are both set to zero, the device server should return a mode parameter header and block descriptor, if applicable.

The mode parameter list for all device types for MODE SELECT commands and MODE SENSE commands is defined in 7.5. Parts of the mode parameter list are specifically defined for each device type. Definitions for the parts of each mode parameter list that are unique for each device type may be found in the applicable command standards.

6.13.2 Current values

A PC field value of 00b requests that the device server return the current values of the mode parameters. The current values returned are:

a) the current values of the mode parameters established by the last successful MODE SELECT command;
b) the saved values of the mode parameters if a MODE SELECT command has not successfully completed since the mode parameters were restored to their saved values (see 6.12); or
c) the default values of the mode parameters if a MODE SELECT command has not successfully completed since the mode parameters were restored to their default values (see 6.12).

6.13.3 Changeable values

A PC field value of 01b requests that the device server return a mask denoting those mode parameters that are changeable. In the mask, the bits in the fields of the mode parameters that are changeable all shall be set to one and the bits in the fields of the mode parameters that are non-changeable (i.e., defined by the logical unit) all shall be set to zero.

If the logical unit does not implement changeable parameters mode pages and the device server receives a MODE SENSE command with 01b in the PC field, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

An attempt to change a non-changeable mode parameter using the MODE SELECT command results in an error condition (see 6.12).

The application client should send a MODE SENSE command with the PC field set to 01b and the PAGE CODE field set to 3Fh to determine which mode pages are supported, which mode parameters within the mode pages are changeable, and the supported length of each mode page prior to issuing any MODE SELECT commands.

6.13.4 Default values

A PC field value of 10b requests that the device server return the default values of the mode parameters. Unsupported parameters shall be set to zero. Default values should be accessible even if the logical unit is not ready.

6.13.5 Saved values

A PC field value of 11b requests that the device server return the saved values of the mode parameters. Mode parameters not supported by the logical unit shall be set to zero. If saved values are not implemented, the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to SAVING PARAMETERS NOT SUPPORTED.

The method of saving parameters is vendor specific. The parameters are preserved such that they are retained while the device is powered down. All saveable mode pages should be considered saved if a MODE SELECT command sent with the SP bit set to one has completed with a GOOD status or after the successful completion of a FORMAT UNIT command.

6.13.6 Initial responses

After a logical unit reset, the device server shall respond in the following manner:

a) if default values are requested, return the default values;

b) if saved values are requested, return valid restored mode parameters, or restore the mode parameters and report them. If the saved values of the mode parameters are not able to be accessed, the device server shall terminate the command with CHECK CONDITION status, with the sense key set to NOT READY. If saved parameters are not implemented, respond as defined in 6.13.5; or

c) if current values are requested and the current values have been received as part of a MODE SELECT command, then the current values shall be returned. If the current values have not been received as part of a MODE SELECT command, the device server shall return:

A) the saved values, if saving is implemented and saved values are available; or

B) the default values.

6.14 PERSISTENT RESERVE IN command

6.14.1 PERSISTENT RESERVE IN command introduction

The PERSISTENT RESERVE IN command (see table 171) requests the device server to return information about persistent reservations and reservation keys (i.e., registrations) that are active within a device server. This command is used in conjunction with the PERSISTENT RESERVE OUT command (see 6.15).

Table 171 – PERSISTENT RESERVE IN command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (5Eh)							
1	Reserved			SERVICE ACTION				
2 ••• 6	Reserved							
7	(MSB)	ALLOCATION LENGTH						
8								(LSB)
9	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 171 for the PERSISTENT RESERVE IN command.

The SERVICE ACTION field is defined in 4.2.5.2. The service action codes for the PERSISTENT RESERVE IN command are defined in table 172.

Table 172 – PERSISTENT RESERVE IN service action codes

Code	Name	Description	Reference
00h	READ KEYS	Returns all registered reservation keys (i.e., registrations) as described in 5.14.6.2	6.14.2
01h	READ RESERVATION	Returns the current persistent reservations as described in 5.14.6.3	6.14.3
02h	REPORT CAPABILITIES	Returns capability information	6.14.4
03h	READ FULL STATUS	Returns complete information about all registrations and the persistent reservations, if any	6.14.5
04h to 1Fh	Reserved	Reserved	

The ALLOCATION LENGTH field is defined in 4.2.5.6. The PERSISTENT RESERVE IN parameter data includes a length field that indicates the number of parameter data bytes that follow in the parameter data. The allocation length should be set to a value large enough to include the length field for the specified service action.

The CONTROL byte is defined in SAM-6.

6.14.2 READ KEYS service action

The READ KEYS service action requests the device server to return a parameter list containing a header and a list of each currently registered I_T nexus' reservation key. If multiple I_T nexuses have registered with the same key, then that key value shall be listed multiple times, once for each such registration.

For more information on READ KEYS see 5.14.6.2.

The format for the parameter data provided in response to a PERSISTENT RESERVE IN command with the READ KEYS service action is shown in table 173.

Table 173 – PERSISTENT RESERVE IN parameter data for READ KEYS

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
•••				PRGENERATION				
3								(LSB)
4	(MSB)							
•••				ADDITIONAL LENGTH (n-7)				
7								(LSB)
	Reservation key list							
8	(MSB)							
•••				Reservation key [first]				
15								(LSB)
	⋮							
n-7	(MSB)							
•••				Reservation key [last]				
n								(LSB)

The Persistent Reservations Generation (PRGENERATION) field shall contain the value of a 32-bit wrapping counter that the device server shall update (e.g., increment) during the processing of any PERSISTENT RESERVE OUT command as described in table 184 (see 6.15.2). The PRgeneration value shall not be updated by a PERSISTENT RESERVE IN command or by a PERSISTENT RESERVE OUT command that is terminated due to an error or reservation conflict. Regardless of the APTPL bit value the PRgeneration value shall be set to zero by a power on.

The ADDITIONAL LENGTH field indicates the number of bytes in the Reservation key list. The contents of the ADDITIONAL LENGTH field are not altered based on the allocation length (see 4.2.5.6).

The reservation key list contains the eight-byte reservation keys for all I_T nexuses that have been registered (see 5.14.7).

6.14.3 READ RESERVATION service action

6.14.3.1 READ RESERVATION service action operation

The READ RESERVATION service action requests the device server to return parameter data that contains a header (see table 174) or the persistent reservation, if any, that is present in the device server (see table 175).

For more information on READ RESERVATION see 5.14.6.3.

If no persistent reservation is held, the format for the parameter data provided in response to a PERSISTENT RESERVE IN command with the READ RESERVATION service action is shown in table 174.

Table 174 – Format of PERSISTENT RESERVE IN parameter data for READ RESERVATION with no reservation held

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
•••				PRGENERATION				
3								(LSB)
4	(MSB)							
•••				ADDITIONAL LENGTH (00000000h)				
7								(LSB)

The PRGENERATION field shall be as defined for the PERSISTENT RESERVE IN command with READ KEYS service action parameter data (see 6.14.2).

The ADDITIONAL LENGTH field shall be set to zero (see table 174), indicating that no persistent reservation is held.

If a persistent reservation is held, the format for the parameter data provided in response to a PERSISTENT RESERVE IN command with the READ RESERVATION service action is shown in table 175.

Table 175 – Format of PERSISTENT RESERVE IN parameter data for READ RESERVATION with a reservation held

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
•••				PRGENERATION				
3								(LSB)
4	(MSB)							
•••				ADDITIONAL LENGTH (00000010h)				
7								(LSB)
8	(MSB)							
•••				RESERVATION KEY				
15								(LSB)
16								
•••				Obsolete				
19								
20				Reserved				
21			SCOPE				TYPE	
22				Obsolete				
23								

The PRGENERATION field shall be as defined for the PERSISTENT RESERVE IN command with READ KEYS service action parameter data.

The ADDITIONAL LENGTH field indicates the number of bytes that follow and shall be set as shown in table 175. The contents of the ADDITIONAL LENGTH field are not altered based on the allocation length (see 4.2.5.6).

The RESERVATION KEY field shall indicate the reservation key under which the persistent reservation is held (see 5.14.10).

The SCOPE field shall be set to LU_SCOPE (see 6.14.3.2).

The TYPE field shall indicate the persistent reservation type (see 6.14.3.3) specified in the PERSISTENT RESERVE OUT command that created the persistent reservation.

The obsolete fields in bytes 16 to 19, byte 22, and byte 23 were defined in SPC-2.

6.14.3.2 Persistent reservations scope

The SCOPE field (see table 176) shall be set to LU_SCOPE, specifying that the persistent reservation applies to the entire logical unit.

Table 176 – Persistent reservation SCOPE field

Code	Name	Description
0h	LU_SCOPE	Persistent reservation applies to the full logical unit
1h to 2h		Obsolete
3h to Fh		Reserved

The LU_SCOPE scope shall be implemented by all device servers that implement PERSISTENT RESERVE OUT.

6.14.3.3 Persistent reservations type

The TYPE field (see table 177) specifies the characteristics of the persistent reservation being established for all logical blocks within the logical unit. Table 66 (see 5.14.1) defines the persistent reservation types under which each command defined in this standard is processed. Each other command standard defines the persistent reservation types under which each command defined in that command standard is processed.

Table 177 – Persistent reservation TYPE field (part 1 of 2)

Code	Name	Description
0h		Obsolete
1h	Write Exclusive	**Access Restrictions**: Some commands (e.g., media-access write commands) are only allowed for the persistent reservation holder (see 5.14.10). **Persistent Reservation Holder:** There is only one persistent reservation holder.
2h		Obsolete
3h	Exclusive Access	**Access Restrictions**: Some commands (e.g., media-access commands) are only allowed for the persistent reservation holder (see 5.14.10). **Persistent Reservation Holder:** There is only one persistent reservation holder.
4h		Obsolete
5h	Write Exclusive – Registrants Only	**Access Restrictions**: Some commands (e.g., media-access write commands) are only allowed for registered I_T nexuses. **Persistent Reservation Holder:** There is only one persistent reservation holder (see 5.14.10).
6h	Exclusive Access – Registrants Only	**Access Restrictions**: Some commands (e.g., media-access commands) are only allowed for registered I_T nexuses. **Persistent Reservation Holder:** There is only one persistent reservation holder (see 5.14.10).
7h	Write Exclusive – All Registrants	**Access Restrictions**: Some commands (e.g., media-access write commands) are only allowed for registered I_T nexuses. **Persistent Reservation Holder:** Each registered I_T nexus is a persistent reservation holder (see 5.14.10).

Table 177 – Persistent reservation TYPE field (part 2 of 2)

Code	Name	Description
8h	Exclusive Access – All Registrants	**Access Restrictions**: Some commands (e.g., media-access commands) are only allowed for registered I_T nexuses. **Persistent Reservation Holder:** Each registered I_T nexus is a persistent reservation holder (see 5.14.10).
9h to Fh	Reserved	

6.14.4 REPORT CAPABILITIES service action

The REPORT CAPABILITIES service action requests the device server to return information on persistent reservation features.

The format for the parameter data provided in response to a PERSISTENT RESERVE IN command with the REPORT CAPABILITIES service action is shown in table 178.

Table 178 – PERSISTENT RESERVE IN parameter data for REPORT CAPABILITIES

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			LENGTH (0008h)				
1								(LSB)
2	RLR_C	Reserved		CRH	SIP_C	ATP_C	Reserved	PTPL_C
3	TMV	ALLOW COMMANDS		Reserved				PTPL_A
4	PERSISTENT RESERVATION TYPE MASK							
5								
6	Reserved							
7								

The LENGTH field indicates the length in bytes of the parameter data and shall be set as shown in table 178 in the parameter data for a PERSISTENT RESERVE IN command with the REPORT CAPABILITIES service action. The contents of the LENGTH field are not altered based on the allocation length (see 4.2.5.6).

A replace lost reservation capable (RLR_C) bit set to one indicates that the device server supports the REPLACE LOST RESERVATION service action in the PERSISTENT RESERVE OUT command. An RLR_C bit set to zero indicates that the device server does not support the REPLACE LOST RESERVATION service action in the PERSISTENT RESERVE OUT command. If the RLR_C bit is set to zero then the device server shall not terminate any commands with CHECK CONDITION status with the sense key set to DATA PROTECT and the additional sense code set to PERSISTENT RESERVATION INFORMATION LOST (see 5.14.5.4).

A compatible reservation handling (CRH) bit set to one indicates that the device server supports the exceptions to the SPC-2 RESERVE commands and RELEASE commands described in 5.14.3. A CRH bit set to zero indicates that RESERVE commands and RELEASE commands are processed as defined in SPC-2.

A specify initiator ports capable (SIP_C) bit set to one indicates that the device server supports the SPEC_I_PT bit in the PERSISTENT RESERVE OUT command parameter data (see 6.15.3). An SIP_C bit set to zero

indicates that the device server does not support the SPEC_I_PT bit in the PERSISTENT RESERVE OUT command parameter data.

An all target ports capable (ATP_C) bit set to one indicates that the device server supports the ALL_TG_PT bit in the PERSISTENT RESERVE OUT command parameter data. An ATP_C bit set to zero indicates that the device server does not support the ALL_TG_PT bit in the PERSISTENT RESERVE OUT command parameter data.

A persist through power loss capable (PTPL_C) bit set to one indicates that the device server supports the persist through power loss capability (see 5.14.5) for persistent reservations and the APTPL bit in the PERSISTENT RESERVE OUT command parameter data. An PTPL_C bit set to zero indicates that the device server does not support the persist through power loss capability.

A type mask valid (TMV) bit set to one indicates that the PERSISTENT RESERVATION TYPE MASK field contains a bit map indicating which persistent reservation types are supported by the device server. A TMV bit set to zero indicates that the PERSISTENT RESERVATION TYPE MASK field shall be ignored.

The ALLOW COMMANDS field (see table 179) indicates whether certain commands are allowed through certain types of persistent reservations.

Table 179 – ALLOW COMMANDS field (part 1 of 2)

Code	Description
000b	No information is provided about whether certain commands are allowed through certain types of persistent reservations.
001b	The device server allows the TEST UNIT READY command (see table 66 in 5.14.1) through Write Exclusive type reservations and Exclusive Access type reservations. The device server does not provide information about whether the following commands are allowed through Write Exclusive type reservations: a) MODE SENSE; b) READ ATTRIBUTE; c) READ BUFFER(10); d) RECEIVE DIAGNOSTIC RESULTS; e) REPORT SUPPORTED OPERATION CODES; f) REPORT SUPPORTED TASK MANAGEMENT FUNCTIONS; and g) READ DEFECT DATA (see SBC-5).
010b	The device server allows the TEST UNIT READY command through Write Exclusive type reservations and Exclusive Access type reservations. The device server does not allow the following commands through Write Exclusive type reservations: a) MODE SENSE; b) READ ATTRIBUTE; c) READ BUFFER(10); d) RECEIVE DIAGNOSTIC RESULTS; e) REPORT SUPPORTED OPERATION CODES; f) REPORT SUPPORTED TASK MANAGEMENT FUNCTIONS; and g) READ DEFECT DATA (see SBC-5).

Table 179 – ALLOW COMMANDS field (part 2 of 2)

Code	Description
011b	The device server allows: a) the TEST UNIT READY command through Write Exclusive type reservations and Exclusive Access type reservations; and b) the following commands through Write Exclusive type reservations: A) MODE SENSE; B) READ ATTRIBUTE; C) READ BUFFER(10); D) RECEIVE DIAGNOSTIC RESULTS; E) REPORT SUPPORTED OPERATION CODES; F) REPORT SUPPORTED TASK MANAGEMENT FUNCTIONS; and G) READ DEFECT DATA (see SBC-5).
100b	The device server allows: a) the following commands through Write Exclusive and Exclusive Access persistent reservations: A) TEST UNIT READY; and b) the following commands through Write Exclusive persistent reservations: A) MODE SENSE; B) READ ATTRIBUTE; C) READ BUFFER(10); D) RECEIVE DIAGNOSTIC RESULTS; E) REPORT SUPPORTED OPERATION CODES; F) REPORT SUPPORTED TASK MANAGEMENT FUNCTIONS; and G) READ DEFECT DATA (see SBC-5).
101b	The device server allows: a) the following commands through Write Exclusive and Exclusive Access persistent reservations: A) TEST UNIT READY; B) REPORT SUPPORTED OPERATION CODES; and C) REPORT SUPPORTED TASK MANAGEMENT FUNCTIONS; and b) the following commands through Write Exclusive persistent reservations: A) MODE SENSE; B) READ ATTRIBUTE; C) READ BUFFER(10); D) RECEIVE DIAGNOSTIC RESULTS; and E) READ DEFECT DATA (see SBC-5).
all others	Reserved

A Persist Through Power Loss Activated (PTPL_A) bit set to one indicates that the persist through power loss capability is activated (see 5.14.5). A PTPL_A bit set to zero indicates that the persist through power loss capability is not activated.

The PERSISTENT RESERVATION TYPE MASK field (see table 180) contains a bit map that indicates the persistent reservation types that are supported by the device server.

Table 180 – Persistent Reservation Type Mask

Bit Byte	7	6	5	4	3	2	1	0
4	WR_EX_AR	EX_AC_RO	WR_EX_RO	Reserved	EX_AC	Reserved	WR_EX	Reserved
5	Reserved							EX_AC_AR

A Write Exclusive – All Registrants (WR_EX_AR) bit set to one indicates that the device server supports the Write Exclusive – All Registrants persistent reservation type. An WR_EX_AR bit set to zero indicates that the device server does not support the Write Exclusive – All Registrants persistent reservation type.

An Exclusive Access – Registrants Only (EX_AC_RO) bit set to one indicates that the device server supports the Exclusive Access – Registrants Only persistent reservation type. An EX_AC_RO bit set to zero indicates that the device server does not support the Exclusive Access – Registrants Only persistent reservation type.

A Write Exclusive – Registrants Only (WR_EX_RO) bit set to one indicates that the device server supports the Write Exclusive – Registrants Only persistent reservation type. An WR_EX_RO bit set to zero indicates that the device server does not support the Write Exclusive – Registrants Only persistent reservation type.

An Exclusive Access (EX_AC) bit set to one indicates that the device server supports the Exclusive Access persistent reservation type. An EX_AC bit set to zero indicates that the device server does not support the Exclusive Access persistent reservation type.

A Write Exclusive (WR_EX) bit set to one indicates that the device server supports the Write Exclusive persistent reservation type. An WR_EX bit set to zero indicates that the device server does not support the Write Exclusive persistent reservation type.

An Exclusive Access – All Registrants (EX_AC_AR) bit set to one indicates that the device server supports the Exclusive Access – All Registrants persistent reservation type. An EX_AC_AR bit set to zero indicates that the device server does not support the Exclusive Access – All Registrants persistent reservation type.

6.14.5 READ FULL STATUS service action

The READ FULL STATUS service action requests the device server to return a parameter list describing the registration status and persistent reservation status of each currently registered I_T nexus for the logical unit.

For more information on READ FULL STATUS see 5.14.6.4.

The format for the parameter data provided in response to a PERSISTENT RESERVE IN command with the READ FULL STATUS service action is shown in table 181.

Table 181 – PERSISTENT RESERVE IN parameter data for READ FULL STATUS

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
•••				PRGENERATION				
3								(LSB)
4	(MSB)							
•••				ADDITIONAL LENGTH (n-7)				
7								(LSB)
				Full status descriptor list				
8								
•••				Full status descriptor (see table 182) [first]				
				$\vdots$				
•••				Full status descriptor (see table 182) [last]				
n								

The PRGENERATION field shall be as defined for the PERSISTENT RESERVE IN command with READ KEYS service action parameter data (see 6.14.2).

The ADDITIONAL LENGTH field indicates the number of bytes that follow in the full status descriptors. The contents of the ADDITIONAL LENGTH field are not altered based on the allocation length (see 4.2.5.6).

The format of the full status descriptors is shown in table 182. Each full status descriptor describes one or more registered I_T nexuses. The device server shall return persistent reservations status information for every registered I_T nexus.

Table 182 – PERSISTENT RESERVE IN full status descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
•••			RESERVATION KEY					
7								(LSB)
8								
•••			Reserved					
11								
12				Reserved			ALL_TG_PT	R_HOLDER
13		SCOPE				TYPE		
14								
•••			Reserved					
17								
18	(MSB)							
19			RELATIVE TARGET PORT IDENTIFIER					(LSB)
20	(MSB)							
•••			ADDITIONAL DESCRIPTOR LENGTH (n-23)					
23								(LSB)
24								
•••			TransportID					
n								

The RESERVATION KEY field contains the reservation key.

A Reservation Holder (R_HOLDER) bit set to one indicates that all I_T nexuses described by this full status descriptor are registered and are persistent reservation holders (see 5.14.10). An R_HOLDER bit set to zero indicates that all I_T nexuses described by this full status descriptor are registered but are not persistent reservation holders.

An All Target Ports (ALL_TG_PT) bit set to zero indicates that this full status descriptor represents a single I_T nexus. An ALL_TG_PT bit set to one indicates that:

a) this full status descriptor represents all the I_T nexuses that are associated with both:
    A) the SCSI initiator port specified by the TransportID; and
    B) every target port in the SCSI target device;
b) all the I_T nexuses are registered with the same reservation key; and
c) all the I_T nexuses are either reservation holders or not reservation holders as indicated by the R_HOLDER bit.

The device server is not required to return a full status descriptor with the ALL_TG_PT bit set to one. Instead, it may return separate full status descriptors for each I_T nexus.

If the R_HOLDER bit is set to one (i.e., if the I_T nexus described by this full status descriptor is a reservation holder), then the SCOPE field and the TYPE field are as defined in the READ RESERVATION service action parameter data (see 6.14.3). If the R_HOLDER bit is set to zero, the contents of the SCOPE field and the TYPE field are outside the scope of this standard.

If the ALL_TG_PT bit is set to zero, the RELATIVE TARGET PORT IDENTIFIER field (see 4.3.4) is set to the relative port identifier of the target port that is part of the I_T nexus described by this full status descriptor. If the ALL_TG_PT bit is set to one, the contents of the RELATIVE TARGET PORT IDENTIFIER field are outside the scope of this standard.

The ADDITIONAL DESCRIPTOR LENGTH field indicates the number of bytes that follow in the descriptor (i.e., the size of the TransportID).

The TransportID specifies a TransportID (see 7.6.4) identifying the SCSI initiator port that is part of the I_T nexus or I_T nexuses described by this full status descriptor.

6.15 PERSISTENT RESERVE OUT command

6.15.1 PERSISTENT RESERVE OUT command introduction

The PERSISTENT RESERVE OUT command (see table 183) requests the device server to perform a service action that adds, removes, or manages a persistent reservation for the logical unit for the exclusive or shared use of one or more I_T nexuses.

I_T nexuses performing PERSISTENT RESERVE OUT service actions are identified by a registered reservation key provided by the application client. An application client may use the PERSISTENT RESERVE IN command to obtain the reservation key, if any, for the I_T nexus holding a persistent reservation and may use the PERSISTENT RESERVE OUT command to preempt that persistent reservation.

Table 183 – PERSISTENT RESERVE OUT command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (5Fh)							
1	Reserved			SERVICE ACTION				
2	SCOPE				TYPE			
3	Reserved							
4								
5	(MSB)							
•••			PARAMETER LIST LENGTH					
8								(LSB)
9	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 183 for the PERSISTENT RESERVE OUT command.

The SERVICE ACTION field is defined in 4.2.5.2 and 6.15.2.

If a PERSISTENT RESERVE OUT command is attempted, but there are insufficient device server resources to complete the operation, the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INSUFFICIENT REGISTRATION RESOURCES.

The PERSISTENT RESERVE OUT command contains fields that specify a persistent reservation service action, the intended scope of the persistent reservation, and the restrictions caused by the persistent reservation. The SCOPE field and TYPE field are defined in 6.14.3.2 and 6.14.3.3. If a SCOPE field specifies a scope that is not implemented, the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

Fields contained in the PERSISTENT RESERVE OUT parameter list specify the information required to perform a particular persistent reservation service action.

The PARAMETER LIST LENGTH field specifies the number of bytes of parameter data for the PERSISTENT RESERVE OUT command.

The parameter list shall be 24 bytes in length and the PARAMETER LIST LENGTH field shall contain 24 (i.e., 18h), if the following conditions are true:

    a)   the SPEC_I_PT bit (see 6.15.3) is set to zero; and
    b)   the service action is not REGISTER AND MOVE.

If the SPEC_I_PT bit is set to zero, the service action is not REGISTER AND MOVE, and the parameter list length is not 24, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to PARAMETER LIST LENGTH ERROR.

If the parameter list length is larger than the device server is able to process, the device server should terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to PARAMETER LIST LENGTH ERROR.

The CONTROL byte is defined in SAM-6.

6.15.2 PERSISTENT RESERVE OUT service actions and parameter list formats

As part of processing the PERSISTENT RESERVE OUT service actions, the device server shall increment the PRgeneration value as defined in table 184.

The PERSISTENT RESERVE OUT command service actions are defined in table 184.

Table 184 – PERSISTENT RESERVE OUT service action codes

Code	Name	Description	PRGENERATION field incremented	Parameter list format
00h	REGISTER	Register a reservation key with the device server (see 5.14.7) or unregister a reservation key (see 5.14.11.2.3)	Yes	Basic (see 6.15.3)
01h	RESERVE	Creates a persistent reservation having a specified SCOPE and TYPE (see 5.14.9). The SCOPE and TYPE of a persistent reservation are defined in 6.14.3.2 and 6.14.3.3	No	Basic (see 6.15.3)
02h	RELEASE	Releases the selected persistent reservation (see 5.14.11.2.2)	No	Basic (see 6.15.3)
03h	CLEAR	Clears all reservation keys (i.e., registrations) and all persistent reservations (see 5.14.11.2.7)	Yes	Basic (see 6.15.3)
04h	PREEMPT	Preempts persistent reservations and/or removes registrations (see 5.14.11.2.4)	Yes	Basic (see 6.15.3)
05h	PREEMPT AND ABORT	Preempts persistent reservations and/or removes registrations and aborts all commands for all preempted I_T nexuses (see 5.14.11.2.4 and 5.14.11.2.6)	Yes	Basic (see 6.15.3)
06h	REGISTER AND IGNORE EXISTING KEY	Register a reservation key with the device server (see 5.14.7) or unregister a reservation key (see 5.14.11.2.3)	Yes	Basic (see 6.15.3)
07h	REGISTER AND MOVE	Register a reservation key for another I_T nexus with the device server and move an existing persistent reservation to that I_T nexus (see 5.14.8)	Yes	Register and move (see 6.15.4)
08h	REPLACE LOST RESERVATION	Replace lost persistent reservation information (see 5.14.11.3)	No [a]	Basic (see 6.15.3)
09h to 1Fh	Reserved			
[a] The processing of a REPLACE LOST RESERVATION service action does not increment the PRGENERATION field. Instead, the PRGENERATION field is set to zero (see 5.14.11.3).				

Table 185 summarizes which fields are set by the application client and interpreted by the device server for each service action and scope value.

Table 185 – PERSISTENT RESERVE OUT service actions and valid parameters (part 1 of 2)

		Parameters (part 1 of 2)				
Service action	**Allowed** SCOPE	**Parameter list format**	TYPE	RESERVATION KEY	SERVICE ACTION RESERVATION KEY	APTPL
REGISTER	ignored	Basic (see 6.15.3)	ignored	valid	valid	valid
REGISTER AND IGNORE EXISTING KEY	ignored	Basic (see 6.15.3)	ignored	ignored	valid	valid
RESERVE	LU_SCOPE	Basic (see 6.15.3)	valid	valid	ignored	ignored
RELEASE	LU_SCOPE	Basic (see 6.15.3)	valid	valid	ignored	ignored
CLEAR	ignored	Basic (see 6.15.3)	ignored	valid	ignored	ignored
PREEMPT	LU_SCOPE	Basic (see 6.15.3)	valid	valid	valid	ignored
PREEMPT AND ABORT	LU_SCOPE	Basic (see 6.15.3)	valid	valid	valid	ignored
REGISTER AND MOVE	ignored	Register and move (see 6.15.4)	ignored	valid	valid	valid
REPLACE LOST RESERVATION	LU_SCOPE	Basic (see 6.15.3)	valid	valid	valid	ignored

Table 185 — PERSISTENT RESERVE OUT service actions and valid parameters (part 2 of 2)

Service action	Allowed SCOPE	Parameter list format	Parameters (part 2 of 2)		
			ALL_TG_PT	SPEC_I_PT	UNREG
REGISTER	ignored	Basic (see 6.15.3)	valid	valid	n/a
REGISTER AND IGNORE EXISTING KEY	ignored	Basic (see 6.15.3)	valid	invalid	n/a
RESERVE	LU_SCOPE	Basic (see 6.15.3)	ignored	invalid	n/a
RELEASE	LU_SCOPE	Basic (see 6.15.3)	ignored	invalid	n/a
CLEAR	ignored	Basic (see 6.15.3)	ignored	invalid	n/a
PREEMPT	LU_SCOPE	Basic (see 6.15.3)	ignored	invalid	n/a
PREEMPT AND ABORT	LU_SCOPE	Basic (see 6.15.3)	ignored	invalid	n/a
REGISTER AND MOVE	LU_SCOPE	Register and move (see 6.15.4)	n/a	n/a	valid
REPLACE LOST RESERVATION	LU_SCOPE	Basic (see 6.15.3)	invalid	invalid	n/a

6.15.3 Basic PERSISTENT RESERVE OUT parameter list

The parameter list format shown in table 186 shall be used by the PERSISTENT RESERVE OUT command with all service actions except the REGISTER AND MOVE service action. All fields shall be sent, even if the field is not required for the specified service action and scope values.

Table 186 – PERSISTENT RESERVE OUT parameter list

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
•••			RESERVATION KEY					
7								(LSB)
8	(MSB)							
•••			SERVICE ACTION RESERVATION KEY					
15								(LSB)
16								
•••			Obsolete					
19								
20	Reserved				SPEC_I_PT	ALL_TG_PT	Reserved	APTPL
21	Reserved							
22			Obsolete					
23								
24								
•••			Additional parameter data					
n								

The obsolete fields in bytes 16 to 19, byte 22, and byte 23 were defined in SPC-2.

The RESERVATION KEY field contains an eight-byte value provided by the application client to the device server to identify the I_T nexus that is the source of the PERSISTENT RESERVE OUT command. The device server shall verify that the contents of the RESERVATION KEY field in a PERSISTENT RESERVE OUT command parameter data matches the registered reservation key for the I_T nexus from which the command was received, except for:

a) the REGISTER AND IGNORE EXISTING KEY service action where the RESERVATION KEY field shall be ignored;
b) the REGISTER service action for an unregistered I_T nexus where the RESERVATION KEY field shall contain zero; and
c) the REPLACE LOST RESERVATION service action where the RESERVATION KEY field shall contain zero.

Except as noted in this subclause, if a PERSISTENT RESERVE OUT command specifies a RESERVATION KEY field other than the reservation key registered for the I_T nexus, then the device server shall complete the command with RESERVATION CONFLICT status. Except as noted in this subclause, the reservation key of the I_T nexus shall be verified to be correct regardless of the SERVICE ACTION and SCOPE field values.

The SERVICE ACTION RESERVATION KEY field contains information associated with the following service actions:

  a) REGISTER;
  b) REGISTER AND IGNORE EXISTING KEY;
  c) PREEMPT;
  d) PREEMPT AND ABORT; and
  e) REPLACE LOST RESERVATION.

The SERVICE ACTION RESERVATION KEY field is ignored for the following service actions:

  a) RESERVE;
  b) RELEASE; and
  c) CLEAR.

For the REGISTER service action and REGISTER AND IGNORE EXISTING KEY service action, the SERVICE ACTION RESERVATION KEY field contains:

  a) the new reservation key to be registered in place of the registered reservation key; or
  b) zero to unregister the registered reservation key.

For the PREEMPT service action and PREEMPT AND ABORT service action, the SERVICE ACTION RESERVATION KEY field contains the reservation key of:

  a) the registrations to be removed; and
  b) if the SERVICE ACTION RESERVATION KEY field identifies a persistent reservation holder (see 5.14.10), then the persistent reservations to be preempted.

For the REPLACE LOST RESERVATION service action, the SERVICE ACTION RESERVATION KEY field contains the new reservation key to be registered.

If the Specify Initiator Ports (SPEC_I_PT) bit is set to zero, the device server shall apply the registration only to the I_T nexus that sent the PERSISTENT RESERVE OUT command. If the SPEC_I_PT bit is set to one for any service action except the REGISTER service action, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST. If the SPEC_I_PT bit is set to one for the REGISTER service action, then the additional parameter data (see table 187) shall include a list of transport IDs and the device server shall also apply the registration to the I_T nexus for each SCSI initiator port specified by a TransportID. If a registration fails for any SCSI initiator port (e.g., if the logical unit does not have enough resources available to hold the registration information), then no registrations shall be made and the command shall be terminated with CHECK CONDITION status.

Table 187 – PERSISTENT RESERVE OUT specify initiator ports additional parameter data

Bit Byte	7	6	5	4	3	2	1	0
24 ••• 27	TRANSPORTID PARAMETER DATA LENGTH (n-27)
	TransportID list
28 •••	TransportID [first]
	⋮
••• n	TransportID [last]

The TRANSPORTID PARAMETER DATA LENGTH field specifies the number of bytes of TransportIDs that follow.

If:

a) the value in the PARAMETER LIST LENGTH field in the CDB does not include all of the additional parameter list bytes specified by the TRANSPORTID PARAMETER DATA LENGTH field; or
b) the value in the TRANSPORTID PARAMETER DATA LENGTH field results in the truncation of a TransportID,

then the device server:

a) shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST; and
b) should set the additional sense code to PARAMETER LIST LENGTH ERROR.

The format of a TransportID is defined in 7.6.4.

The All Target Ports (ALL_TG_PT) bit is valid only for the REGISTER service action and the REGISTER AND IGNORE EXISTING KEY service action, and shall be ignored for all other service actions. If the device server receives a REGISTER service action or a REGISTER AND IGNORE EXISTING KEY service action with the ALL_TG_PT bit set to one, then the device server shall create the specified registration on all target ports in the SCSI target device known to the device server (i.e., as if the same registration request had been received individually through each target port). If the device server receives a REGISTER service action or a REGISTER AND IGNORE EXISTING KEY service action with the ALL_TG_PT bit set to zero, then the device server shall apply the registration only to the target port through which the PERSISTENT RESERVE OUT command was received. If a device server that does not support an ALL_TG_PT bit set to one receives that value in a REGISTER service action or a REGISTER AND IGNORE EXISTING KEY service action, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

The Activate Persist Through Power Loss (APTPL) bit is:

a) valid only for the REGISTER service action and REGISTER AND IGNORE EXISTING KEY service action; and
b) shall be ignored for all other service actions.

If a device server that does not support an APTPL bit set to one detects that value in a REGISTER service action or a REGISTER AND IGNORE EXISTING KEY service action, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

If the last valid APTPL bit value processed by the device server is zero, the loss of power in the SCSI target device shall cause the device server to release the persistent reservation for the logical unit and remove all registered reservation keys (see 5.14.7). If the last valid APTPL bit value processed by the device server is one, the logical unit shall retain any persistent reservation(s) that may be present and all reservation keys (i.e., registrations) for all I_T nexuses even if power is lost (see 5.14.5).

6.15.4 Parameter list for the PERSISTENT RESERVE OUT command with REGISTER AND MOVE service action

The parameter list format shown in table 188 shall be used by the PERSISTENT RESERVE OUT command with REGISTER AND MOVE service action.

Table 188 – PERSISTENT RESERVE OUT command with REGISTER AND MOVE service action parameter list

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
•••				RESERVATION KEY				
7								(LSB)
8	(MSB)							
•••				SERVICE ACTION RESERVATION KEY				
15								(LSB)
16				Reserved				
17				Reserved			UNREG	APTPL
18	(MSB)							
19				RELATIVE TARGET PORT IDENTIFIER				(LSB)
20	(MSB)							
•••				TRANSPORTID LENGTH (n-23)				
23								(LSB)
24								
•••				TransportID				
n								

The RESERVATION KEY field contains an eight-byte value provided by the application client to the device server to identify the I_T nexus that is the source of the PERSISTENT RESERVE OUT command. The device server shall verify that the contents of the RESERVATION KEY field in a PERSISTENT RESERVE OUT command

parameter data matches the registered reservation key for the I_T nexus from which the command was received. If a PERSISTENT RESERVE OUT command specifies a RESERVATION KEY field other than the reservation key registered for the I_T nexus, then the device server shall complete the command with RESERVATION CONFLICT status.

The SERVICE ACTION RESERVATION KEY field contains the reservation key to be registered to the specified I_T nexus.

If a device server that does not support an Activate Persist Through Power Loss (APTPL) bit set to one detects that value in a REGISTER AND MOVE service action, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

If the last valid APTPL bit value processed by the device server is zero, the loss of power in the SCSI target device shall cause the device server to release the persistent reservation for the logical unit and remove all registered reservation keys (see 5.14.6). If the last valid APTPL bit value processed by the device server is one, the logical unit shall retain any persistent reservation(s) that may be present and all reservation keys (i.e., registrations) for all I_T nexuses even if power is lost (see 5.14.5).

An unregister (UNREG) bit set to zero specifies that the device server shall not unregister the I_T nexus on which the PERSISTENT RESERVE OUT command REGISTER AND MOVE service action was received. An UNREG bit set to one specifies that the device server shall unregister the I_T nexus on which the PERSISTENT RESERVE OUT command REGISTER AND MOVE service action was received.

The RELATIVE TARGET PORT IDENTIFIER field (see 4.3.4) specifies the relative port identifier of the target port in the I_T nexus to which the persistent reservation is to be moved.

The TRANSPORTID LENGTH field specifies the number of bytes of the TransportID that follow, shall be a minimum of 24 bytes, and shall be a multiple of four.

The TransportID specifies the SCSI initiator port in the I_T nexus to which the persistent reservation is to be moved. The format of the TransportID is defined in 7.6.4.

If:

    a) the value in the PARAMETER LIST LENGTH field in the CDB does not include all of the parameter list bytes specified by the TRANSPORTID LENGTH field; or
    b) the value in the TRANSPORTID LENGTH field results in the truncation of a TransportID,

then the device server:

    a) shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST; and
    b) should set the additional sense code to PARAMETER LIST LENGTH ERROR.

6.16 PREPARE BINDING REPORT command

The PREPARE BINDING REPORT command (see table 189) requests that the device server prepare a binding report as described in 5.8.12. Device servers that implement the PREPARE BINDING REPORT command shall also implement the RECEIVE BINDING REPORT command (see 6.21).

Table 189 – PREPARE BINDING REPORT command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (9Fh)							
1	Reserved			SERVICE ACTION (0Ch)				
2 ••• 11	Reserved							
12	(MSB)		PARAMETER LIST LENGTH					
13								(LSB)
14	Reserved							
15	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 189 for the PREPARE BINDING REPORT command.

The SERVICE ACTION field is defined in 4.2.5.2 and shall be set as shown in table 189 for the PREPARE BINDING REPORT command.

The PARAMETER LIST LENGTH field is defined in 4.2.5.5.

The CONTROL byte is defined in SAM-6.

The format of the PREPARE BINDING REPORT command parameter list is shown in table 190.

Table 190 – PREPARE BINDING REPORT command parameter list

Bit Byte	7	6	5	4	3	2	1	0
0				BINDING REPORT TYPE				
1 ••• 3				Reserved				
4 ••• 7	(MSB)			BINDING LIST IDENTIFIER				(LSB)
8 9	(MSB)			PREPARE BINDING REPORT PARAMETER LIST LENGTH (n-9)				(LSB)
10 ••• 15				Reserved				
16 ••• 31	(MSB)			HOST BIND IDENTIFIER				(LSB)
32 ••• k				SUBSIDIARY LU DESIGNATOR				
k+1 ••• k+8				Reserved				
k+9 ••• n				PAD (if any)				

The BINDING REPORT TYPE field (see table 191) specifies the bindings that shall be described in the binding report (see 5.8.12.1). If the device server does not support the specified binding report type, the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

Table 191 – BINDING REPORT TYPE field

Code	Description
00h	Reserved
01h	The binding report contains at most one affiliated binding for the application client specified by the HOST BIND IDENTIFIER field and the subsidiary logical unit specified by the SUBSIDIARY LU DESIGNATOR field. If there are multiple affiliated bindings, the device server selects one binding.
10h	The binding report contains all bindings for the application client specified by the HOST BIND IDENTIFIER field and the subsidiary logical unit specified by the SUBSIDIARY LU DESIGNATOR field.
all others	Reserved

The BINDING LIST IDENTIFIER field is defined in 5.8.12.1.

The PREPARE BINDING REPORT PARAMETER LIST LENGTH field specifies the number of bytes that follow in the parameter list. If the PARAMETER LIST LENGTH field results in truncation of the parameter list as specified by the PREPARE BINDING REPORT PARAMETER LIST LENGTH field, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to PARAMETER LIST LENGTH ERROR.

The HOST BIND IDENTIFIER field specifies a host bind identifier (see 5.8.2) that identifies an application client. If the HOST BIND IDENTIFIER field is set to FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFFh, the device server shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

The SUBSIDIARY LU DESIGNATOR field contains a designation descriptor (see 7.7.6.1) that specifies the subsidiary logical unit for the PREPARE BINDING REPORT command. The device server shall terminate the PREPARE BINDING REPORT command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST unless that designation descriptor has:

   a) the ASSOCIATION field set to 00b (i.e., logical unit);
   b) the SUBSIDIARY LU DESIGNATOR field set to a value that specifies an existing logical unit; and
   c) the DESIGNATOR TYPE field set to:
      A) 2h (i.e., EUI);
      B) 3h (i.e., NAA);
      C) 8h (i.e., SCSI name string); or
      D) Ah (i.e., UUID).

The PAD field shall contain zero to seven bytes set to zero such that the total length of the parameter list is a multiple of eight.

6.17 READ ATTRIBUTE command

6.17.1 READ ATTRIBUTE command introduction

The READ ATTRIBUTE command (see table 192) requests the device server to read attribute information from medium auxiliary memory.

Table 192 – READ ATTRIBUTE command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (8Ch)							
1	Reserved			SERVICE ACTION				
2 ••• 4	Restricted (see SMC-3)							
5	LOGICAL VOLUME NUMBER							
6	Reserved							
7	PARTITION NUMBER							
8	(MSB)	FIRST ATTRIBUTE IDENTIFIER						
9								(LSB)
10	(MSB)	ALLOCATION LENGTH						
••• 13								(LSB)
14	Reserved							CACHE
15	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 192 for the READ ATTRIBUTE command.

The SERVICE ACTION field is defined in 4.2.5.2. The service action codes defined for the READ ATTRIBUTE command are shown in table 193.

Table 193 – READ ATTRIBUTE service action codes

Code	Name	Description	Reference
00h	ATTRIBUTE VALUES	Return attribute values.	6.17.2
01h	ATTRIBUTE LIST	Return a list of available attribute identifiers, identifiers that are in the read only state or in the read/write state (see 5.9).	6.17.3
02h	LOGICAL VOLUME LIST	Return a list of known logical volume numbers.	6.17.4
03h	PARTITION LIST	Return a list of known partition numbers.	6.17.5
04h	Obsolete		
05h	SUPPORTED ATTRIBUTES	Return a list of supported attribute identifiers, identifiers that are in the read only state, in the read/write state, or in the nonexistent state (see 5.9).	6.17.6
06h to 1Fh	Reserved		

The LOGICAL VOLUME NUMBER field specifies a logical volume (e.g., the medium auxiliary memory storage for one side of a double sided medium) within the medium auxiliary memory. The number of logical volumes of the medium auxiliary memory shall equal the number of logical volumes of the attached medium. If the medium only has a single logical volume, then its logical volume number shall be zero.

The PARTITION NUMBER field specifies a partition (see SSC-5) within a logical volume. The number of partitions of the medium auxiliary memory shall equal the number of partitions of the attached medium. If the medium only has a single partition, then its partition number shall be zero.

If the combination of logical volume number and partition number is not valid, the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

The FIRST ATTRIBUTE IDENTIFIER field specifies the attribute identifier of the first attribute to be returned. If the specified attribute is in the unsupported state or nonexistent state (see 5.9), the device server shall terminate the READ ATTRIBUTE command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

The ALLOCATION LENGTH field is defined in 4.2.5.6.

Caching of either a subset or the complete set of attribute information from the most recently mounted medium may be supported as cached attribute information. If cached attribute information is supported the device server shall:

   a) support the CACHE bit being set to one; and
   b) clear cached attribute information at the start of a medium load.

A CACHE bit set to one specifies that the device server may return cached attribute information. A CACHE bit set to zero specifies that the device server shall not return cached attribute information.

If medium auxiliary memory is not accessible, the device server shall return the status defined in table 194.

Table 194 – Status to be returned if medium auxiliary memory is not accessible

CACHE bit	Medium state	Cached attribute information	Status	Sense Key	Additional sense code
0b	not present	ignored	CHECK CONDITION	NOT READY	MEDIUM NOT PRESENT
	present	ignored	CHECK CONDITION	MEDIUM ERROR	LOGICAL UNIT NOT READY, AUXILIARY MEMORY NOT ACCESSIBLE
1b	not present	available	GOOD	NO SENSE	NO ADDITIONAL SENSE INFORMATION
		not available	CHECK CONDITION	NOT READY	MEDIUM NOT PRESENT
	present	available	GOOD	NO SENSE	NO ADDITIONAL SENSE INFORMATION
		not available	CHECK CONDITION	MEDIUM ERROR	LOGICAL UNIT NOT READY, AUXILIARY MEMORY NOT ACCESSIBLE

If the medium auxiliary memory is not operational, the device server shall terminate the READ ATTRIBUTE command with CHECK CONDITION status, with the sense key set to MEDIUM ERROR, and the additional sense code set to AUXILIARY MEMORY READ ERROR.

If a medium is mounted and the medium auxiliary memory is accessible, the CACHE bit shall be ignored.

The CONTROL byte is defined in SAM-6.

The format of parameter data returned by the READ ATTRIBUTE command depends on the service action specified.

6.17.2 ATTRIBUTE VALUES service action

The READ ATTRIBUTE command with ATTRIBUTE VALUES service action returns parameter data containing the attributes that are in the read only state or read/write state (see 5.9) specified by the PARTITION NUMBER field, LOGICAL VOLUME NUMBER field, and FIRST ATTRIBUTE IDENTIFIER field in the CDB. The parameter data shall contain the requested attributes in ascending numerical order by attribute identifier value and in the format shown in table 195.

The AVAILABLE DATA field shall contain the number of bytes of attribute information in the parameter data. The contents of the AVAILABLE DATA field are not altered based on the allocation length (see 4.2.5.6).

The format of the attributes is described in 7.4.1.

Table 195 – READ ATTRIBUTE with ATTRIBUTE VALUES service action parameter data

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
•••				AVAILABLE DATA (n-3)				
3								(LSB)
				Attribute list				
4								
•••				Attribute (see 7.4.1) [first]				
				$\vdots$				
•••				Attribute (see 7.4.1) [last]				
n								

6.17.3 ATTRIBUTE LIST service action

The READ ATTRIBUTE command with ATTRIBUTE LIST service action returns parameter data containing the attribute identifiers for the attributes that are in the read only state or in the read/write state (see 5.9) in the specified partition number and volume number. The contents of FIRST ATTRIBUTE IDENTIFIER field in the CDB shall be ignored. The parameter data shall contain the requested attribute identifiers in ascending numerical order by attribute identifier value and in the format shown in table 196.

Table 196 – READ ATTRIBUTE with ATTRIBUTE LIST service action parameter data

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
•••				AVAILABLE DATA (n-3)				
3								(LSB)
				Attribute identifier list				
4	(MSB)							
5				ATTRIBUTE IDENTIFIER [first]				(LSB)
				$\vdots$				
n-1	(MSB)							
n				ATTRIBUTE IDENTIFIER [last]				(LSB)

The AVAILABLE DATA field shall contain the number of bytes of attribute identifiers in the parameter data. The contents of the AVAILABLE DATA field are not altered based on the allocation length (see 4.2.5.6).

An ATTRIBUTE IDENTIFIER field is returned for each attribute that is in the read only state or in the read/write state (see 5.9) in the specified partition number and volume number. See 7.4.2 for a description of the attribute identifier values.

6.17.4 LOGICAL VOLUME LIST service action

The READ ATTRIBUTE command with LOGICAL VOLUME LIST service action returns parameter data (see table 197) identifying the supported number of logical volumes. The contents of LOGICAL VOLUME NUMBER field, PARTITION NUMBER field, and FIRST ATTRIBUTE IDENTIFIER field in the CDB shall be ignored.

Table 197 – READ ATTRIBUTE with LOGICAL VOLUME LIST service action parameter data

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
1			AVAILABLE DATA (0002h)					(LSB)
2	FIRST LOGICAL VOLUME NUMBER							
3	NUMBER OF LOGICAL VOLUMES AVAILABLE							

The AVAILABLE DATA field shall be set as shown in table 197 for the parameter data returned by a READ ATTRIBUTE command with LOGICAL VOLUME LIST service action. The contents of the AVAILABLE DATA field are not altered based on the allocation length (see 4.2.5.6).

The FIRST LOGICAL VOLUME NUMBER field indicates the first volume available. Logical volume numbering should start at zero.

The NUMBER OF LOGICAL VOLUMES AVAILABLE field indicates the number of volumes available.

6.17.5 PARTITION LIST service action

The READ ATTRIBUTE command with PARTITION LIST service action returns parameter data (see table 198) identifying the number of partitions supported in the specified logical volume number. The contents of PARTITION NUMBER field and FIRST ATTRIBUTE IDENTIFIER field in the CDB shall be ignored.

Table 198 – READ ATTRIBUTE with PARTITION LIST service action parameter data

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
1			AVAILABLE DATA (0002h)					(LSB)
2	FIRST PARTITION NUMBER							
3	NUMBER OF PARTITIONS AVAILABLE							

The AVAILABLE DATA field shall be set as shown in table 198 for the parameter data returned by a READ ATTRIBUTE command with PARTITION LIST service action. The contents of the AVAILABLE DATA field are not altered based on the allocation length (see 4.2.5.6).

The FIRST PARTITION NUMBER field indicates the first partition available on the specified logical volume number. Partition numbering should start at zero.

The NUMBER OF PARTITIONS AVAILABLE field indicates the number of partitions available on the specified logical volume number.

6.17.6 SUPPORTED ATTRIBUTES service action

The READ ATTRIBUTE command with SUPPORTED ATTRIBUTES service action returns parameter data containing the attribute identifiers for the attributes that are supported by the device server in the specified partition number and volume number. The contents of FIRST ATTRIBUTE IDENTIFIER field in the CDB shall be ignored. The parameter data shall contain the requested attribute identifiers in ascending numerical order by attribute identifier value and in the format shown in table 199.

Table 199 – READ ATTRIBUTE with SUPPORTED ATTRIBUTES service action parameter data

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
•••			AVAILABLE DATA (n-3)					
3								(LSB)
	Attribute identifier list							
4	(MSB)							
5			ATTRIBUTE IDENTIFIER [first]					(LSB)
				⋮				
n-1	(MSB)							
n			ATTRIBUTE IDENTIFIER [last]					(LSB)

The AVAILABLE DATA field shall contain the number of bytes of attribute identifiers in the parameter data. The contents of the AVAILABLE DATA field are not altered based on the allocation length (see 4.2.5.6).

For each attribute that is in the read only state, in the read/write state, or in the nonexistent state (see 5.9) in the specified partition number and volume number:

  a) an attribute identifier (see 7.4.2) is returned for device type attributes (see 7.4.2.2), medium type attributes (see 7.4.2.3), and host type attributes defined in the applicable command standards; and
  b) if vendor specific host type attributes (see 7.4.2.1) are supported, then an attribute identifier is returned for the first supported vendor specific host type attribute and attribute identifiers may be returned for other supported vendor specific host type attributes.

6.18 READ BUFFER(10) command

6.18.1 READ BUFFER command summary

The READ BUFFER command is used in conjunction with the WRITE BUFFER command for:

  a) testing logical unit buffer memory;
  b) testing the integrity of the service delivery subsystem;
  c) downloading microcode (see 5.5); and
  d) retrieving error history.

The READ BUFFER(10) command is defined in table 200.

Table 200 – READ BUFFER(10) command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (3Ch)							
1	MODE SPECIFIC			MODE				
2	BUFFER ID							
3	(MSB)							
•••				BUFFER OFFSET				
5								(LSB)
6	(MSB)							
•••				ALLOCATION LENGTH				
8								(LSB)
9	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 200 for the READ BUFFER(10) command.

The usage of the MODE SPECIFIC field depends on the value in the MODE field.

The function of this command and the meaning of fields within the CDB depend on the contents of the MODE field. The MODE field is defined in table 201.

Table 201 – READ BUFFER MODE field

Code	Description	Reference
00h	Obsolete	
01h	Vendor specific	6.18.2
02h	Data	6.18.3
03h	Descriptor	6.18.4
04h to 09h	Reserved	
0Ah	Read data from echo buffer	6.18.5
0Bh	Echo buffer descriptor	6.18.6
0Ch to 0Eh	Reserved	
0Fh	Read microcode status	6.18.7
10h to 19h	Reserved	
1Ah	Obsolete	
1Bh	Reserved	
1Ch	Error history	6.18.8
1Dh to 1Fh	Reserved	

The MODE field may be processed as specifying a service action by the REPORT SUPPORTED OPERATION CODES command (see 6.32).

If the MODE field is not set to 01h (i.e., vendor specific), the ALLOCATION LENGTH field is defined in 4.2.5.6.

The CONTROL byte is defined in SAM-6.

6.18.2 Vendor specific mode (01h)

In this mode, the meanings of the MODE SPECIFIC field, BUFFER ID field, BUFFER OFFSET field, and ALLOCATION LENGTH field are not specified by this standard.

6.18.3 Data mode (02h)

In this mode, the device server returns parameter data that contains logical unit buffer data. The BUFFER ID field specifies a buffer within the logical unit from which data shall be transferred. The manufacturer assigns buffer ID codes to buffers within the logical unit. Buffer ID zero shall be supported. If more than one buffer is supported, then additional buffer ID codes shall be assigned contiguously, beginning with one. Buffer ID code assignments for the READ BUFFER command with data mode shall be the same as for the WRITE BUFFER command with data mode (see 6.49.3). If an unsupported buffer ID code is selected, the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

The MODE SPECIFIC field is reserved.

The BUFFER OFFSET field specifies the byte offset within the specified buffer from which data shall be transferred. The application client should conform to the offset boundary requirements returned in the READ BUFFER descriptor (see 6.18.4). If the device server is unable to accept the specified buffer offset, the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

6.18.4 Descriptor mode (03h)

The MODE SPECIFIC field is reserved.

In this mode, the device server returns parameter data that contains a maximum of four bytes of READ BUFFER descriptor information. The BUFFER OFFSET field is reserved in this mode. The allocation length should be set to four or greater. The READ BUFFER descriptor is defined as shown in table 202.

Table 202 – READ BUFFER descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	OFFSET BOUNDARY							
1	(MSB)							
2	BUFFER CAPACITY							
3								(LSB)

For READ BUFFER commands, the OFFSET BOUNDARY field (see table 203) applies to the following modes:

a) data (i.e., 02h) (see 6.18.3); and
b) error history (i.e., 1Ch) (see).

For WRITE BUFFER commands, the OFFSET BOUNDARY field (see table 203) applies to the following modes:

a) data (i.e., 02h) (see 6.49.3);
b) download microcode with offsets and activate (i.e., 06h) (see 6.49.6);
c) download microcode with offsets, save, and activate (i.e., 07h) (see 6.49.7);
d) download microcode with offsets, select activation events, save, and defer activate (i.e., 0Dh) (see 6.49.9); and
e) download microcode with offsets, save, and defer activate (i.e., 0Eh) (see 6.49.10).

For data mode (i.e., 02h), the boundary alignment indicated by the OFFSET BOUNDARY field applies only to the buffer specified by the BUFFER ID field. For modes other than data to which the OFFSET BOUNDARY field applies, the boundary alignment applies regardless of the buffer specified by the BUFFER ID field.

Table 203 – OFFSET BOUNDARY field

Code	Description
00h to FEh	Multiples of 2^{code} (e.g., 00h means multiples of 1 byte or no offset restrictions, 01h means multiples of 2 bytes or even offsets, 02h means multiples of 4 bytes)
FFh	000000h is the only supported buffer offset

The BUFFER CAPACITY field indicates the maximum size in bytes of the buffer specified by the BUFFER ID field for:

a) the READ BUFFER command with data mode (i.e., 02h); and
b) the WRITE BUFFER command with data mode (i.e., 02h).

6.18.5 Read data from echo buffer mode (0Ah)

In this mode, the device server returns parameter data that contains the echo buffer (i.e., parameter list data sent to the device server by the most recent WRITE BUFFER command with the MODE field set to write data to echo buffer (see 6.49.8) received on the same I_T nexus). The device server shall return the same number of bytes of data as was received during the processing of the prior WRITE BUFFER command with the MODE field set to write data to echo buffer, limited by the allocation length (see 4.2.5.6).

The MODE SPECIFIC field is reserved in this mode.

The BUFFER ID field and BUFFER OFFSET field are ignored in this mode.

If the device server has not received a WRITE BUFFER command with the mode set to write data to echo buffer received on this I_T nexus since the last logical unit reset condition (see SAM-6) and completed that command without an error, then the device server shall terminate the READ BUFFER command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to COMMAND SEQUENCE ERROR. If the data in the echo buffer has been overwritten as the result of a WRITE BUFFER command received on another I_T nexus and the device server supports error reporting on echo buffer overwrites (i.e., the EBOS bit is set to one in the echo buffer descriptor (see 6.18.6)), then the device server shall terminate the READ BUFFER command with CHECK CONDITION status, with the sense key set to ABORTED COMMAND, and the additional sense code set to ECHO BUFFER OVERWRITTEN.

After a WRITE BUFFER command with the mode set to write data to echo buffer has completed without an error, the application client may send multiple READ BUFFER commands with the mode set to read data from echo buffer in order to read the echo buffer data multiple times.

6.18.6 Echo buffer descriptor mode (0Bh)

The MODE SPECIFIC field is reserved in this mode.

In this mode, the device server returns parameter data that contains a maximum of four bytes of READ BUFFER descriptor information for the echo buffer. If the echo buffer is not implemented, the device server shall return all zeros in the READ BUFFER descriptor. The BUFFER ID field and BUFFER OFFSET field are reserved in this mode. The allocation length should be set to four or greater. The echo buffer descriptor is defined as shown in table 204.

Table 204 – Echo buffer descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved							EBOS
1	Reserved							
2	Reserved			(MSB)				
3	BUFFER CAPACITY							(LSB)

If the echo buffer is implemented, the echo buffer descriptor shall be implemented.

An echo buffer overwritten supported (EBOS) bit set to one indicates either:

   a) the device server returns the ECHO BUFFER OVERWRITTEN additional sense code if the data being read from the echo buffer is not the data previously written by the same I_T nexus; or
   b) the device server ensures echo buffer data returned to each I_T nexus is the same as the echo buffer data previously written by that I_T nexus.

An EBOS bit set to zero specifies that the echo buffer may be overwritten by any intervening command received on any I_T nexus.

The BUFFER CAPACITY field shall contain the size of the echo buffer in bytes aligned to a four-byte boundary. The maximum echo buffer size is 4 096 bytes.

A READ BUFFER command with the mode set to echo buffer descriptor may be used to determine the echo buffer capacity and supported features before a WRITE BUFFER command with the mode set to write data to echo buffer (see 6.49.8) is sent.

6.18.7 Read microcode status mode (0Fh)

In this mode, the device server returns parameter data that contains information about microcode status. The BUFFER ID field (see 6.49) specifies the download microcode buffer within the logical unit for which microcode status is requested. The MODE SPECIFIC field and the BUFFER OFFSET field are reserved.

Table 205 defines the format of the read microcode status descriptor.

Table 205 – Read microcode status descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	ACTIVATED MICROCODE STATUS (see table 206)							
1	REDUNDANT MICROCODE STATUS (see table 207)							
2	DOWNLOAD MICROCODE STATUS (see table 208)							
3	Reserved							
4	(MSB)							
•••			DOWNLOAD MICROCODE MAXIMUM SIZE					
7								(LSB)
8	(MSB)							
•••			Reserved					
11								(LSB)
12	(MSB)							
•••			DOWNLOAD MICROCODE EXPECTED BUFFER OFFSET					
15								(LSB)

The ACTIVATED MICROCODE STATUS field (see table 206) indicates status of the activated microcode.

Table 206 – ACTIVATED MICROCODE STATUS **field**

Code	Description
00h	Microcode status not reported
01h	Activated microcode is valid
02h	Activated microcode is not valid
03h	Activated microcode is not a full microcode image (e.g., a boot ROM)
all others	Reserved

The REDUNDANT MICROCODE STATUS field (see table 207) indicates status of the redundant microcode, if any.

Table 207 – REDUNDANT MICROCODE STATUS **field**

Code	Description
00h	Redundant microcode status is not reported
01h	At least one redundant microcode copy is valid
02h	No redundant microcode copy is valid
03h	Redundant microcode is not a full microcode image (e.g., a boot ROM)
all others	Reserved

The DOWNLOAD MICROCODE STATUS field indicates the status of download microcode operations and is defined in table 208. Enclosure services devices may set the DOWNLOAD MICROCODE STATUS field to any value defined

for the SUBENCLOSURE DOWNLOAD MICROCODE STATUS field for the Download Microcode Status diagnostic page (see SES-4). After activating microcode, the device server shall set the DOWNLOAD MICROCODE STATUS field to 00h.

Table 208 – DOWNLOAD MICROCODE STATUS field (part 1 of 2)

Code	Description
Codes indicating interim status	
00h	No download microcode operation is in progress
01h to 1Fh	Restricted (see SES-4)
20h	Reserved
21h	Download microcode operation is in progress. The device server has received one or more Download microcode WRITE BUFFER commands and is awaiting additional microcode data.
22h	Download microcode operation data transfer is complete, currently updating nonvolatile storage with microcode that is to be activated after saving.
23h	Download microcode operation data transfer of deferred microcode is complete, currently updating nonvolatile storage.
24h to 2Fh	Reserved
Codes indicating completion with no errors	
30h	Download of deferred microcode completed with no error. Microcode activation events are not reported.
31h	Download of deferred microcode completed with no error. The new microcode activation occurs after the next hard reset or power on.
32h	Download of deferred microcode completed with no error. The new microcode activation occurs after the next power on.
33h	Download of deferred microcode completed with no error. The new microcode activation occurs after: a) processing a WRITE BUFFER command specifying the activate deferred microcode mode; b) hard reset; c) power on; or d) other events (e.g., vendor specific events).
34h	Download of deferred microcode completed with no error. The new microcode activation occurs after processing a WRITE BUFFER command specifying the activate deferred microcode mode.
35h	Download of deferred microcode completed with no error. The new microcode activation occurs after: a) processing a WRITE BUFFER command specifying the activate deferred microcode mode; b) hard reset; c) power on; or d) other events (e.g., vendor specific events). Microcode activation due to processing a WRITE BUFFER command that specifies the activate deferred microcode mode affects only the logical unit containing that device server.
36h to 6Fh	Reserved

Table 208 – DOWNLOAD MICROCODE STATUS field (part 2 of 2)

Code	Description
Other codes that may indicate conditions that are not errors	
70h to 7Fh	Vendor specific
Codes indicating completion with errors	
80 to 8Fh	Restricted (see SES-4)
90h	There was an error in one or more of the WRITE BUFFER command fields and the new microcode was discarded. The DOWNLOAD MICROCODE ADDITIONAL STATUS field shall be set to the offset of the lowest byte of the field in the WRITE BUFFER command that was in error.
91h	A microcode image error was detected (e.g., by a vendor specific check of the microcode image such as a checksum) and the new microcode was discarded.
92h	A download microcode vendor specific timeout occurred and the new microcode was discarded.
93h	An internal error occurred in the download microcode operation and no valid persistent microcode image is available for use after a hard reset or power on.
94h	An internal error occurred in the download microcode operation and a valid persistent microcode image is available.
95h	The device server processed a WRITE BUFFER command with the MODE field set to 0Fh (i.e., activate deferred microcode), when there was no deferred microcode. If a download microcode operation was in progress then that microcode was discarded.
96h to EFh	Reserved
Other codes that may indicate conditions that are errors	
F0h to FFh	Vendor specific

The DOWNLOAD MICROCODE MAXIMUM SIZE field indicates the maximum size in bytes of the microcode image that the device server accepts. The image may be delivered using one or more WRITE BUFFER command download microcode modes.

The DOWNLOAD MICROCODE EXPECTED BUFFER OFFSET field indicates the next value that the device server expects in the BUFFER OFFSET field in the WRITE BUFFER command. If the device server accepts arbitrary BUFFER OFFSET field values, then it shall set the DOWNLOAD MICROCODE EXPECTED BUFFER OFFSET field to FFFF FFFFh.

6.18.8 Error history mode (1Ch)

6.18.8.1 Error history overview

This mode is used to manage and retrieve error history (see 5.6).

The usage of the MODE SPECIFIC field depends on the value in the BUFFER ID field (see table 211).

If the device server is unable to process a READ BUFFER command with the MODE field set to 1Ch, the device server shall terminate the READ BUFFER command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to COMMAND SEQUENCE ERROR.

The BUFFER ID field (see table 209) specifies the action that the device server shall perform, and the parameter data, if any, that the device server shall return.

Table 209 – BUFFER ID field for error history mode

Code	Description	Buffer offset	Error history I_T nexus constrained	Reference
00h	Return error history directory [a]	Zero [b]	Yes	6.18.8.2
01h	Return error history directory and create new error history snapshot	Zero [b]	Yes	6.18.8.2
02h	Return error history directory and establish new error history I_T nexus [a]	Zero [b]	No	6.18.8.2
03h	Return error history directory, establish new error history I_T nexus, and create new error history snapshot	Zero [b]	No	6.18.8.2
04h to 0Fh	Reserved		Yes	
10h to EFh	Return error history	Zero [b] to Maximum [c]	Yes	6.18.8.3
F0h to FDh	Reserved		Yes	
FEh	Clear error history I_T nexus	Ignored	Yes	6.18.8.4
FFh	Clear error history I_T nexus and release any error history snapshots	Ignored	Yes	6.18.8.5

[a] A new error history snapshot may be created (see table 210).
[b] Zero is 000000h for the READ BUFFER(10) command and 0000 0000 0000 0000h for the READ BUFFER(16) command.
[c] Maximum is FFFFFFh for the READ BUFFER(10) command and FFFF FFFF FFFF FFFFh for the READ BUFFER(16) command.

The device server shall terminate the READ BUFFER command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to OPERATION IN PROGRESS if the device server receives a READ BUFFER command:

a) with the MODE field set to 1Ch;
b) with the BUFFER ID field set to a value that table 209 shows as constrained by error history I_T nexus;
c) if an error history I_T nexus exists and the command is received from an I_T nexus that is different than that I_T nexus; and
d) an error history snapshot exists.

The BUFFER OFFSET field specifies the byte offset from the start of the buffer specified by the BUFFER ID field from which the device server shall return data. The application client should conform to the offset boundary requirements indicated in the READ BUFFER descriptor (see 6.18.4). If the buffer offset is not one of those shown in table 209 or the device server is unable to accept the specified buffer offset, then the device server shall terminate the READ BUFFER command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

The application client should set the ALLOCATION LENGTH field in the READ BUFFER command to a value that is a multiple of 512 if the BUFFER ID field in that command specifies an error history buffer that contains:

a) current internal status parameter data (i.e., the associated error history directory entry (see table 215) BUFFER FORMAT field is set to 01h); or
b) saved internal status parameter data (i.e., the associated error history directory entry (see table 215) BUFFER FORMAT field is set to 02h).

6.18.8.2 Error history directory

Whenever allowed by established error history I_T nexus constraints (see 6.18.8.1), if any, all error history directory device server actions return an error history directory (see table 212). Some error history directory device server actions also discard the existing error history snapshot and create a new error history snapshot (see table 210).

Table 210 – Summary of error history directory device server actions

BUFFER ID field	Establish new error history I_T nexus	Error history snapshot	
		Preserved (if exists)	Created
00h	No [a]	Yes	No [b]
01h	No [a]	No	Yes
02h	Yes	Yes	No [b]
03h	Yes	No	Yes

[a] If no error history I_T nexus is established, a new one is established.
[b] If no error history snapshot exists, a new one may be created.

Table 211 defines the meaning of the combinations of values for the BUFFER ID field and the MODE SPECIFIC field for the error history mode.

Table 211 – BUFFER ID field and MODE SPECIFIC field meanings for the error history mode

BUFFER ID field	MODE SPECIFIC field	Description
00h to 03h	000b	If a new error history snapshot is created (see table 210), vendor specific parameter data shall be created (i.e., at least one error history directory entry (see table 215) shall contain a BUFFER FORMAT field that is set to 00h).
	001b	If a new error history snapshot is created (see table 210), current internal status parameter data shall be created (i.e., at least one error history directory entry (see table 215) shall contain a BUFFER FORMAT field that is set to 01h).
	010 to 111b	Reserved
all others	000 to 111b	Reserved

The error history directory is defined in table 212.

Table 212 – Error history directory

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
•••			T10 VENDOR IDENTIFICATION					
7								(LSB)
8	VERSION							
9	Reserved			EHS_RETRIEVED		EHS_SOURCE		CLR_SUP
10								
•••				Reserved				
29								
30	(MSB)							
31				DIRECTORY LENGTH (n-31)				(LSB)
	Error history directory list							
32								
•••				Error history directory entry (see table 215) [first]				
39								
	⋮							
n-7								
•••				Error history directory entry (see table 215) [last]				
n								

The T10 VENDOR IDENTIFICATION field contains eight bytes of left-aligned ASCII data (see 4.3.1) identifying the manufacturer of the logical unit. The T10 vendor identification shall be one assigned by INCITS. A list of assigned T10 vendor identifications is in Annex F and on the T10 web site (http://www.t10.org).

> NOTE 17 - The T10 VENDOR IDENTIFICATION field may contain a different value than the VENDOR IDENTIFI-CATION field in the standard INQUIRY data (see 6.7.2) (e.g., this field may indicate a disk drive component manufacturer while the standard INQUIRY data indicates the original equipment manufacturer).

The VERSION field indicates the version and format of the vendor specific error history. The VERSION field is assigned by the manufacturer indicated in the T10 VENDOR IDENTIFICATION field.

The error history retrieved (EHS_RETRIEVED) field (see table 213) indicates whether a clear error history device server action has been requested for the error history snapshot. EHS_RETRIEVED field shall be set to 00b or 10b when the error history snapshot is created.

Table 213 – EHS_RETRIEVED field

Code	Description
00b	No information
01b	The error history I_T nexus has requested buffer ID FEh (i.e., clear error history I_T nexus) or buffer ID FFh (i.e., clear error history I_T nexus and release snapshot) for the current error history snapshot.
10b	An error history I_T nexus has not requested buffer ID FEh (i.e., clear error history I_T nexus) or buffer ID FFh (i.e., clear error history I_T nexus and release snapshot) for the current error history snapshot.
11b	Reserved

The error history source (EHS_SOURCE) field (see table 214) indicates the source of the error history snapshot (i.e., error history buffers with the BUFFER ID field set to 10h to EFh (see table 209)).

Table 214 – EHS_SOURCE field

Code	Description
00b	The error history snapshot was created by the device server and was not created due to processing a READ BUFFER command.
01b	Error history snapshot was created due to processing of the current READ BUFFER command.
10b	Error history snapshot was created due to processing of a previous READ BUFFER command.
11b	The source of the error history snapshot is indicated in the BUFFER SOURCE field in each error history directory entry (see table 215).

A clear support (CLR_SUP) bit set to one indicates that the CLR bit is supported in the WRITE BUFFER command download error history mode (see 6.49.12). A CLR_SUP bit set to zero indicates that the CLR bit is not supported.

The DIRECTORY LENGTH field indicates the number of bytes that follow in the error history directory list. This value shall not be altered even if the allocation length is not sufficient to transfer the entire error history directory list.

The error history directory list contains an error history directory entry (see table 215) for each supported buffer ID in the range of 00h to EFh. The first entry shall be for buffer ID 00h and the entries shall be in order of ascending buffer IDs. The supported buffer IDs are not required to be contiguous. There shall not be any entries for buffer IDs greater than or equal to F0h.

Table 215 – Error history directory entry

Bit Byte	7	6	5	4	3	2	1	0
0	SUPPORTED BUFFER ID							
1	BUFFER FORMAT							
2	Reserved				BUFFER SOURCE			
3	Reserved							
4	(MSB)							
•••				MAXIMUM AVAILABLE LENGTH					
7								(LSB)

The SUPPORTED BUFFER ID field indicates the error history buffer ID associated with this entry.

If the SUPPORTED BUFFER ID field is set to 10h to EFh, the BUFFER FORMAT field (see table 216) indicates the format of the parameter data for the error history buffer indicated by the SUPPORTED BUFFER ID field. If the SUPPORTED BUFFER ID field is not set to 10h to EFh, the BUFFER FORMAT field should be ignored by the application client.

Table 216 – BUFFER FORMAT field

Code	Description	Format Reference
00h	Contains vendor specific data	
01h	Contains current internal status parameter data	6.18.8.3.2
02h	Contains saved internal status parameter data	6.18.8.3.3
all others	Reserved	

If the SUPPORTED BUFFER ID field is set to 10h to EFh, the BUFFER SOURCE field (see table 217) indicates the source field the error history buffer indicated by the SUPPORTED BUFFER ID field. If the SUPPORTED BUFFER ID field is set to 10h to EFh, the BUFFER SOURCE field should be ignored by the application client.

Table 217 – BUFFER SOURCE field

Code	Description
0h	The source is indicated in the EHS_SOURCE field in the error history directory (see table 212).
1h	The source is unknown.
2h	The error history information was: a) created by the device server as the result of a vendor specific event; and b) not created due to processing of a READ BUFFER command.
3h	The error history information was created due to the processing of the current READ BUFFER command.
4h	The error history information was created due to the processing of a previous READ BUFFER command.
all others	Reserved

The MAXIMUM AVAILABLE LENGTH field indicates the maximum number of data bytes contained in the buffer indicated by the SUPPORTED BUFFER ID field. The actual number of bytes available for transfer may be smaller.

6.18.8.3 Error history data buffer

6.18.8.3.1 Overview

Unless an error is encountered, the device server shall return parameter data that contains error history from the error history snapshot from the specified buffer at the specified buffer offset. The parameter data shall be formatted as indicated by the BUFFER FORMAT field in the error history directory entry (see table 215) associated with the buffer ID specified by the READ BUFFER command.

If the device server receives a READ BUFFER command with the MODE field set to 1Ch from the established error history I_T nexus and the BUFFER ID field is set to a value that the error history directory (see 6.18.8.2) shows as not supported, then the device server shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.

If the value in the BUFFER OFFSET field is not supported, the device server shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.

The amount of error history in the specified buffer shall be less than or equal to the number of bytes indicated by the MAXIMUM AVAILABLE LENGTH field in the error history directory (see 6.18.8.2).

6.18.8.3.2 Current internal status parameter data

The format of the current internal status parameter data is shown in table 218.

Table 218 – Current internal status parameter data (part 1 of 2)

Bit Byte	7	6	5	4	3	2	1	0
0 ••• 3				Reserved				
4				Obsolete [a]				
5 ••• 7	(MSB)			AOI				(LSB)
8 9	(MSB)			CURRENT INTERNAL STATUS DATA SET ONE LENGTH ((w–511)/512)				(LSB)
10 11	(MSB)			CURRENT INTERNAL STATUS DATA SET TWO LENGTH ((x–511)/512)				(LSB)
12 13	(MSB)			CURRENT INTERNAL STATUS DATA SET THREE LENGTH ((y–511)/512)				(LSB)
14 ••• 17	(MSB)			CURRENT INTERNAL STATUS DATA SET FOUR LENGTH ((z–511)/512)				(LSB)
18 ••• 381				Reserved				
382				NEW SAVED DATA AVAILABLE				
383				SAVED DATA GENERATION NUMBER				
384 ••• 511				CURRENT REASON IDENTIFIER				
512 ••• w				CURRENT INTERNAL STATUS DATA SET A, if any				
w+1 ••• x				CURRENT INTERNAL STATUS DATA SET B, if any				
x+1 ••• y				CURRENT INTERNAL STATUS DATA SET C, if any				
[a] SPC-5 shows this byte as being part of the 32 bit IEEE COMPANY ID field (i.e., the 24 bit AOI field in this table).								

Table 218 – Current internal status parameter data (part 2 of 2)

Bit Byte	7	6	5	4	3	2	1	0
y+1 **•••** **z**				CURRENT INTERNAL STATUS DATA SET D, if any				

ᵃ SPC-5 shows this byte as being part of the 32 bit IEEE COMPANY ID field (i.e., the 24 bit AOI field in this table).

The AOI field contains a 24 bit AOI assigned by the IEEE.

The CURRENT INTERNAL STATUS DATA SET ONE LENGTH field indicates the amount of data contained in the CURRENT INTERNAL STATUS DATA SET A field.

The value is expressed in increments of 512 bytes (e.g., a value of one means 512 bytes, two means 1 024 bytes, etc.) and is calculated as follows:

length = (offset W–511) / 512

where:

length   is the value of the CURRENT INTERNAL STATUS DATA SET ONE LENGTH field; and

offset W   is the offset in the current internal status parameter data of the last byte in the CURRENT INTERNAL STATUS DATA SET A field.

The CURRENT INTERNAL STATUS DATA SET TWO LENGTH field indicates the amount of data contained in:

a) the CURRENT INTERNAL STATUS DATA SET A field; and
b) the CURRENT INTERNAL STATUS DATA SET B field.

The value is expressed in increments of 512 bytes (e.g., a value of one means 512 bytes, two means 1 024 bytes, etc.) and is calculated as follows:

length = (offset X–511) / 512

where:

length   is the value of the CURRENT INTERNAL STATUS DATA SET TWO LENGTH field; and

offset X   is the offset in the current internal status parameter data of the last byte in the CURRENT INTERNAL STATUS DATA SET B field.

The CURRENT INTERNAL STATUS DATA SET THREE LENGTH field indicates the amount of data contained in:

a) the CURRENT INTERNAL STATUS DATA SET A field;
b) the CURRENT INTERNAL STATUS DATA SET B field; and
c) the CURRENT INTERNAL STATUS DATA SET C field.

The value is expressed in increments of 512 bytes (e.g., a value of one means 512 bytes, two means 1 024 bytes, etc.) and is calculated as follows:

length = (offset Y–511) / 512

where:

    length   is the value of the CURRENT INTERNAL STATUS DATA SET THREE LENGTH field; and

    offset Y   is the offset in the current internal status parameter data of the last byte in the CURRENT INTERNAL STATUS DATA SET C field.

A value of zero in the CURRENT INTERNAL STATUS DATA SET FOUR LENGTH field with a non-zero value in the CURRENT INTERNAL STATUS DATA SET ONE LENGTH field indicates that the current internal status data set four is not supported.

The CURRENT INTERNAL STATUS DATA SET FOUR LENGTH field indicates the amount of data contained in:

  a) the CURRENT INTERNAL STATUS DATA SET A field;
  b) the CURRENT INTERNAL STATUS DATA SET B field;
  c) the CURRENT INTERNAL STATUS DATA SET C field; and
  d) the CURRENT INTERNAL STATUS DATA SET D field.

The value is expressed in increments of 512 bytes (e.g., a value of one means 512 bytes, two means 1 024 bytes, etc.) and is calculated as follows:

length = (offset Z–511) / 512

where:

    length   is the value of the CURRENT INTERNAL STATUS DATA SET FOUR LENGTH field; and

    offset Z   is the offset in the current internal status parameter data of the last byte in the CURRENT INTERNAL STATUS DATA SET D field.

The NEW SAVED DATA AVAILABLE field shall be set to the value in the NEW SAVED DATA AVAILABLE field in the saved internal status parameter data (see 6.18.8.3.3).

The SAVED DATA GENERATION NUMBER field shall be set to the value in the SAVED DATA GENERATION NUMBER field in the saved internal status parameter data (see 6.18.8.3.3).

The CURRENT REASON IDENTIFIER field indicates an identification of different unique operating conditions of the logical unit at the time the device server created the current internal status error history data.

The CURRENT INTERNAL STATUS DATA SET A field, if any, contains the data for current internal status data set A that forms current internal status data set one.

The CURRENT INTERNAL STATUS DATA SET B field, if any, contains additional data that when concatenated with current internal status data set A, if any, forms current internal status data set two.

The CURRENT INTERNAL STATUS DATA SET C field, if any, contains additional data that when concatenated with current internal status data set A, if any, and current internal status data set B, if any, forms current internal status data set three.

The CURRENT INTERNAL STATUS DATA SET D field, if any, contains additional data that when concatenated with current internal status data set A, if any, current internal status data set B, if any, and current internal status data set C, if any, forms current internal status data set four.

6.18.8.3.3 Saved internal status parameter data

The format of the saved internal status parameter data is shown in table 219.

Table 219 – Saved internal status parameter data (part 1 of 2)

Bit Byte	7	6	5	4	3	2	1	0
0 ••• **3**				Reserved				
4				Obsolete [a]				
5 ••• **6**	(MSB)			AOI				(LSB)
7 **8**	(MSB)			SAVED INTERNAL STATUS DATA SET ONE LENGTH ((w–511)/512)				(LSB)
9 **10**	(MSB)			SAVED INTERNAL STATUS DATA SET TWO LENGTH ((x–511)/512)				(LSB)
11 **12**	(MSB)			SAVED INTERNAL STATUS DATA SET THREE LENGTH ((y–511)/512)				(LSB)
13 ••• **16**	(MSB)			SAVED INTERNAL STATUS DATA SET FOUR LENGTH ((z–511)/512)				(LSB)
17 ••• **381**				Reserved				
382				NEW SAVED DATA AVAILABLE				
383				SAVED DATA GENERATION NUMBER				
384 ••• **511**				SAVED REASON IDENTIFIER				
512 ••• **w**				SAVED INTERNAL STATUS DATA SET A, if any				
w+1 ••• **x**				SAVED INTERNAL STATUS DATA SET B, if any				
x+1 ••• **y**				SAVED INTERNAL STATUS DATA SET C, if any				
[a] SPC-5 shows this byte as being part of the 32 bit IEEE COMPANY ID field (i.e., the 24 bit AOI field in this table).								

Table 219 – Saved internal status parameter data (part 2 of 2)

Bit Byte	7	6	5	4	3	2	1	0
y+1 ••• z				SAVED INTERNAL STATUS DATA SET D, if any				

ᵃ SPC-5 shows this byte as being part of the 32 bit IEEE COMPANY ID field (i.e., the 24 bit AOI field in this table).

The AOI field contains a 24 bit AOI assigned by the IEEE.

The SAVED INTERNAL STATUS DATA SET ONE LENGTH field indicates the amount of data contained in the SAVED INTERNAL STATUS DATA SET A field.

The value is expressed in increments of 512 bytes (e.g., a value of one means 512 bytes, two means 1 024 bytes, etc.) and is calculated as follows:

$$\text{length} = (\text{offset W} - 511) / 512$$

where:

    length   is the value of the SAVED INTERNAL STATUS DATA SET ONE LENGTH field; and

    offset W   is the offset in the saved internal status parameter data of the last byte in the SAVED INTERNAL STATUS DATA SET A field.

The SAVED INTERNAL STATUS DATA SET TWO LENGTH field indicates the amount of data contained in:

    a) the SAVED INTERNAL STATUS DATA SET A field; and
    b) the SAVED INTERNAL STATUS DATA SET B field.

The value is expressed in increments of 512 bytes (e.g., a value of one means 512 bytes, two means 1 024 bytes, etc.) and is calculated as follows:

$$\text{length} = (\text{offset X} - 511) / 512$$

where:

    length   is the value of the SAVED INTERNAL STATUS DATA SET TWO LENGTH field; and

    offset X   is the offset in the saved internal status parameter data of the last byte in the SAVED INTERNAL STATUS DATA SET B field.

The SAVED INTERNAL STATUS DATA SET THREE LENGTH field indicates the amount of data contained in:

    a) the SAVED INTERNAL STATUS DATA SET A field;
    b) the SAVED INTERNAL STATUS DATA SET B field; and
    c) the SAVED INTERNAL STATUS DATA SET C field.

The value is expressed in increments of 512 bytes (e.g., a value of one means 512 bytes, two means 1 024 bytes, etc.) and is calculated as follows:

$$\text{length} = (\text{offset Y} - 511) / 512$$

where:

length   is the value of the SAVED INTERNAL STATUS DATA SET THREE LENGTH field; and

offset Y   is the offset in the saved internal status parameter data of the last byte in the SAVED INTERNAL STATUS DATA SET C field.

A value of zero in the SAVED INTERNAL STATUS DATA SET FOUR LENGTH field with a non-zero value in the SAVED INTERNAL STATUS DATA SET ONE LENGTH field indicates that the saved internal status data set four is not supported.

The SAVED INTERNAL STATUS DATA SET FOUR LENGTH field indicates the amount of data contained in:

a) the SAVED INTERNAL STATUS DATA SET A field;
b) the SAVED INTERNAL STATUS DATA SET B field;
c) the SAVED INTERNAL STATUS DATA SET C field; and
d) the SAVED INTERNAL STATUS DATA SET D field.

The value is expressed in increments of 512 bytes (e.g., a value of one means 512 bytes, two means 1 024 bytes, etc.) and is calculated as follows:

length = (offset Z–511) / 512

where:

length   is the value of the SAVED INTERNAL STATUS DATA SET FOUR LENGTH field; and

offset Z   is the offset in the saved internal status parameter data of the last byte in the SAVED INTERNAL STATUS DATA SET D field.

If the NEW SAVED DATA AVAILABLE field is set to 00h, the saved internal status data has not changed since it was last read. If the NEW SAVED DATA AVAILABLE field is set to 01h, the saved internal status data has changed since it was last read. All other values are reserved.

The SAVED DATA GENERATION NUMBER field indicates the generation number of the saved internal status error history.

The SAVED REASON IDENTIFIER field contains a vendor specific value that identifies different unique operating conditions of the logical unit at the time the device server created the saved internal status error history data.

The SAVED INTERNAL STATUS DATA SET A field, if any, contains the data for saved internal status data set A that forms saved internal status data set one.

The SAVED INTERNAL STATUS DATA SET B field, if any, contains additional data that when concatenated with saved internal status data set A, if any, forms saved internal status data set two.

The SAVED INTERNAL STATUS DATA SET C field, if any, contains additional data that when concatenated with saved internal status data set A, if any, and saved internal status data set B, if any, forms saved internal status data set three.

The SAVED INTERNAL STATUS DATA SET D field, if any, contains additional data that when concatenated with saved internal status data set A, if any, saved internal status data set B, if any, and saved internal status data set C, if any, forms saved internal status data set three.

6.18.8.4 Clear error history I_T nexus

If the BUFFER ID field is set to FEh, the device server shall:

    a) clear the error history I_T nexus, if any; and
    b) not transfer any data.

6.18.8.5 Clear error history I_T nexus and release snapshot

If the BUFFER ID field is set to FFh, the device server shall:

    a) clear the error history I_T nexus, if any;
    b) release the error history snapshot, if any; and
    c) not transfer any data.

6.19 READ BUFFER(16) command

The READ BUFFER (16) command (see table 220) requests that the device server perform the actions defined for the READ BUFFER (10) command (see 6.18).

Table 220 – READ BUFFER(16) command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (9Bh)							
1	MODE SPECIFIC			MODE				
2	(MSB)							
•••				BUFFER OFFSET				
9								(LSB)
10	(MSB)							
•••				ALLOCATION LENGTH				
13								(LSB)
14	BUFFER ID							
15	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 220 for the READ BUFFER(16) command.

The MODE SPECIFIC field, MODE field, BUFFER OFFSET field, ALLOCATION LENGTH field, and BUFFER ID field are defined in 6.18.

The CONTROL field is defined in SAM-6.

6.20 READ MEDIA SERIAL NUMBER command

The READ MEDIA SERIAL NUMBER command (see table 221) requests the device server to return the current media serial number. This command uses the SERVICE ACTION IN(12) CDB format (see 4.2.2.3.5).

Table 221 – READ MEDIA SERIAL NUMBER command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (ABh)							
1	Reserved			SERVICE ACTION (01h)				
2 ••• 5	Reserved							
6 ••• 9	(MSB) ALLOCATION LENGTH (LSB)							
10	Reserved							
11	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 221 for the READ MEDIA SERIAL NUMBER command.

The SERVICE ACTION field is defined in 4.2.5.2 and shall be set as shown in table 221 for the READ MEDIA SERIAL NUMBER command.

The ALLOCATION LENGTH field is defined in 4.2.5.6.

The CONTROL byte is defined in SAM-6.

The READ MEDIA SERIAL NUMBER parameter data format is shown in table 222.

Table 222 – READ MEDIA SERIAL NUMBER parameter data

Bit Byte	7	6	5	4	3	2	1	0
0 ••• 3	(MSB) MEDIA SERIAL NUMBER LENGTH ((4×n)-4) (LSB)							
4 ••• (4×n)-1	MEDIA SERIAL NUMBER							

The MEDIA SERIAL NUMBER LENGTH field shall contain the number of bytes in the MEDIA SERIAL NUMBER field. The media serial number length shall be a multiple of four. The contents of the MEDIA SERIAL NUMBER LENGTH field are not altered based on the allocation length (see 4.2.5.6).

The MEDIA SERIAL NUMBER field shall contain the vendor specific serial number of the media currently installed. If the number of bytes in the vendor specific serial number is not a multiple of four, then up to three bytes containing zero shall be appended to the highest numbered bytes of the MEDIA SERIAL NUMBER field.

If the media serial number is not available (e.g., the currently installed media has no valid media serial number), then the MEDIA SERIAL NUMBER LENGTH field shall be set to zero.

If the media serial number is not accessible as a result of there is no media present, the device server shall terminate the command with CHECK CONDITION status, with the sense key set to NOT READY, and the additional sense code set to MEDIUM NOT PRESENT.

6.21 RECEIVE BINDING REPORT command

The RECEIVE BINDING REPORT command (see table 223) returns a list of binding descriptors whose preparation was requested by a previous PREPARE BINDING REPORT command as described in 5.8.12. Device servers that implement the RECEIVE BINDING REPORT command shall also implement the PREPARE BINDING REPORT command (see 6.16).

Table 223 – RECEIVE BINDING REPORT command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (9Eh)							
1	Reserved			SERVICE ACTION (0Fh)				
2	Reserved							
3								
4	(MSB)							
•••				BINDING LIST IDENTIFIER				
7								(LSB)
8								
•••				Reserved				
11								
12	(MSB)			ALLOCATION LENGTH				
13								(LSB)
14	Reserved							
15	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 223 for the RECEIVE BINDING REPORT command.

The SERVICE ACTION field is defined in 4.2.5.2 and shall be set as shown in table 223 for the RECEIVE BINDING REPORT command.

The BINDING LIST IDENTIFIER field specifies the binding report to be returned as described in 5.8.12.1.

The ALLOCATION LENGTH field is defined in 4.2.5.6.

The CONTROL byte is defined in SAM-6.

For the RECEIVE BINDING REPORT command, the device server returns parameter data (see table 224) containing zero or more binding descriptors.

Table 224 – RECEIVE BINDING REPORT command parameter data

Bit Byte	7	6	5	4	3	2	1	0
0 ••• 3	(MSB) 		BINDING REPORT PARAMETER LIST LENGTH (n-3)					 (LSB)
4 ••• 15				Reserved				
				Binding descriptor list				
16 •••				Binding descriptor (see table 225) [first]				
				⋮				
••• n				Binding descriptor (see table 225) [last]				

The BINDING REPORT PARAMETER LIST LENGTH field indicates the number of bytes of parameter data that follow.

Each binding descriptor (see table 225) describes one binding (see 5.8.1).

Table 225 – Binding descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
1			BINDING DESCRIPTOR DATA LENGTH (n-1)					(LSB)
2				Reserved				LGDVALID
3 ••• 7				Reserved				
8 ••• 23	(MSB)			HOST BIND IDENTIFIER				(LSB)
				SUBSIDIARY ELEMENT INFORMATION				
24 25	(MSB)			AFFILIATION CONDITION				(LSB)
26 ••• 31	(MSB)			SLUN				(LSB)
32 ••• 35				LOGICAL UNIT GROUP DESIGNATOR				
36 ••• k				ADMINISTRATIVE LOGICAL UNIT DESIGNATOR				
k+1 ••• k+8				Reserved				
k+9 ••• n				PAD (if any)				

The BINDING DESCRIPTOR DATA LENGTH indicates the number of bytes that follow in the binding descriptor.

A logical unit group descriptor bit valid (LGDVALID) bit set to one indicates that the LOGICAL UNIT GROUP DESIG-NATOR field is valid. A LGDVALID bit set to zero indicates that the LOGICAL UNIT GROUP DESIGNATOR field is not valid.

The HOST BIND IDENTIFIER field indicates the host bind identifier (see 5.8.2) for an S_A binding pair.

The SUBSIDIARY ELEMENT INFORMATION field indicates the LUN information for the subsidiary logical unit and the affiliation condition for this binding descriptor in the same format as the sense data INFORMATION field defined in 5.8.8.2.

The AFFILIATION CONDITION field indicates the condition of the binding described by this descriptor and is set as defined in 5.8.8.2.2.

The SLUN field indicates the subsidiary logical unit LUN information that is being described by this descriptor and is set as defined in 5.8.8.2.3.

If the LGDVALID bit set to one, the LOGICAL UNIT GROUP DESIGNATOR field (see 7.7.6.9) indicates the logical unit group for this binding descriptor.

The ADMINISTRATIVE LOGICAL UNIT DESIGNATOR field (see 7.7.6.2.1) indicates the administrative logical unit for this binding descriptor.

The PAD field shall contain zero to seven bytes set to zero such that the total length of the binding descriptor is a multiple of eight.

6.22 RECEIVE COPY DATA command

The RECEIVE COPY DATA command (see table 226) is a third-party copy command (see 5.19.3) that requests the copy manager to return the held data (see 5.19.4.5), if any, for the copy operation (see 5.19.4.3) specified by the LIST IDENTIFIER field (see 5.19.4.2) in the CDB.

Table 226 – RECEIVE COPY DATA command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (84h)							
1	Reserved			SERVICE ACTION (06h)				
2	(MSB)							
•••				LIST IDENTIFIER				
5								(LSB)
6								
•••				Reserved				
9								
10	(MSB)							
•••				ALLOCATION LENGTH				
13								(LSB)
14	Reserved							
15	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 226 for the RECEIVE COPY DATA command.

The SERVICE ACTION field is defined in 4.2.5.2 and shall be set as shown in table 226 for the RECEIVE COPY DATA command.

The LIST IDENTIFIER field is defined in 5.19.4.2 and 6.6.3.2, and specifies the copy operation (see 5.19.4.3) about which information is to be transferred. The receive command shall return information from the copy operation that was received on the same I_T nexus with a list identifier that matches the list identifier specified

in the RECEIVE COPY RESULTS command's CDB. If no copy operation known to the copy manager has a matching list identifier, the copy manager shall terminate the RECEIVE COPY DATA command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

The ALLOCATION LENGTH field is defined in 4.2.5.6. The actual length of the parameter data is available in the AVAILABLE DATA field in the parameter data.

The CONTROL byte is defined in SAM-6.

Table 227 shows the format of the parameter data for the RECEIVE COPY DATA command.

Table 227 – Parameter data for the RECEIVE COPY DATA command

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
•••				AVAILABLE DATA (n-3)				
3								(LSB)
4		Reserved			RESPONSE TO SERVICE ACTION			
5	HDD			COPY OPERATION STATUS				
6	(MSB)							
7				OPERATION COUNTER				(LSB)
8	(MSB)							
•••				ESTIMATED STATUS UPDATE DELAY				
11								(LSB)
12				EXTENDED COPY COMPLETION STATUS				
13				LENGTH OF THE SENSE DATA FIELD (x-31)				
14				SENSE DATA LENGTH				
15				TRANSFER COUNT UNITS				
16	(MSB)							
•••				TRANSFER COUNT				
23								(LSB)
24	(MSB)							
25				SEGMENTS PROCESSED				(LSB)
26								
•••				Reserved				
31								
32								
•••				SENSE DATA				
x								
x+1	(MSB)							
•••				HELD DATA LENGTH (n-(x+4))				
x+4								(LSB)
x+5								
•••				HELD DATA				
n								

The copy manager shall not discard the data returned by a RECEIVE COPY DATA command in response to an ABORT TASK task management function (see SAM-6) or a COPY OPERATION ABORT command (see 6.4).

The AVAILABLE DATA field, RESPONSE TO SERVICE ACTION field, COPY OPERATION STATUS field, OPERATION COUNTER field, ESTIMATED STATUS UPDATE DELAY field, EXTENDED COPY COMPLETION STATUS field, LENGTH OF THE SENSE DATA FIELD field, SENSE DATA LENGTH field, TRANSFER COUNT UNITS field, TRANSFER COUNT field, SEGMENTS PROCESSED field, and SENSE DATA field are defined in 6.23.

The held data discarded (HDD) bit indicates whether held data has been discarded as described in 5.19.4.5.

If the COPY OPERATION STATUS field is set to a value that table 230 (see 6.23) describes as meaning the operation completed without errors, then the HELD DATA LENGTH field indicates the number of bytes that follow in the HELD DATA field. If the COPY OPERATION STATUS field is not set to a value that table 230 describes as meaning the operation completed without errors, then the HELD DATA LENGTH field shall be set to zero.

The HELD DATA field contains the held data (see 5.19.4.5) for the copy operation (see 5.19.4.3) specified by the list identifier in the CDB (see 5.19.4.2). Unless the copy manager's held data limit (see 5.19.4.5) is exceeded, the first byte held (i.e., the oldest byte held) in response to the copy operation (e.g., the first segment descriptor in the EXTENDED COPY parameter list prescribing the holding of data) is returned in the first byte in the HELD DATA field. The last byte held (i.e., the newest byte held) in response to the copy operation (e.g., the last segment descriptor in the EXTENDED COPY parameter list prescribing the holding of data) is returned in the last byte in the HELD DATA field.

6.23 RECEIVE COPY STATUS command

The RECEIVE COPY STATUS command (see table 228) is a third-party copy command (see 5.19.3) that requests the copy manager to return the status information (see 5.19.4.4) for the copy operation (see 5.19.4.3) specified by the LIST IDENTIFIER field (see 5.19.4.2) in the CDB.

Table 228 – RECEIVE COPY STATUS command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (84h)							
1	Reserved			SERVICE ACTION (05h)				
2	(MSB)							
•••	LIST IDENTIFIER							
5	(LSB)							
6								
•••	Reserved							
9								
10	(MSB)							
•••	ALLOCATION LENGTH							
13	(LSB)							
14	Reserved							
15	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 228 for the RECEIVE COPY STATUS command.

The SERVICE ACTION field is defined in 4.2.5.2 and shall be set as shown in table 228 for the RECEIVE COPY STATUS command.

The LIST IDENTIFIER field and ALLOCATION LENGTH field are defined in 6.22.

If no copy operation known to the copy manager has a list identifier that matches the contents of the LIST IDENTIFIER field, then the copy manager shall terminate the RECEIVE COPY STATUS command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

The CONTROL byte is defined in SAM-6.

Table 229 shows the format of the parameter data for the RECEIVE COPY STATUS command.

Table 229 – Parameter data for the RECEIVE COPY STATUS command

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
•••			AVAILABLE DATA (n-3)					
3								(LSB)
4	Reserved			RESPONSE TO SERVICE ACTION				
5	Reserved	COPY OPERATION STATUS						
6	(MSB)							
7		OPERATION COUNTER						(LSB)
8	(MSB)							
•••			ESTIMATED STATUS UPDATE DELAY					
11								(LSB)
12	EXTENDED COPY COMPLETION STATUS							
13	LENGTH OF THE SENSE DATA FIELD (x-31)							
14	SENSE DATA LENGTH							
15	TRANSFER COUNT UNITS							
16	(MSB)							
•••			TRANSFER COUNT					
23								(LSB)
24	(MSB)							
25		SEGMENTS PROCESSED						(LSB)
26								
•••			Reserved					
31								
32								
•••			SENSE DATA					
x								

The AVAILABLE DATA field shall contain the number of bytes that follow in the parameter data. The contents of the AVAILABLE DATA field are not altered based on the allocation length (see 4.2.5.6).

The RESPONSE TO SERVICE ACTION field indicates the value in the SERVICE ACTION field of the third-party copy command (see 5.19.3) specified by the LIST IDENTIFIER field in the CDB.

The COPY OPERATION STATUS field indicates the status of the copy operation (see 5.19.4.3) specified by the LIST IDENTIFIER field in the CDB as defined in table 230.

Table 230 – COPY OPERATION STATUS field

Code	Meaning	Operation completed without errors
01h	Operation completed without errors	Yes
02h	Operation completed with errors	No
03h [a]	Operation completed without errors but with partial ROD token usage (e.g., the residual is negative (see SBC-5))	Yes
04h	Operation completed without errors but with residual data [b]	Yes
05h	Operation ended without errors by a COPY OPERATION CLOSE command (see 6.5)	Yes
06h	Operation ended with errors by a COPY OPERATION CLOSE command (see 6.5)	No
10h	Operation in progress, foreground or background unknown [c]	No
11h	Operation in progress in foreground (see 5.19.4.3)	No
12h	Operation in progress in background (see 5.19.4.3)	No
13h	Copy operation close in progress in foreground (see 6.5)	No
14h	Copy operation close in progress in background (see 6.5)	No
60h	Operation terminated (e.g., by the preemption of a persistent reservation (see 5.14.11.2.6) or by a COPY OPERATION ABORT command (see 6.4))	No
all others	Reserved	

[a] If the third-party copy command that originated the copy operation is an EXTENDED COPY command, then the COPY OPERATION STATUS field shall never be set to 03h.
[b] The copy manager has determined that the application client should verify that all requested data transfers have been performed.
[c] Codes 11h and 12h should be used instead of this code whenever possible.

The OPERATION COUNTER field contains a wrapping counter of the number of SCSI commands, or equivalent, that the copy manager has sent to a copy source or copy destination as part of processing the copy operation (see 5.19.4.3) specified by the LIST IDENTIFIER field in the CDB, and for which the copy manager has received one of the following completion status values:

a) GOOD;
b) CONDITION MET; or
c) CHECK CONDITION with the sense key set to RECOVERED ERROR.

The ESTIMATED STATUS UPDATE DELAY field indicates the number of milliseconds that the copy manager recommends that the application client wait before sending another RECEIVE COPY STATUS command on the same I_T nexus with the same list identifier. If a RECEIVE COPY STATUS command is received sooner than the indicated time, the copy manager may return the same parameter data that was returned in response to the previous RECEIVE COPY STATUS command. If the COPY OPERATION STATUS field is set to 01h, 02h, 03h, 04h, or 60h, then the ESTIMATED STATUS UPDATE DELAY field shall be set to FFFF FFFEh. If the ESTIMATED STATUS UPDATE DELAY field is set to FFFF FFFFh, then the copy manager is unable to recommend a delay interval.

The EXTENDED COPY COMPLETION STATUS field indicates the status code (see SAM-6), if any, established for the completed copy operation (see 5.19.4.3) specified by the LIST IDENTIFIER field and is affected by the contents of the COPY OPERATION STATUS field as shown in table 231. If the IMMED bit, if any, (see 5.19.4.3) is set to one in the third-party copy command that originated the copy operation, then the contents of the EXTENDED COPY COMPLETION STATUS field may be different than the status returned by the originating third-party copy command.

Table 231 – EXTENDED COPY COMPLETION STATUS field contents based on COPY OPERATION STATUS field

COPY OPERATION STATUS field contents	EXTENDED COPY COMPLETION STATUS field contents
10h, 11h, 12h, 13h, or 14h	The EXTENDED COPY COMPLETION STATUS field is reserved.
01h, 02h, 03h, 04h, 05h, or 06h	The EXTENDED COPY COMPLETION STATUS field indicates the status code (see SAM-6) established for the completed copy operation specified by the LIST IDENTIFIER field.
60h	The EXTENDED COPY COMPLETION STATUS field shall be set to TASK ABORTED (see SAM-6).

The LENGTH OF THE SENSE DATA FIELD field indicates the number of bytes in the SENSE DATA field. The LENGTH OF THE SENSE DATA FIELD field shall be set to zero or a multiple of four.

If the COPY OPERATION STATUS field is set to 10h, 11h, 12h, 13h, 14h, or 60h, then the SENSE DATA LENGTH field shall be set to zero. If the COPY OPERATION STATUS field is set to 01h, 02h, 03h, 04h, 05h, or 06h then the SENSE DATA LENGTH field indicates the number of bytes in the SENSE DATA field that contain sense data. The value in the SENSE DATA LENGTH field shall be less than or equal to the value in the LENGTH OF THE SENSE DATA FIELD field (e.g., the SENSE DATA field may contain pad bytes that are counted in the LENGTH OF THE SENSE DATA FIELD field but not in the SENSE DATA LENGTH field).

The TRANSFER COUNT UNITS field indicates the units for the TRANSFER COUNT field as shown in table 232.

Table 232 – COPY STATUS TRANSFER COUNT UNITS field (part 1 of 2)

Code	Meaning [a]	Multiplier to convert TRANSFER COUNT field to bytes
00h	Bytes	1
01h	Kibibytes	2^{10} (i.e., 1 024)
02h	Mebibytes	2^{20}
03h	Gibibytes	2^{30}
[a] See 3.5.2.		

Table 232 – COPY STATUS TRANSFER COUNT UNITS field (part 2 of 2)

Code	Meaning [a]	Multiplier to convert TRANSFER COUNT field to bytes
04h	Tebibytes	2^{40}
05h	Pebibytes	2^{50}
06h	Exbibytes	2^{60}
F1h	n/a	logical block length of copy destination
all others	Reserved	
[a] See 3.5.2.		

The TRANSFER COUNT field indicates the amount of data written to a copy destination for the copy operation (see 5.19.4.3) specified by the LIST IDENTIFIER field prior to the time at which the copy manager processed the RECEIVE COPY STATUS command. If data has been written to the copy destination in an order other than what the command specified (e.g., if concurrent processing of multiple segment descriptors has resulted in some data being written out of order), then the TRANSFER COUNT field shall indicate only those bytes that have been written in strict order conformance with what the command specified.

The SEGMENTS PROCESSED field indicates the number of segments the copy manager has processed for the copy operation (see 5.19.4.3) specified by the LIST IDENTIFIER field including the segment currently being processed. The SEGMENTS PROCESSED field shall be set to zero if:

  a) the copy manager has not yet begun processing segment descriptors; or
  b) the RESPONSE TO SERVICE ACTION field indicates a third-party copy command that does not support segment descriptors.

6.24 RECEIVE DIAGNOSTIC RESULTS command

The RECEIVE DIAGNOSTIC RESULTS command (see table 233) requests the device server to return data based on the most recent SEND DIAGNOSTIC command (see 6.39) or a diagnostic page specified by the PAGE CODE field.

Table 233 – RECEIVE DIAGNOSTIC RESULTS command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (1Ch)							
1	Reserved							PCV
2	PAGE CODE							
3	(MSB)			ALLOCATION LENGTH				
4								(LSB)
5	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 233 for the RECEIVE DIAGNOSTIC RESULTS command.

A page code valid (PCV) bit set to zero specifies that the device server return parameter data based on the most recent SEND DIAGNOSTIC command (e.g., the diagnostic page with the same page code as that specified in the most recent SEND DIAGNOSTIC command). The response to a RECEIVE DIAGNOSTIC RESULTS command with the PCV bit set to zero is vendor specific if:

   a) the most recent SEND DIAGNOSTIC command was not a SEND DIAGNOSTIC command defining parameter data to return;
   b) a RECEIVE DIAGNOSTIC RESULTS command with a PCV bit set to one has been processed since the last SEND DIAGNOSTIC command was processed; or
   c) no SEND DIAGNOSTIC command with the PF bit set to one defining parameter data to return has been processed since power on, hard reset, or logical unit reset.

A page code valid (PCV) bit set to one specifies that the device server return the diagnostic page specified in the PAGE CODE field. Page code values are defined in 7.2 or in another command standard.

> NOTE 18 - Logical units compliant with SPC-2 may transfer more than one diagnostic page in the parameter data if the PCV bit is set to zero and the previous SEND DIAGNOSTIC command sent more than one diagnostic page in the parameter list.

To prevent the diagnostic information from being modified due to a command received through another I_T nexus, the application client should use reservations (see 5.14).

The ALLOCATION LENGTH field is defined in 4.2.5.6.

The CONTROL byte is defined in SAM-6.

See 7.2 for RECEIVE DIAGNOSTIC RESULTS diagnostic page format definitions.

6.25 RECEIVE ROD TOKEN INFORMATION command

The RECEIVE ROD TOKEN INFORMATION command (see table 234) is a third-party copy command (see 5.19.3) that requests the copy manager to return all the ROD tokens (see 5.19.6.1) created during the copy operation (see 5.19.4.3) specified by the LIST IDENTIFIER field (see 5.19.4.2) in the CDB.

Table 234 – RECEIVE ROD TOKEN INFORMATION command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (84h)							
1	Reserved			SERVICE ACTION (07h)				
2	(MSB)							
•••				LIST IDENTIFIER				
5								(LSB)
6								
•••				Reserved				
9								
10	(MSB)							
•••				ALLOCATION LENGTH				
13								(LSB)
14	Reserved							
15	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 234 for the RECEIVE ROD TOKEN INFORMATION command.

The SERVICE ACTION field is defined in 4.2.5.2 and shall be set as shown in table 234 for the RECEIVE ROD TOKEN INFORMATION command.

The LIST IDENTIFIER field and ALLOCATION LENGTH field are defined in 6.22.

If no copy operation known to the copy manager has a list identifier that matches the contents of the LIST IDENTIFIER field, then the copy manager shall terminate the RECEIVE ROD TOKEN INFORMATION command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

The CONTROL byte is defined in SAM-6.

Table 235 shows the format of the parameter data for the RECEIVE ROD TOKEN INFORMATION command.

Table 235 – Parameter data for the RECEIVE ROD TOKEN INFORMATION command

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
•••			AVAILABLE DATA (n-3)					
3								(LSB)
4	Reserved			RESPONSE TO SERVICE ACTION				
5	Reserved	COPY OPERATION STATUS						
6	(MSB)			OPERATION COUNTER				
7								(LSB)
8	(MSB)							
•••			ESTIMATED STATUS UPDATE DELAY					
11								(LSB)
12	EXTENDED COPY COMPLETION STATUS							
13	LENGTH OF THE SENSE DATA FIELD (X-31)							
14	SENSE DATA LENGTH							
15	TRANSFER COUNT UNITS							
16	(MSB)							
•••			TRANSFER COUNT					
23								(LSB)
24	(MSB)			SEGMENTS PROCESSED				
25								(LSB)
26								
•••			Reserved					
31								
32								
•••			SENSE DATA					
x								
x+1								
•••			ROD TOKEN DESCRIPTORS LENGTH (n-(x+4))					
x+4								
	ROD token descriptor list							
x+5								
•••			ROD token descriptor (see table 236) [first]					
	⋮							
•••			ROD token descriptor (see table 236) [last]					
n								

The AVAILABLE DATA field, RESPONSE TO SERVICE ACTION field, COPY OPERATION STATUS field, OPERATION COUNTER field, ESTIMATED STATUS UPDATE DELAY field, EXTENDED COPY COMPLETION STATUS field, LENGTH OF THE SENSE DATA FIELD field, SENSE DATA LENGTH field, TRANSFER COUNT UNITS field, TRANSFER COUNT field, SEGMENTS PROCESSED field, and SENSE DATA field are defined in 6.23.

If the COPY OPERATION STATUS field is set to a value that table 230 (see 6.23) describes as meaning the operation completed without errors, then the ROD TOKEN DESCRIPTORS LENGTH field indicates the number of bytes that follow in ROD token descriptors. If the COPY OPERATION STATUS field is not set to a value that table 230 (see 6.23) describes as meaning the operation completed without errors, then the ROD TOKEN DESCRIPTORS LENGTH field shall be set to zero.

If the COPY OPERATION STATUS field is set to 01h or 03h, then each ROD token descriptor (see table 236) shall contain one ROD token created by the copy operation whose service action is indicated by the RESPONSE TO SERVICE ACTION field.

Table 236 – ROD token descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
1			ID FOR CREATING ROD CSCD DESCRIPTOR					(LSB)
2								
•••				ROD TOKEN				
n								

If the RESPONSE TO SERVICE ACTION field is set to 00h or 01h (i.e., if the ROD tokens being returned were created by an EXTENDED COPY command), then the ID FOR CREATING ROD CSCD DESCRIPTOR field indicates the CSCD descriptor ID for the ROD CSCD descriptor in which the R_TOKEN bit was set to one resulting in the creation of the ROD token contained in the ROD TOKEN field (i.e., the value any segment descriptor that caused the ROD to be populated had in its DESTINATION CSCD DESCRIPTOR ID field). If the RESPONSE TO SERVICE ACTION field does not contain 00h or 01h (i.e., if the ROD tokens being returned were created by a command other than the EXTENDED COPY command), then the ID FOR CREATING ROD CSCD DESCRIPTOR field is reserved.

The ROD TOKEN field contains a ROD token (see 5.19.6.4) created by the copy manager.

6.26 REMOVE I_T NEXUS command

The REMOVE I_T NEXUS command (see table 237) requests the device server to establish an I_T nexus loss (see SAM-6) for the logical unit containing the device server for each specified I_T nexus. This command uses the MAINTENANCE OUT CDB format (see 4.2.2.3.4).

Table 237 – REMOVE I_T NEXUS command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (A4h)							
1	Reserved			SERVICE ACTION (0Ch)				
2 ••• 5	Reserved							
6 ••• 9	(MSB)		PARAMETER LIST LENGTH					(LSB)
10	Reserved							
11	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 237 for the REMOVE I_T NEXUS command.

The SERVICE ACTION field is defined in 4.2.5.2 and shall be set as shown in table 237 for the REMOVE I_T NEXUS command.

The PARAMETER LIST LENGTH field specifies the length in bytes of the parameter data that shall be transferred from the application client to the device server. A parameter list length value of zero specifies that no data shall be transferred and no I_T nexuses shall be removed.

The CONTROL byte is defined in SAM-6.

If the parameter list length results in the truncation of the header or any I_T nexus descriptor, then the device server:

    a) shall not remove any I_T nexuses; and
    b) shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to PARAMETER LIST LENGTH ERROR.

Table 238 shows the format of the REMOVE I_T NEXUS parameter list.

Table 238 – REMOVE I_T NEXUS parameter list

Bit Byte	7	6	5	4	3	2	1	0
0				Reserved				
1								
2	(MSB)			I_T NEXUS DESCRIPTOR LIST LENGTH (n-3)				
3								(LSB)
				I_T nexus descriptor list				
4 •••				I_T nexus descriptor [first]				
				$\vdots$				
••• n				I_T nexus descriptor [last]				

The I_T NEXUS DESCRIPTOR LIST LENGTH field specifies the length in bytes of the I_T nexus descriptor list.

The I_T nexus descriptor list contains one or more I_T nexus descriptors (see table 239). The I_T nexus descriptors may appear in the I_T nexus descriptor list in any order. The device server shall process the I_T nexus descriptors in order. The device server shall ignore any I_T nexus descriptor that describes an I_T nexus not known to the logical unit.

The device server shall not remove any I_T nexuses and shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST if any of the I_T nexus descriptors describe:

    a) the same I_T nexus as the one through which the REMOVE I_T NEXUS command is received; or
    b) an I_T nexus that does not support the I_T NEXUS RESET task management function.

Table 239 – I_T nexus descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			RELATIVE TARGET PORT IDENTIFIER				
1								(LSB)
2	(MSB)			TRANSPORTID LENGTH (n-3)				
3								(LSB)
4 ••• n				TRANSPORTID				

The RELATIVE TARGET PORT IDENTIFIER field (see 4.3.4) specifies the relative target port identifier of the target port of the I_T nexus to be reset.

The TRANSPORTID LENGTH field specifies the length in bytes of the TRANSPORTID field.

The TRANSPORTID field specifies a TransportID (see 7.6.4) identifying the SCSI initiator port of the I_T nexus to be reset.

6.27 REPORT ALIASES command

The REPORT ALIASES command (see table 240) requests the device server to return the alias list. This command uses the MAINTENANCE IN CDB format (see 4.2.2.3.3). The alias list is managed using the CHANGE ALIASES command (see 6.3). If the CHANGE ALIASES command is supported, the REPORT ALIASES command shall also be supported.

Table 240 – REPORT ALIASES command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (A3h)							
1	Reserved			SERVICE ACTION (0Bh)				
2 ••• 5	Reserved							
6 ••• 9	(MSB) ALLOCATION LENGTH (LSB)							
10	Reserved							
11	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 240 for the REPORT ALIASES command.

The SERVICE ACTION field is defined in 4.2.5.2 and shall be set as shown in table 240 for the REPORT ALIASES command.

The ALLOCATION LENGTH field is defined in 4.2.5.6.

The CONTROL byte is defined in SAM-6.

The parameter data for a REPORT ALIASES command (see table 241) contains zero or more alias entries.

Table 241 – REPORT ALIASES parameter data

Bit Byte	7	6	5	4	3	2	1	0
0 **•••** **3**	(MSB)			ADDITIONAL LENGTH (n-3)				(LSB)
4	Reserved							
5	Reserved							
6 **7**	(MSB)			NUMBER OF ALIASES				(LSB)
	Alias entry list							
8 **•••**				Alias entry (see 6.3.2) [first]				
				⋮				
••• **n**				Alias entry (see 6.3.2) [last]				

The ADDITIONAL LENGTH field indicates the number of bytes in the remaining parameter data. The contents of the ADDITIONAL LENGTH field are not altered based on the allocation length (see 4.2.5.6).

The NUMBER OF ALIASES field indicates the number of alias entries in the alias list and shall not be changed if the CDB contains an insufficient allocation length.

The parameter data shall include one alias entry for each alias in the alias list. The format of an alias entry is described in 6.3.2.

6.28 REPORT ALL ROD TOKENS command

The REPORT ALL ROD TOKENS command (see table 242) is a third-party copy command (see 5.19.3) that requests the copy manager to return a ROD management token (see 5.19.6.4) for each ROD token that was created by and is known to the copy manager.

Table 242 – REPORT ALL ROD TOKENS command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (84h)							
1	Reserved			SERVICE ACTION (08h)				
2 ••• 9	Reserved							
10 ••• 13	(MSB) ALLOCATION LENGTH (LSB)							
14	Reserved							
15	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 242 for the REPORT ALL ROD TOKENS command.

The SERVICE ACTION field is defined in 4.2.5.2 and shall be set as shown in table 242 for the REPORT ALL ROD TOKENS command.

The ALLOCATION LENGTH field is defined in 4.2.5.6.

The CONTROL byte is defined in SAM-6.

In response to the REPORT ALL ROD TOKENS command, the copy manager shall return one or more ROD management tokens. Each ROD management token shall represent a ROD token that:

a) has fields defined in the ROD token body;
b) was created by the copy manager that is processing the REPORT ALL ROD TOKENS command; and
c) is known to that copy manager.

The format of the REPORT ALL ROD TOKENS parameter data is shown in table 243.

Table 243 – Parameter data for the REPORT ALL ROD TOKENS command

Bit Byte	7	6	5	4	3	2	1	0
0 ••• 3	(MSB) AVAILABLE DATA (n-3) 							(LSB)
4 ••• 7	Reserved							
	ROD management token list							
8 ••• 103	ROD management token [first]							
	⋮							
n-95 ••• n	ROD management token [last]							

The AVAILABLE DATA field shall contain the number of bytes that follow in the parameter data. The contents of the AVAILABLE DATA field are not altered based on the allocation length (see 4.2.5.6).

Each ROD management token is a 96-byte token that contains the fields described in 5.19.6.4, and represents a ROD token that meets the criteria described in this subclause.

6.29 REPORT IDENTIFYING INFORMATION command

6.29.1 REPORT IDENTIFYING INFORMATION command overview

The REPORT IDENTIFYING INFORMATION command (see table 244) requests the device server to return identifying information (see 5.7). This command uses the MAINTENANCE IN CDB format (see 4.2.2.3.3). The REPORT IDENTIFYING INFORMATION command is an extension to the REPORT PERIPHERAL DEVICE/COMPONENT DEVICE IDENTIFIER service action of the MAINTENANCE IN command defined in SCC-2.

The device server shall return the same identifying information regardless of the I_T nexus being used to transfer the identifying information.

Processing a REPORT IDENTIFYING INFORMATION command may require the enabling of a nonvolatile memory within the logical unit. If the nonvolatile memory is not ready, the device server shall terminate the command with CHECK CONDITION status, and not wait for the nonvolatile memory to become ready. The sense key shall be set to NOT READY and the additional sense code shall be set as described in table 304 (see 6.46). This information should allow the application client to determine the action required to cause the device server to become ready.

Table 244 – REPORT IDENTIFYING INFORMATION command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (A3h)							
1	Reserved			SERVICE ACTION (05h)				
2	Reserved							
3								
4	Restricted (see SCC-2)							
5								
6	(MSB)							
•••				ALLOCATION LENGTH				
9								(LSB)
10	IDENTIFYING INFORMATION TYPE							Reserved
11	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 244 for the REPORT IDENTIFYING INFORMATION command.

The SERVICE ACTION field is defined in 4.2.5.2 and shall be set as shown in table 244 for the REPORT IDENTIFYING INFORMATION command.

The ALLOCATION LENGTH field is defined in 4.2.5.6.

The IDENTIFYING INFORMATION TYPE field (see table 245) specifies the type of identifying information to be returned. If the specified identifying information type is not implemented by the device server, the device server shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

Table 245 – IDENTIFYING INFORMATION TYPE field

Code	Description	Reference
0000000b	Logical unit identifying information (see 5.7).	6.29.2
0000010b	Logical unit text identifying information (see 5.7).	6.29.2
1111110b	Identifying information supported – The parameter data contains a list of supported identifying information types and the maximum length of each.	6.29.3
xxxxxx1b	Restricted	SCC-2
all others	Reserved	

The CONTROL byte is defined in SAM-6.

6.29.2 Logical unit identifying information parameter data

The logical unit identifying information parameter data format (see table 246) is used if the IDENTIFYING INFOR-MATION TYPE field is set to 0000000b or 0000010b.

Table 246 – Logical unit identifying information parameter data

Bit Byte	7	6	5	4	3	2	1	0
0				Reserved				
1								
2	(MSB)			IDENTIFYING INFORMATION LENGTH (n-3)				
3								(LSB)
4				IDENTIFYING INFORMATION				
•••								
n								

The IDENTIFYING INFORMATION LENGTH field indicates the length in bytes of the IDENTIFYING INFORMATION field. The contents of the IDENTIFYING INFORMATION LENGTH field are not altered based on the allocation length (see 4.2.5.6).

The IDENTIFYING INFORMATION field contains the logical unit identifying information that has the specified identifying information type (see 6.29.1).

6.29.3 Identifying information supported parameter data

The identifying information supported parameter data format (see table 247) is used if the IDENTIFYING INFOR-MATION TYPE field is set to 1111110b.

Table 247 – Identifying information supported parameter data

Bit Byte	7	6	5	4	3	2	1	0
0				Reserved				
1								
2	(MSB)			IDENTIFYING INFORMATION LENGTH (n-3)				
3								(LSB)
				Identifying information descriptor list				
4				Identifying information descriptor [first] (see table 248)				
•••								
7								
				⋮				
n-3				Identifying information descriptor [last] (see table 248)				
•••								
n								

The IDENTIFYING INFORMATION LENGTH field indicates the length in bytes of the identifying information descriptor list. The contents of the IDENTIFYING INFORMATION LENGTH field are not altered based on the allocation length (see 4.2.5.6).

The identifying information descriptor list contains an identifying information descriptor (see table 248) for each identifying information type supported by the device server. The identifying information descriptors shall be sorted in increasing order based on the value in the IDENTIFYING INFORMATION TYPE field.

Table 248 – Identifying information descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	IDENTIFYING INFORMATION TYPE							Reserved
1	Reserved							
2	(MSB)	MAXIMUM IDENTIFYING INFORMATION LENGTH						
3								(LSB)

The IDENTIFYING INFORMATION TYPE field indicates the identifying information type (see table 245) associated with the descriptor.

The MAXIMUM IDENTIFYING INFORMATION LENGTH field indicates the maximum number of bytes supported for the identifying information type indicated the value in the IDENTIFYING INFORMATION TYPE field.

6.30 REPORT LUNS command

The REPORT LUNS command (see table 249) requests the device server to return the logical unit inventory accessible to the I_T nexus. The logical unit inventory returned to the application client is a list that shall include the logical unit numbers of all logical units having a PERIPHERAL QUALIFIER value of 000b (see 6.7.2) based on the SELECT REPORT field. Logical unit numbers for logical units with PERIPHERAL QUALIFIER values other than 000b and 011b may be included in the logical unit inventory. Logical unit numbers for logical units with a PERIPHERAL QUALIFIER value of 011b shall not be included in the logical unit inventory.

Table 249 – REPORT LUNS command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (A0h)							
1	Reserved							
2	SELECT REPORT							
3 ••• 5	Reserved							
6 ••• 9	(MSB) ALLOCATION LENGTH (LSB)							
10	Reserved							
11	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 249 for the REPORT LUNS command.

The SELECT REPORT field (see table 250) specifies the types of logical unit addresses that shall be reported.

Table 250 – SELECT REPORT field (part 1 of 2)

Code	Description

00h	The list shall contain the logical units accessible to the I_T nexus with the following addressing methods (see SAM-6):
	  a) simple logical unit addressing method;
	  b) logical unit addressing method;
	  c) peripheral device addressing method;
	  d) flat space addressing method;
	  e) extended flat space addressing method; and
	  f) long extended flat space addressing method.
	If there are no logical units to report, the LUN LIST LENGTH field shall be set to zero.

01h	The list shall contain only well known logical units, if any. If there are no well known logical units, the LUN LIST LENGTH field shall be zero.
02h	The list shall contain all logical units accessible to the I_T nexus.

Table 250 – SELECT REPORT field (part 2 of 2)

Code	Description

10h	If the device server processing the command is in LUN 0 or the REPORT LUNS well known logical unit, then the list shall contain only administrative logical units (see SAM-6).
	 The LUN LIST LENGTH field shall be set to zero if the device server processing the command is not in:
	    a) LUN 0; or
	    b) the REPORT LUNS well known logical unit.
	 If there are no logical units to report, the LUN LIST LENGTH field shall be set to zero.

11h	If the device server processing the command is in LUN 0 or the REPORT LUNS well known logical unit, then the list shall contain only:
	    a) administrative logical units (see SAM-6);
	    b) logical units with the logical unit addressing method at level 1; and
	    c) logical units with single level LUN structure with the following addressing methods (see SAM-6):
	        A) peripheral device addressing method;
	        B) flat space addressing method;
	        C) extended flat space addressing method; and
	        D) long extended flat space addressing method.
	 The LUN LIST LENGTH field shall be set to zero if the device server processing the command is not in:
	    a) LUN 0; or
	    b) the REPORT LUNS well known logical unit.
	 If there are no logical units to report, the LUN LIST LENGTH field shall be set to zero.

12h	If the device server processing the command is in an administrative logical unit, the list shall contain:
	    a) the logical unit processing the command; and
	    b) subsidiary logical units that are contained in the same logical unit conglomerate that contains the logical unit processing the command.
	 The LUN LIST LENGTH field shall be set to zero if the device server processing the command is not in an administrative logical unit.
	 If there are no logical units to report, the LUN LIST LENGTH field shall be set to zero.

F8h to FFh	Vendor specific
all others	Reserved

The ALLOCATION LENGTH field is defined in 4.2.5.6.

The CONTROL byte is defined in SAM-6.

The REPORT LUNS command shall return CHECK CONDITION status only if the device server is unable to return the requested report of the logical unit inventory.

If a REPORT LUNS command is received from an I_T nexus with a pending unit attention condition (i.e., before the device server reports CHECK CONDITION status), then the device server shall perform the REPORT LUNS command (see SAM-6).

The REPORT LUNS parameter data should be returned even though the device server is not ready for other commands. The report of the logical unit inventory should be available without incurring any media access delays. If the device server is not ready with the logical unit inventory or if the inventory list is null for the requesting I_T nexus and the SELECT REPORT field set to 02h, then the device server shall provide a default

logical unit inventory that contains at least LUN 0 or the REPORT LUNS well known logical unit (see 8.2). A non-empty logical unit inventory that does not contain either LUN 0 or the REPORT LUNS well known logical unit is valid.

If a REPORT LUNS command is received for a logical unit that the SCSI target device does not support and the device server is not capable of returning the logical unit inventory, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to LOGICAL UNIT NOT SUPPORTED.

The device server shall report those devices in the logical unit inventory using the format shown in table 251.

Table 251 – REPORT LUNS parameter data

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
•••				LUN LIST LENGTH (n-7)				
3								(LSB)
4								
•••				Reserved				
7								
				LUN list				
8								
•••				LUN [first]				
15								
				⋮				
n-7								
•••				LUN [last]				
n								

The LUN LIST LENGTH field shall contain the length in bytes of the LUN list. The LUN list length is the number of logical unit numbers in the logical unit inventory multiplied by eight. The contents of the LUN LIST LENGTH field are not altered based on the allocation length (see 4.2.5.6).

6.31 REPORT PRIORITY command

The REPORT PRIORITY command (see table 252) requests the device server to return the command priorities (see SAM-6) that have been assigned to one or more I_T nexuses associated with the logical unit (i.e., I_T_L nexuses). This command uses the MAINTENANCE IN CDB format (see 4.2.2.3.3).

Table 252 – REPORT PRIORITY command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (A3h)							
1	Reserved			SERVICE ACTION (0Eh)				
2	PRIORITY REPORTED		Reserved					
3 ••• 5	Reserved							
6 ••• 9	(MSB) ALLOCATION LENGTH (LSB)							
10	Reserved							
11	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 252 for the REPORT PRIORTY command.

The SERVICE ACTION field is defined in 4.2.5.2 and shall be set as shown in table 252 for the REPORT PRIORTY command.

The PRIORITY REPORTED field (see table 253) specifies the information to be returned in the parameter data.

Table 253 – PRIORITY REPORTED field

Code	Description
00b	Only the priority for the I_T nexus on which the command was received shall be reported in the REPORT PRIORITY parameter data.
01b	The priority for each I_T nexus that is not set to the initial command priority shall be reported in the REPORT PRIORITY parameter data.
10b to 11b	Reserved

The ALLOCATION LENGTH field is defined in 4.2.5.6. The allocation length should be at least four.

The CONTROL byte is defined in SAM-6.

The format of the parameter data for the REPORT PRIORITY command is shown in table 254.

Table 254 – REPORT PRIORITY parameter data

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
•••			PRIORITY PARAMETER DATA LENGTH (n-3)					
3								(LSB)
	Priority descriptor list							
4								
•••			Priority descriptor (see table 255) [first]					
	⋮							
•••			Priority descriptor (see table 255) [last]					
n								

The PRIORITY PARAMETER DATA LENGTH field indicates the number of bytes of parameter data that follow. The contents of the PRIORITY PARAMETER DATA LENGTH field are not altered based on the allocation length (see 4.2.5.6).

Each priority descriptor (see table 255) contains priority information for a single I_T_L nexus.

Table 255 – Priority descriptor

Bit Byte	7	6	5	4	3	2	1	0
0			Reserved			CURRENT PRIORITY		
1				Reserved				
2	(MSB)							
3			RELATIVE TARGET PORT IDENTIFIER					(LSB)
4				Reserved				
5				Reserved				
6	(MSB)							
7			ADDITIONAL DESCRIPTOR LENGTH (n-7)					(LSB)
8								
•••			TransportID					
n								

The CURRENT PRIORITY field indicates the priority assigned to the I_T_L nexus represented by this descriptor. If the PRIORITY REPORTED field in this command is set to 00b and the priority for the I_T_L nexus associated with this command is set to the initial command priority, then the CURRENT PRIORITY field shall be set to zero. The priority assigned to an I_T_L nexus may be used as a command priority for commands received via that I_T_L nexus (see SAM-6).

The RELATIVE TARGET PORT IDENTIFIER field (see 4.3.4) indicates the relative port identifier of the target port that is part of the I_T_L nexus to which the current priority applies.

The ADDITIONAL DESCRIPTOR LENGTH field indicates the number of bytes that follow in the descriptor (i.e., the size of the TransportID).

The TransportID specifies a TransportID (see 7.6.4) identifying the SCSI initiator port that is part of the I_T_L nexus to which the current priority applies.

6.32 REPORT SUPPORTED OPERATION CODES command

6.32.1 REPORT SUPPORTED OPERATION CODES command introduction

The REPORT SUPPORTED OPERATION CODES command (see table 256) requests the device server to return information on commands the addressed logical unit supports. This command uses the MAINTE-NANCE IN CDB format (see 4.2.2.3.3). An application client may request a list of all operation codes and service actions supported by the logical unit or the command support data for a specific command.

Table 256 – REPORT SUPPORTED OPERATION CODES command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (A3h)							
1	Reserved			SERVICE ACTION (0Ch)				
2	RCTD	Reserved				REPORTING OPTIONS		
3	REQUESTED OPERATION CODE							
4	(MSB)	REQUESTED SERVICE ACTION						
5								(LSB)
6	(MSB)	ALLOCATION LENGTH						
•••								
9								(LSB)
10	Reserved							
11	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 256 for the REPORT SUPPORTED OPERATION CODES command.

The SERVICE ACTION field is defined in 4.2.5.2 and shall be set as shown in table 256 for the REPORT SUPPORTED OPERATION CODES command.

A return command timeouts descriptor (RCTD) bit set to one specifies that the command timeouts descriptor (see 6.32.4) shall be included in each command descriptor (see 6.32.2) that is returned or in the one_command parameter data (see 6.32.3) that is returned. A RCTD bit set to zero specifies that the command timeouts descriptor shall not be returned.

The REPORTING OPTIONS field (see table 257) specifies the information to be returned in the parameter data.

Table 257 – REPORT SUPPORTED OPERATION CODES REPORTING OPTIONS field

Code	Description	Parameter data reference
000b	A list of all operation codes and service actions [a] supported by the logical unit shall be returned in the all_commands parameter data format. The REQUESTED OPERATION CODE field and REQUESTED SERVICE ACTION field shall be ignored.	6.32.2
001b	The command support data for the operation code specified in the REQUESTED OPERATION CODE field shall be returned in the one_command parameter data format. The REQUESTED SERVICE ACTION field shall be ignored. If the REQUESTED OPERATION CODE field specifies an operation code for which the device server implements service actions [a], then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.	6.32.3
010b	The command support data for the operation code and service action [a] specified in the REQUESTED OPERATION CODE field and REQUESTED SERVICE ACTION field shall be returned in the one_command parameter data format. If the REQUESTED OPERATION CODE field specifies an operation code for which the device server does not implement service actions [a], then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.	6.32.3

011b	The command support data for the operation code and service action [a] specified in the REQUESTED OPERATION CODE field and REQUESTED SERVICE ACTION field shall be returned in the one_command parameter data format. If:
	   a) the operation code specified by the REQUESTED OPERATION CODE field specifies an operation code for which the device server does not implement service actions, the REQUESTED SERVICE ACTION field is set to 00h, and the command is supported; or
	   b) the operation code specified by the REQUESTED OPERATION CODE field specifies an operation code for which the device server implements service actions and the value in the REQUESTED SERVICE ACTION field is supported,
	 then the command support data shall indicate that the command is supported (i.e., the SUPPORT field (see table 262) is set to 011b or 101b). Otherwise, the command support data shall indicate that the command is not supported (i.e., the SUPPORT field is set to 001b).
		6.32.3

100b to 111b	Reserved	

[a] The device server should also process the following fields in the following commands as specifying service actions (i.e., the specified field should be processed as a SERVICE ACTION field):
   a) the MODE field in the READ BUFFER command (see 6.18); and
   b) the MODE field in the WRITE BUFFER command (see 6.49).		

The REQUESTED OPERATION CODE field specifies the operation code of the command to be returned in the one_command parameter data format (see 6.32.3).

The REQUESTED SERVICE ACTION field specifies the service action of the command to be returned in the one_command parameter data format.

The ALLOCATION LENGTH field is defined in 4.2.5.6.

The CONTROL byte is defined in SAM-6.

6.32.2 All_commands parameter data format

The REPORT SUPPORTED OPERATION CODES all_commands parameter data format (see table 258) begins with a four-byte header that contains the length in bytes of the parameter data followed by a list of supported commands. Each command descriptor contains information about a single supported command CDB (i.e., one operation code and service action combination, or one non-service-action operation code). The list of command descriptors shall contain all commands supported by the logical unit.

Table 258 – All_commands parameter data

Bit Byte	7	6	5	4	3	2	1	0
0 ••• 3	(MSB)			COMMAND DATA LENGTH (n-3)				(LSB)
				Command descriptor list				
4 •••				Command descriptor (see table 259) [first]				
				⋮				
••• n				Command descriptor (see table 259) [last]				

The COMMAND DATA LENGTH field indicates the length in bytes of the command descriptor list. The contents of the COMMAND DATA LENGTH field are not altered based on the allocation length (see 4.2.5.6).

Each command descriptor (see table 259) contains information about a single supported command CDB.

Table 259 – Command descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE							
1	Reserved							
2	(MSB)			SERVICE ACTION				
3								(LSB)
4	Reserved							
5	Reserved	RWCDLP	MLU		CDLP		CTDP	SERVACTV
6	(MSB)			CDB LENGTH				
7								(LSB)
8				Command timeouts descriptor, if any (see 6.32.4)				
•••								
19								

The OPERATION CODE field indicates the operation code of a command supported by the logical unit.

The SERVICE ACTION field indicates a supported service action of the supported operation code indicated by the OPERATION CODE field. If the operation code indicated in the OPERATION CODE field does not have any service actions, the SERVICE ACTION field shall be set to 00h.

The multiple logical units (MLU) field is described in table 260.

Table 260 – MLU field description

Code	Description
00b	The effect of this command on other logical units is not reported.
01b	This command affects only this logical unit.
10b	This command affects more than one but not all logical units contained in this SCSI target device.
11b	This command affects all of the logical units contained in this SCSI target device.

The read write command duration limits page (RWCDLP) bit and the command duration limit page (CDLP) field (see table 261) indicate the mode page, if any, that specifies the command duration limit for the command.

Table 261 – RWCDLP bit and CDLP field

RWCDLP bit	CDLP field	Description
0b	00b	No command duration limit mode page is indicated for this command
1b	00b	Reserved
0b [a]	01b [a]	Command Duration Limit A mode page
0b [b]	10b [b]	Command Duration Limit B mode page
1b [c]	01b [c]	Command Duration Limit T2A mode page
1b [d]	10b [d]	Command Duration Limit T2B mode page
0b or 1b	11b	Reserved

[a] If this value is returned, the Command Duration Limit A mode page (see 7.5.9) shall be supported.
[b] If this value is returned, the Command Duration Limit B mode page (see 7.5.10) shall be supported.
[c] If these values are returned, the Command Duration Limit T2A mode page (see 7.5.11) shall be supported.
[d] If these values are returned, the Command Duration Limit T2B mode page (see 7.5.12) shall be supported.

A command timeouts descriptor present (CTDP) bit set to one indicates that the command timeouts descriptor (see 6.32.4) is included in this command descriptor. A CTDP bit set to zero indicates that the command timeouts descriptor is not included in this command descriptor.

A service action valid (SERVACTV) bit set to zero indicates the operation code indicated by the OPERATION CODE field does not have service actions and the SERVICE ACTION field contents are reserved. A SERVACTV bit set to one indicates the operation code indicated by the OPERATION CODE field has service actions and the contents of the SERVICE ACTION field are valid.

The CDB LENGTH field indicates the length of the command CDB in bytes for the operation code indicated in the OPERATION CODE field, and if the SERVACTV bit is set to one the service action indicated by the SERVICE ACTION field.

The command timeouts descriptor is described in 6.32.4.

6.32.3 One_command parameter data format

The REPORT SUPPORTED OPERATION CODES one_command parameter data format (see table 262) contains information about the CDB and a usage map for bits in the CDB for the command specified by the REPORTING OPTIONS field, REQUESTED OPERATION CODE field, and REQUESTED SERVICE ACTION field in the REPORT SUPPORTED OPERATION CODES CDB.

Table 262 – One_command parameter data

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved							RWCDLP
1	CTDP	MLU		CDLP		SUPPORT		
2	(MSB)							
3			CDB SIZE (n-3)					(LSB)
4 ••• n			CDB USAGE DATA					
n+1 ••• n+12			Command timeouts descriptor, if any (see 6.32.4)					

A command timeouts descriptor present (CTDP) bit set to one indicates that the command timeouts descriptor (see 6.32.4) is included in the parameter data. A CTDP bit set to zero indicates that the command timeouts descriptor is not included in the parameter data.

The multiple logical units (MLU) field is described in table 260.

The read write command duration limits page (RWCDLP) bit and the command duration limit page (CDLP) field (see table 261) indicate the mode page, if any, that specifies the command duration limit for the command.

The SUPPORT field is defined in table 263.

Table 263 – SUPPORT values

Support	Description
000b	Data about the requested SCSI command is not currently available. No data after byte one is valid. A subsequent request for command support data may be successful.
001b	The device server does not support the requested command. Data after byte one is undefined.
010b	Reserved
011b	The device server supports the requested command in conformance with a SCSI standard. The parameter data format conforms to the definition in table 262.
100b	Reserved
101b	The device server supports the requested command in a vendor specific manner. The parameter data format conforms to the definition in table 262.
110b to 111b	Reserved

The CDB SIZE field indicates the size of the CDB USAGE DATA field in the parameter data, and the number of bytes in the CDB for command being queried (i.e., the command specified by the REPORTING OPTIONS field, REQUESTED OPERATION CODE field, and REQUESTED SERVICE ACTION field in the REPORT SUPPORTED OPERATION CODES CDB).

The CDB USAGE DATA field contains information about the CDB for the command being queried. The first byte of the CDB USAGE DATA field shall contain the operation code for the command being queried. If the command being queried contains a service action, then that service action code shall be placed in the CDB USAGE DATA field in the same location as the SERVICE ACTION field of the command CDB. All other bytes of the CDB USAGE DATA field shall contain a usage map for bits in the CDB for the command being queried.

The bits in the usage map shall have a one-for-one correspondence to the CDB for the command being queried. If the device server evaluates a bit in the CDB for the command being queried, the usage map shall contain a one in the corresponding bit position. If the device server ignores or treats as reserved a bit in the CDB for the command being queried, the usage map shall contain a zero in the corresponding bit position. The usage map bits for a given CDB field all shall have the same value (e.g., if any bit representing part of a field is set to one, all bits for the field shall be set to one).

For example, the CDB usage bit map for the REPORT SUPPORTED OPERATION CODES command is: A3h, 0Ch, 87h, FFh, FFh, FFh, FFh, FFh, FFh, FFh, 00h, 07h. This example assumes that the logical unit only supports the low-order three bits of the CDB CONTROL byte. The first byte contains the operation code, and the second byte contains three reserved bits and the service action. The remaining bytes contain the usage map.

The command timeouts descriptor is described in 6.32.4.

6.32.4 Command timeouts descriptor

6.32.4.1 Overview

The command timeouts descriptor (see table 264) contains timeout information for commands supported by the logical unit based on the time from the start of processing for the command to its reported completion.

Values contained in the command timeouts descriptor do not include times that are outside the control of the device server (e.g., prior commands with the IMMED bit set to one in the CDB, concurrent commands from the same or different I_T nexuses, manual unloads, power on self tests, prior aborted commands, commands that force cache synchronization, delays in the service delivery subsystem, time in the task set before the start of processing).

For commands that cause a change in power condition (see 5.13), values contained in the command timeouts descriptor do not include the power condition transition time (e.g., the time to spinup rotating media).

Values contained in the command timeouts descriptor should not be used to compare products.

Table 264 – Command timeouts descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
1			DESCRIPTOR LENGTH (000Ah)					(LSB)
2	Reserved							
3	COMMAND SPECIFIC							
4	(MSB)							
•••			NOMINAL COMMAND PROCESSING TIMEOUT					
7								(LSB)
8	(MSB)							
•••			RECOMMENDED COMMAND TIMEOUT					
11								(LSB)

The DESCRIPTOR LENGTH field indicates the number of bytes that follow in the command timeouts descriptor. The contents of the DESCRIPTOR LENGTH field are not altered based on the allocation length (see 4.2.5.6).

The COMMAND SPECIFIC field contains timeout information that is defined for a specific command (e.g., the WRITE BUFFER command (see 6.32.4.2)). If no command specific timeout information is defined by this standard or the applicable command standard, then the COMMAND SPECIFIC field is reserved.

A non-zero value in the NOMINAL COMMAND PROCESSING TIMEOUT field indicates the minimum amount of time in seconds the application client should wait prior to querying for the progress of the command identified by the parameter data that contains this command timeouts descriptor. A value of zero in the NOMINAL COMMAND PROCESSING TIMEOUT field indicates that no timeout is indicated.

> NOTE 19 - The value contained in the NOMINAL COMMAND PROCESSING TIMEOUT field may include time required for typical error recovery procedures that are expected.

A non-zero value in the RECOMMENDED COMMAND TIMEOUT field specifies the recommended time in seconds the application client should wait prior to timing out the command identified by the parameter data that contains this command timeouts descriptor. A value of zero in the RECOMMENDED COMMAND TIMEOUT field indicates that no time is indicated.

The device server should set the recommended command timeout to a value greater than or equal to the nominal command processing timeout.

6.32.4.2 WRITE BUFFER command timeouts descriptor COMMAND SPECIFIC field usage

For the WRITE BUFFER command (see 6.49), the COMMAND SPECIFIC field usage is reserved for all modes except the following:

  a) download microcode and activate mode (i.e., 04h);
  b) download microcode, save, and activate mode (i.e., 05h);
  c) download microcode with offsets and activate mode (i.e., 06h);
  d) download microcode with offsets, save, and activate mode (i.e., 07h);
  e) download microcode with offsets, select activation events, save, and defer activate mode (i.e., 0Dh) only if the microcode is activated by an event other than the activate deferred microcode mode;

     f)   download microcode with offsets, save, and defer activate mode (i.e., 0Eh) only if the microcode is activated by an event other than an activate deferred microcode mode; and

     g)   activate deferred microcode mode (i.e., 0Fh).

If the command timeouts descriptor describes one of the WRITE BUFFER modes listed in this subclause, then the COMMAND SPECIFIC field indicates the maximum time, in one second increments, that access to the SCSI target device is limited or not possible through any SCSI ports associated with a logical unit that processes a WRITE BUFFER command that specifies one of the named modes. A value of zero in the COMMAND SPECIFIC field indicates that no maximum time is indicated.

6.33 REPORT SUPPORTED TASK MANAGEMENT FUNCTIONS command

The REPORT SUPPORTED TASK MANAGEMENT FUNCTIONS command (see table 265) requests the device server to return the task management functions (see SAM-6) that the addressed logical unit supports. This command uses the MAINTENANCE IN CDB format (see 4.2.2.3.3).

Table 265 – REPORT SUPPORTED TASK MANAGEMENT FUNCTIONS command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (A3h)							
1	Reserved			SERVICE ACTION (0Dh)				
2	REPD	Reserved						
3 ••• 5	Reserved							
6 ••• 9	(MSB) ALLOCATION LENGTH (LSB)							
10	Reserved							
11	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 265 for the REPORT SUPPORTED TASK MANAGEMENT FUNCTIONS command.

The SERVICE ACTION field is defined in 4.2.5.2 and shall be set as shown in table 265 for the REPORT SUPPORTED TASK MANAGEMENT FUNCTIONS command.

A return extended parameter data (REPD) bit set to one specifies that the task management timeout information shall be included in the parameter data that is returned. A REPD bit set to zero specifies that the task management timeout information shall not be returned.

The ALLOCATION LENGTH field is defined in 4.2.5.6. The allocation length should be at least four.

The CONTROL byte is defined in SAM-6.

The format of the parameter data for the REPORT SUPPORTED TASK MANAGEMENT FUNCTIONS command depends on the value of the REPD bit as follows:

   a) if the REPD bit is set to zero, the REPORT SUPPORTED TASK MANAGEMENT FUNCTION parameter data returned is shown in table 266; and
   b) if the REPD bit is set to one, the REPORT SUPPORTED TASK MANAGEMENT FUNCTION parameter data returned is shown in table 267.

The REPORT SUPPORTED TASK MANAGEMENT FUNCTIONS basic parameter data format is shown in table 266.

Table 266 – REPORT SUPPORTED TASK MANAGEMENT FUNCTIONS basic parameter data

Bit Byte	7	6	5	4	3	2	1	0
0	ATS	ATSS	CACAS	CTSS	LURS	QTS	Obsolete	Obsolete
1	Reserved					QAES	QTSS	ITNRS
2	Reserved							
3	REPORT SUPPORTED TASK MANAGEMENT FUNCTIONS ADDITIONAL DATA LENGTH (00h)							

The REPORT SUPPORTED TASK MANAGEMENT FUNCTIONS extended parameter data format is shown in table 267.

Table 267 – REPORT SUPPORTED TASK MANAGEMENT FUNCTIONS extended parameter data

Bit Byte	7	6	5	4	3	2	1	0
0	ATS	ATSS	CACAS	CTSS	LURS	QTS	Obsolete	Obsolete
1	Reserved					QAES	QTSS	ITNRS
2	Reserved							
3	REPORT SUPPORTED TASK MANAGEMENT FUNCTIONS ADDITIONAL DATA LENGTH (0Ch)							
4	Reserved							TMFTMOV
5	Reserved							
6	ATTS	ATSTS	CACATS	CTSTS	LURTS	QTTS	Reserved	Reserved
7	Reserved					QAETS	QTSTS	ITNRTS
8	(MSB)							
•••			TASK MANAGEMENT FUNCTIONS LONG TIMEOUT					
11								(LSB)
12	(MSB)							
•••			TASK MANAGEMENT FUNCTIONS SHORT TIMEOUT					
15								(LSB)

An ABORT TASK supported (ATS) bit set to one indicates the ABORT TASK task management function (see SAM-6) is supported by the logical unit. An ATS bit set to zero indicates the ABORT TASK task management function is not supported.

An ABORT TASK SET supported (ATSS) bit set to one indicates the ABORT TASK SET task management function (see SAM-6) is supported by the logical unit. An ATSS bit set to zero indicates the ABORT TASK SET task management function is not supported.

A CLEAR ACA supported (CACAS) bit set to one indicates the CLEAR ACA task management function (see SAM-6) is supported by the logical unit. A CACAS bit set to zero indicates the CLEAR ACA task management function is not supported.

A CLEAR TASK SET supported (CTSS) bit set to one indicates the CLEAR TASK SET task management function (see SAM-6) is supported by the logical unit. A CTSS bit set to zero indicates the CLEAR TASK SET task management function is not supported.

A LOGICAL UNIT RESET supported (LURS) bit set to one indicates the LOGICAL UNIT RESET task management function (see SAM-6) is supported by the logical unit. An LURS bit set to zero indicates the LOGICAL UNIT RESET task management function is not supported.

A QUERY TASK supported (QTS) bit set to one indicates the QUERY TASK task management function (see SAM-6) is supported by the logical unit. A QTS bit set to zero indicates the QUERY TASK task management function is not supported.

A QUERY ASYNCHRONOUS EVENT supported (QAES) bit set to one indicates the QUERY ASYNCHRONOUS EVENT task management function (see SAM-6) is supported by the logical unit. A QAES bit set to zero indicates the QUERY ASYNCHRONOUS EVENT task management function is not supported.

A QUERY TASK SET supported (QTSS) bit set to one indicates the QUERY TASK SET task management function (see SAM-6) is supported by the logical unit. A QTSS bit set to zero indicates the QUERY TASK SET task management function is not supported.

An I_T NEXUS RESET supported (ITNRS) bit set to one indicates the I_T NEXUS RESET task management function (see SAM-6) is supported by the logical unit. An ITNRS bit set to zero indicates the I_T NEXUS RESET task management function is not supported.

The REPORT SUPPORTED TASK MANAGEMENT FUNCTIONS ADDITIONAL DATA LENGTH field indicates the number of bytes that follow in the parameter data. The contents of the REPORT SUPPORTED TASK MANAGEMENT FUNCTIONS ADDITIONAL DATA LENGTH field are not altered based on the allocation length (see 4.2.5.6).

A task management function timeouts valid (TMFTMOV) bit set to one indicates the contents of the TASK MANAGEMENT FUNCTIONS SHORT TIMEOUT field and TASK MANAGEMENT FUNCTIONS LONG TIMEOUT field are valid. A TMFTMOV bit set to zero indicates the contents of the TASK MANAGEMENT FUNCTIONS SHORT TIMEOUT field and TASK MANAGEMENT FUNCTIONS LONG TIMEOUT field are not valid and should be ignored.

An ABORT TASK timeout selector (ATTS) bit set to one indicates that the value in the TASK MANAGEMENT FUNCTIONS SHORT TIMEOUT field applies to the ABORT TASK task management function. An ATTS bit set to zero indicates that the value in the TASK MANAGEMENT FUNCTIONS LONG TIMEOUT field applies to the ABORT TASK task management function.

An ABORT TASK SET timeout selector (ATSTS) bit set to one indicates that the value in the TASK MANAGEMENT FUNCTIONS SHORT TIMEOUT field applies to the ABORT TASK SET task management function. An ATSTS bit set to zero indicates that the value in the TASK MANAGEMENT FUNCTIONS LONG TIMEOUT field applies to the ABORT TASK SET task management function.

A CLEAR ACA timeout selector (CACATS) bit set to one indicates that the value in the TASK MANAGEMENT FUNCTIONS SHORT TIMEOUT field applies to the CLEAR ACA task management function. A CACATS bit set to zero indicates that the value in the TASK MANAGEMENT FUNCTIONS LONG TIMEOUT field applies to the CLEAR ACA task management function.

A CLEAR TASK SET timeout selector (CTSTS) bit set to one indicates that the value in the TASK MANAGEMENT FUNCTIONS SHORT TIMEOUT field applies to the CLEAR TASK SET task management function. A CTSTS bit set to zero indicates that the value in the TASK MANAGEMENT FUNCTIONS LONG TIMEOUT field applies to the CLEAR TASK SET task management function.

A LOGICAL UNIT RESET timeout selector (LURTS) bit set to one indicates that the value in the TASK MANAGEMENT FUNCTIONS SHORT TIMEOUT field applies to the LOGICAL UNIT RESET task management function. A LURTS bit set to zero indicates that the value in the TASK MANAGEMENT FUNCTIONS LONG TIMEOUT field applies to the LOGICAL UNIT RESET task management function.

A QUERY TASK timeout selector (QTTS) bit set to one indicates that the value in the TASK MANAGEMENT FUNCTIONS SHORT TIMEOUT field applies to the QUERY TASK task management function. A QTTS bit set to zero indicates that the value in the TASK MANAGEMENT FUNCTIONS LONG TIMEOUT field applies to the QUERY TASK task management function.

A QUERY ASYNCHRONOUS EVENT timeout selector (QAETS) bit set to one indicates that the value in the TASK MANAGEMENT FUNCTIONS SHORT TIMEOUT field applies to the QUERY ASYNCHRONOUS EVENT task management function. A QAETS bit set to zero indicates that the value in the TASK MANAGEMENT FUNCTIONS LONG TIMEOUT field applies to the QUERY ASYNCHRONOUS EVENT task management function.

A QUERY TASK SET timeout selector (QTSTS) bit set to one indicates that the value in the TASK MANAGEMENT FUNCTIONS SHORT TIMEOUT field applies to the QUERY TASK SET task management function. A QTSTS bit set to zero indicates that the value in the TASK MANAGEMENT FUNCTIONS LONG TIMEOUT field applies to the QUERY TASK SET task management function.

An I_T NEXUS RESET timeout selector (ITNRTS) bit set to one indicates that the value in the TASK MANAGEMENT FUNCTIONS SHORT TIMEOUT field applies to the I_T NEXUS RESET task management function. An ITNRTS bit set to zero indicates that the value in the TASK MANAGEMENT FUNCTIONS LONG TIMEOUT field applies to the I_T NEXUS RESET task management function.

If the TMFTMOV bit is set to one and the TASK MANAGEMENT FUNCTIONS LONG TIMEOUT field is not set to zero, then the contents of the TASK MANAGEMENT FUNCTIONS LONG TIMEOUT field indicate the recommended time in 100 millisecond increments that the application client should wait prior to timing out a task management function for which the applicable selector bit is set to zero. If the TMFTMOV bit is set to zero or the TASK MANAGEMENT FUNCTIONS LONG TIMEOUT field is set to zero, then the recommended timeout is unspecified for any task management function for which the applicable selector bit is set to zero.

If the TMFTMOV bit is set to one and the TASK MANAGEMENT FUNCTIONS SHORT TIMEOUT field is not set to zero, then the contents of the TASK MANAGEMENT FUNCTIONS SHORT TIMEOUT field indicate the recommended time in 100 millisecond increments that the application client should wait prior to timing out a task management function for which the applicable selector bit is set to one. If the TMFTMOV bit is set to zero or the TASK MANAGEMENT FUNCTIONS SHORT TIMEOUT field is set to zero, then the recommended timeout is unspecified for any task management function for which the applicable selector bit is set to one.

6.34 REPORT TARGET PORT GROUPS command

The REPORT TARGET PORT GROUPS command (see table 268) requests the device server to return target port group information. This command uses the MAINTENANCE IN CDB format (see 4.2.2.3.3). This command shall be supported by logical units that report in the standard INQUIRY data (see 6.7.2) that they support asymmetric logical unit access (i.e., return a non-zero value in the TPGS field).

Additional processing of the REPORT TARGET PORT GROUPS command shall be performed as described in 5.18.2.2.4, if that command is processed by a subsidiary logical unit (see SAM-6):

a) with the LU COLLECTION TYPE field (see 7.7.7) set to 001b (i.e., conglomerate collection); and
b) based on a LUN that is associated with an administrative logical unit with which the subsidiary logical unit is not affiliated.

Table 268 – REPORT TARGET PORT GROUPS command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (A3h)							
1	PARAMETER DATA FORMAT			SERVICE ACTION (0Ah)				
2 ••• 5	Reserved							
6 ••• 9	(MSB) ALLOCATION LENGTH (LSB)							
10	Reserved							
11	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 268 for the REPORT TARGET PORT GROUPS command.

The SERVICE ACTION field is defined in 4.2.5.2 and shall be set as shown in table 268 for the REPORT TARGET PORT GROUPS command.

The PARAMETER DATA FORMAT field (see table 269) specifies the requested format for the parameter data returned by the REPORT TARGET PORT GROUPS command. The device server may ignore the PARAMETER DATA FORMAT field. If the device server ignores the PARAMETER DATA FORMAT field, the device server shall return the parameter data format defined in table 270.

Table 269 – PARAMETER DATA FORMAT field

Code	Description	Reference
000b	Length only header parameter data format	table 270
001b	Extended header parameter data format	table 271
010b to 111b	Reserved	

The ALLOCATION LENGTH field is defined in 4.2.5.6.

The CONTROL byte is defined in SAM-6.

Returning REPORT TARGET PORT GROUPS parameter data may require the enabling of a nonvolatile memory. If the nonvolatile memory is not ready, the device server shall terminate the command with CHECK CONDITION status, rather than wait for the nonvolatile memory to become ready. The sense key shall be set to NOT READY and the additional sense code shall be set as described in table 304 (see 6.46).

The length only header format of the parameter data for the REPORT TARGET PORT GROUPS command is shown in table 270.

Table 270 – Length only header parameter data

Bit Byte	7	6	5	4	3	2	1	0
0 ••• **3**	(MSB) 			RETURN DATA LENGTH (n-3)				 (LSB)
	Target port group descriptor list							
4 ••• 				Target port group descriptor (see table 272) [first]				
				• • •				
••• **n**				Target port group descriptor (see table 272) [last]				

The RETURN DATA LENGTH field indicates the length in bytes of the list of target port group descriptors. The contents of the RETURN DATA LENGTH field are not altered based on the allocation length (see 4.2.5.6).

There shall be one target port group descriptor (see table 272) for each target port group.

The extended header format of the parameter data for the REPORT TARGET PORT GROUPS command is shown in table 271.

Table 271 – Extended header parameter data

Bit Byte	7	6	5	4	3	2	1	0
0 ••• 3	(MSB)			RETURN DATA LENGTH (n-3)				(LSB)
4	Reserved	RTPG_FMT (001b)			Reserved			
5	IMPLICIT TRANSITION TIME							
6 7	Reserved							
	Target port group descriptor list							
8 •••	Target port group descriptor (see table 272) [first]							
	⋮							
••• n	Target port group descriptor (see table 272) [last]							

The RETURN DATA LENGTH field indicates the length in bytes of the list of target port groups. The contents of the RETURN DATA LENGTH field are not altered based on the allocation length (see 4.2.5.6).

The report target port groups format (RTPG_FMT) field indicates the returned parameter data format and shall be set as shown in table 271 for the extended header parameter data format.

The IMPLICIT TRANSITION TIME field indicates the minimum amount of time in seconds the application client should wait prior to timing out an implicit state transition (see 5.18.2.3). A value of zero indicates that the implicit transition time is not indicated.

There shall be one target port group descriptor (see table 272) for each target port group.

Table 272 – Target port group descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	PREF	RTPG_FMT (000b)			ASYMMETRIC ACCESS STATE			
1	T_SUP	O_SUP	Reserved	LBD_SUP	U_SUP	S_SUP	AN_SUP	AO_SUP
2	(MSB)	TARGET PORT GROUP						
3								(LSB)
4	Reserved							
5	STATUS CODE							
6	Vendor specific							
7	TARGET PORT COUNT							
	Target port descriptor list							
8	Target port descriptor (see table 275) [first]							
•••								
11								
	⋮							
n-3	Target port descriptor (see table 275) [last]							
•••								
n								

A preferred target port (PREF) bit set to one indicates that the primary target port group is a preferred primary target port group for accessing the addressed logical unit (see 5.18.2.7). A PREF bit set to zero indicates the primary target port group is not a preferred primary target port group.

The RTPG_FMT field indicates the returned parameter data format and shall be set as shown in table 272 for the target port group descriptor format.

The ASYMMETRIC ACCESS STATE field (see table 273) contains the target port group's target port asymmetric access state (see 5.18.2.8).

Table 273 – ASYMMETRIC ACCESS STATE field

Code	State	Type (see 5.18.2.1)	Reference
0h	Active/optimized	Primary	5.18.2.5.2
1h	Active/non-optimized	Primary	5.18.2.5.3
2h	Standby	Primary	5.18.2.5.4
3h	Unavailable	Primary	5.18.2.5.5
4h	Logical block dependent	Primary	5.18.2.5.7
5h to Dh	Reserved		
Eh	Offline	Secondary	5.18.2.5.6
Fh	Transitioning between states	Primary	5.18.2.6

If any of the T_SUP bit, O_SUP bit, LBD_SUP bit, U_SUP bit, S_SUP bit, AN_SUP bit, or AO_SUP bit are set to one, then the T_SUP bit, O_SUP bit, LBD_SUP bit, U_SUP bit, S_SUP bit, AN_SUP bit, and AO_SUP bit are as defined in this standard. If the T_SUP bit, O_SUP bit, U_SUP bit, S_SUP bit, AN_SUP bit, and AO_SUP bit are all set to zero, then which target port asymmetric access states are supported is vendor specific.

A transitioning supported (T_SUP) bit set to one indicates that the device server supports returning the ASYMMETRIC ACCESS STATE field set to Fh (i.e., transitioning between states). A T_SUP bit set to zero indicates that the device server does not return an ASYMMETRIC ACCESS STATE field set to Fh.

An offline supported (O_SUP) bit set to one indicates that the offline secondary target port asymmetric access state is supported. A O_SUP bit set to zero indicates that the offline secondary target port asymmetric access state is not supported.

A logical block dependent (LBD_SUP) bit set to one indicates that the logical block dependent primary target port asymmetric access state is supported. An LBD_SUP bit set to zero indicates that the logical block dependent primary target port asymmetric access state is not supported.

An unavailable supported (U_SUP) bit set to one indicates that the unavailable primary target port asymmetric access state is supported. A U_SUP bit set to zero indicates that the unavailable primary target port asymmetric access state is not supported.

A standby supported (S_SUP) bit set to one indicates that the standby primary target port asymmetric access state is supported. An S_SUP bit set to zero indicates that the standby primary target port asymmetric access state is not supported.

An active/non-optimized supported (AN_SUP) bit set to one indicates that the active/non-optimized primary target port asymmetric access state is supported. An AN_SUP bit set to zero indicates that the active/non-optimized primary target port asymmetric access state is not supported.

An active/optimized supported (AO_SUP) bit set to one indicates that the active/optimized primary target port asymmetric access state is supported. An AO_SUP bit set to zero indicates that the active/optimized primary target port asymmetric access state is not supported.

The TARGET PORT GROUP field contains an identification of the target port group (see 5.18) described by this target port group descriptor. Target port group information is also returned in the Device Identification VPD page (see 7.7.6).

The STATUS CODE field (see table 274) indicates why a target port group may be in a specific target port asymmetric access state.

Table 274 – STATUS CODE field

Code	Description
00h	No status available.
01h	The target port asymmetric access state altered by SET TARGET PORT GROUPS command.
02h	The target port asymmetric access state altered by implicit asymmetrical logical unit access behavior.
03h to FFh	Reserved

The TARGET PORT COUNT field indicates the number of target ports that are in that target port group and the number of target port descriptors in the target port group descriptor. Every target port group shall contain at least one target port. The target port group descriptor shall include one target port descriptor for each target port in the target port group.

The format of each target port descriptor is shown in table 275.

Table 275 – Target port descriptor

Bit Byte	7	6	5	4	3	2	1	0
0				Reserved				
1								
2	(MSB)			RELATIVE TARGET PORT IDENTIFIER				
3								(LSB)

The RELATIVE TARGET PORT IDENTIFIER field (see 4.3.4) indicates a relative port identifier of a target port in the target port group.

6.35 REPORT TIMESTAMP command

The REPORT TIMESTAMP command (see table 276) requests the device server to return the current value of a device clock (see 5.3). This command uses the MAINTENANCE IN CDB format (see 4.2.2.3.3).

Table 276 – REPORT TIMESTAMP command

Bit Byte	7	6	5	4	3	2	1	0
0				OPERATION CODE (A3h)				
1		Reserved			SERVICE ACTION (0Fh)			
2 ••• 5				Reserved				
6 ••• 9	(MSB)			ALLOCATION LENGTH				(LSB)
10				Reserved				
11				CONTROL				

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 276 for the REPORT TIMESTAMP command.

The SERVICE ACTION field is defined in 4.2.5.2 and shall be set as shown in table 276 for the REPORT TIMESTAMP command.

The ALLOCATION LENGTH field is defined in 4.2.5.6.

The CONTROL byte is defined in SAM-6.

The format for the parameter data for the REPORT TIMESTAMP command is shown in table 277.

Table 277 – REPORT TIMESTAMP parameter data

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
1			TIMESTAMP PARAMETER DATA LENGTH (000Ah)					(LSB)
2			Reserved			TIMESTAMP ORIGIN		
3				Reserved				
4	(MSB)							
•••				TIMESTAMP				
9								(LSB)
10				Reserved				
11				Reserved				

The TIMESTAMP PARAMETER DATA LENGTH field indicates the number of bytes of parameter data that follow. The contents of the TIMESTAMP PARAMETER DATA LENGTH field are not altered based on the allocation length (see 4.2.5.6).

The TIMESTAMP ORIGIN field indicates the most recent event that initialized the returned device clock using the values shown in table 52 (see 5.3).

The TIMESTAMP field contains the current value of a device clock (see 5.3).

6.36 REQUEST SENSE command

The REQUEST SENSE command (see table 278) requests the device server to return parameter data that contains sense data (see 4.4).

Table 278 – REQUEST SENSE command

Bit Byte	7	6	5	4	3	2	1	0
0				OPERATION CODE (03h)				
1				Reserved				DESC
2				Reserved				
3								
4				ALLOCATION LENGTH				
5				CONTROL				

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 278 for the REQUEST SENSE command.

The descriptor format (DESC) bit (see table 279) specifies which sense data format the device server shall return in the parameter data.

Table 279 – DESC bit

Code	Descriptor format sense data supported?	Description
0b	yes or no	The device server shall return fixed format sense data (see 4.4.3) in the parameter data.
1b	yes	The device server shall return descriptor format sense data (see 4.4.2) in the parameter data.
	no	The device server shall return no parameter data and shall terminate the REQUEST SENSE command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.
Note: Device servers that are compliant with SPC-3 are capable of ignoring a DESC bit that is set to one.		

The ALLOCATION LENGTH field is defined in 4.2.5.6. Application clients should request 252 bytes of sense data to ensure they retrieve all the sense data. If fewer than 252 bytes are requested, sense data may be lost since the REQUEST SENSE command with any allocation length clears the sense data.

The CONTROL byte is defined in SAM-6.

Sense data shall be available and cleared under the conditions defined in SAM-6.

Upon completion of the REQUEST SENSE command, the logical unit shall be in the same power condition (see 5.13) that was active before the REQUEST SENSE command was received. A REQUEST SENSE command shall not affect any power condition timers.

The device server shall return CHECK CONDITION status for a REQUEST SENSE command only to report exception conditions specific to the REQUEST SENSE command itself. Examples of conditions that cause a REQUEST SENSE command to return CHECK CONDITION status are:

    a) an invalid field value is detected in the CDB;
    b) the device server does not support the REQUEST SENSE command (see 4.2.1);
    c) an unrecovered error is detected by a SCSI target port; or
    d) a malfunction prevents return of the sense data.

If a REQUEST SENSE command is terminated with CHECK CONDITION status, then:

    a) any parameter data that is transferred is invalid (i.e., the parameter data does not contain sense data); and
    b) if the REQUEST SENSE command was received on an I_T nexus with a pending unit attention condition (i.e., before the device server reports CHECK CONDITION status), then the device server shall not clear the pending unit attention condition (see SAM-6).

The REQUEST SENSE command shall be capable of being processed to completion with GOOD status in any power condition (see 5.13). However, the processing of a REQUEST SENSE command may require a level of power consumption that is higher than associated with the current power condition in any other circumstance. Details of how much power processing a REQUEST SENSE command requires is outside the scope of this standard.

Except as described elsewhere in this subclause, the device server and task router (see SAM-6) shall process a REQUEST SENSE command as follows:

1) return applicable sense data in the parameter data as follows:
    1) if the logical unit reports a peripheral qualifier of 011b or 001b in its standard INQUIRY data (see 6.7.2), then return parameter data containing sense data with the sense key set to ILLEGAL REQUEST and the additional sense code shall be set to LOGICAL UNIT NOT SUPPORTED;
    2) if the logical unit reports a peripheral qualifier of 000b in its standard INQUIRY data because that logical unit is not accessible to the task router (see SAM-6) contained in the SCSI target port that received the REQUEST SENSE command at the time that command was received, then return parameter data containing sense data appropriate to the condition that is making the logical unit not operational;
    3) if the REQUEST SENSE command was received on an I_T nexus with a pending unit attention condition, then return parameter data containing sense data for the unit attention and clear the unit attention condition as described in SAM-6;
    4) if a recovered error occurs during the processing of the REQUEST SENSE command, then return parameter data containing sense data with the sense key set to RECOVERED ERROR;
    5) if deferred error sense data (see 4.4.7) is available, then return parameter data containing sense data for the deferred error;
    6) return pollable sense data (see 5.12.2), if any; or
    7) return parameter data containing sense data with the sense key set to NO SENSE and the additional sense code set to NO ADDITIONAL SENSE INFORMATION;
    and
2) complete the REQUEST SENSE command with GOOD status.

Device servers and task routers (see SAM-6) shall return at least 18 bytes of parameter data in response to a REQUEST SENSE command if the allocation length is 18 or greater and the DESC bit is set to zero. Application clients may determine how much sense data has been returned by examining the ALLOCATION LENGTH field in the CDB and the ADDITIONAL SENSE LENGTH field in the sense data. Device servers shall not adjust the additional sense length to reflect truncation if the allocation length is less than the sense data available.

6.37 SECURITY PROTOCOL IN command

The SECURITY PROTOCOL IN command (see table 280) requests the device server to return security protocol information (see SFSC) or the results of one or more SECURITY PROTOCOL OUT commands (see 6.38).

Table 280 – SECURITY PROTOCOL IN command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (A2h)							
1	SECURITY PROTOCOL							
2	SECURITY PROTOCOL SPECIFIC							
3								
4	INC_512	Reserved						
5	Reserved							
6	(MSB)							
•••	ALLOCATION LENGTH							
9								(LSB)
10	Reserved							
11	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 280 for the SECURITY PROTOCOL IN command.

The SECURITY PROTOCOL field (see table 281) specifies which security protocol is being used.

Table 281 – SECURITY PROTOCOL field in SECURITY PROTOCOL IN command

Code	Description	Reference
00h	Security protocol information	SFSC
01h to 06h	Defined by TCG	3.1.133
07h	Obsolete	
08h to 1Fh	Reserved	
20h	Tape Data Encryption	SSC-5
21h	Data Encryption Configuration	ADC-3
22h to 3Fh	Reserved	
40h	SA Creation Capabilities	SFSC
41h	IKEv2-SCSI	SFSC
42h to E6h	Reserved	
E7h	SD Association	3.1.110
E8h	DMTF Security Protocol and Data Model	SPDM
E9h to EAh	Defined by NVM Express	NVMe
EBh	Defined by SCSA	3.1.113
ECh	JEDEC Universal Flash Storage	UFS
EDh	Obsolete	
EEh	Authentication in Host Attachments of Transient Storage Devices	IEEE 1667
EFh	ATA Device Server Password	SAT-5
F0h to FFh	Vendor Specific	

The contents of the SECURITY PROTOCOL SPECIFIC field are defined by the protocol specified by the SECURITY PROTOCOL field (see table 281).

A 512 increment (INC_512) bit set to one specifies that the ALLOCATION LENGTH field (see 4.2.5.6) expresses the maximum number of bytes available to receive data in increments of 512 bytes (e.g., a value of one means 512 bytes, two means 1 024 bytes, etc.). Pad bytes may or may not be appended to meet this length. Pad bytes shall have a value of 00h. An INC_512 bit set to zero specifies that the ALLOCATION LENGTH field expresses the maximum number of bytes available to receive data in increments of one byte.

Indications of data overrun or underrun and the mechanism, if any, for processing retries are defined by the protocol specified by the SECURITY PROTOCOL field (see table 281).

The CONTROL byte is defined in SAM-6.

Any association between a previous SECURITY PROTOCOL OUT command and the data transferred by a SECURITY PROTOCOL IN command depends on the protocol specified by the SECURITY PROTOCOL field (see table 281). If the device server has no data to transfer (e.g., the results for any previous SECURITY PROTOCOL OUT commands are not yet available), then the device server may transfer data indicating it has no other data to transfer.

The format of the data transferred depends on the protocol specified by the SECURITY PROTOCOL field (see table 281).

The device server shall retain data resulting from a SECURITY PROTOCOL OUT command, if any, until one of the following events is processed:

    a) transfer of the data via a SECURITY PROTOCOL IN command from the same I_T_L nexus as defined by the protocol specified by the SECURITY PROTOCOL field (see table 281);
    b) logical unit reset (see SAM-6); or
    c) I_T nexus loss (see SAM-6) associated with the I_T nexus that sent the SECURITY PROTOCOL OUT command.

6.38 SECURITY PROTOCOL OUT command

The SECURITY PROTOCOL OUT command (see table 282) requests the device server to process the specified parameter list using the specified security protocol. Depending on the protocol specified by the SECURITY PROTOCOL field, the application client may use the SECURITY PROTOCOL IN command (see 6.37) to retrieve data that results from the processing of one or more SECURITY PROTOCOL OUT commands.

Table 282 – SECURITY PROTOCOL OUT command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (B5h)							
1	SECURITY PROTOCOL							
2	SECURITY PROTOCOL SPECIFIC							
3								
4	INC_512	Reserved						
5	Reserved							
6	(MSB)							
•••	TRANSFER LENGTH							
9								(LSB)
10	Reserved							
11	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 282 for the SECURITY PROTOCOL OUT command.

The SECURITY PROTOCOL field (see table 283) specifies which security protocol is being used.

Table 283 – SECURITY PROTOCOL field in SECURITY PROTOCOL OUT command

Code	Description	Reference
00h	Reserved	
01h to 06h	Defined by TCG	3.1.133
07h	Obsolete	
08h to 1Fh	Reserved	
20h	Tape Data Encryption	SSC-5
21h	Data Encryption Configuration	ADC-3
22h to 40h	Reserved	
41h	IKEv2-SCSI	SFSC
42h to E6h	Reserved	
E7h	SD Association	3.1.110
E8h	DMTF Security Protocol and Data Model	SPDM
E9h to EAh	Defined by NVM Express	NVMe
EBh	Defined by SCSA	3.1.113
ECh	JEDEC Universal Flash Storage	UFS
EDh	Obsolete	
EEh	Authentication in Host Attachments of Transient Storage Devices	IEEE 1667
EFh	ATA Device Server Password	SAT-5
F0h to FFh	Vendor Specific	

The contents of the SECURITY PROTOCOL SPECIFIC field are defined by the protocol specified by the SECURITY PROTOCOL field (see table 283).

A 512 increment (INC_512) bit set to one specifies that the TRANSFER LENGTH field (see 4.2.5.4) expresses the number of bytes to be transferred in increments of 512 bytes (e.g., a value of one means 512 bytes, two means 1 024 bytes, etc.). Pad bytes shall be appended as needed to meet this requirement. Pad bytes shall have a value of 00h. A INC_512 bit set to zero specifies that the TRANSFER LENGTH field indicates the number of bytes to be transferred.

The CONTROL byte is defined in SAM-6.

Any association between a SECURITY PROTOCOL OUT command and a subsequent SECURITY PROTOCOL IN command is defined by the protocol specified by the SECURITY PROTOCOL field (see table 283). Each protocol shall define whether:

   a) the device server shall complete the command with GOOD status as soon as it determines the data has been correctly received. An indication that the data has been processed is obtained by sending a SECURITY PROTOCOL IN command and receiving the results in the associated data transfer; or
   b) the device server shall complete the command with GOOD status only after the data has been successfully processed and an associated SECURITY PROTOCOL IN command is not required.

The format of the data transferred depends on the protocol specified by the SECURITY PROTOCOL field (see table 283).

6.39 SEND DIAGNOSTIC command

The SEND DIAGNOSTIC command (see table 284) requests the device server to perform diagnostic operations on the SCSI target device, on the logical unit, or on both. Logical units that support this command shall support, at a minimum, the default self-test feature (i.e., the SELFTEST bit equal to one and a parameter list length of zero).

Table 284 – SEND DIAGNOSTIC command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (1Dh)							
1	SELF-TEST CODE			PF	Reserved	SELFTEST	DEVOFFL	UNITOFFL
2	Reserved							
3	(MSB)							
4	PARAMETER LIST LENGTH							(LSB)
5	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 284 for the SEND DIAGNOSTIC command.

The SELF-TEST CODE field is defined in table 285 and further described in table 286.

Table 285 – SELF-TEST CODE field (part 1 of 2)

Code	Name	Description
000b		This value is used if an operation not described in this table is being requested (see table 286).
001b	Background short self-test	The device server shall start its short self-test (see 5.15.3) in the background mode (see 5.15.4.3).
010b	Background extended self-test	The device server shall start its extended self-test (see 5.15.3) in the background mode (see 5.15.4.3).
011b	Reserved	

[a] Device servers compliant with SPC-3 may terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.

Table 285 – SELF-TEST CODE field (part 2 of 2)

Code	Name	Description
100b	Abort background self-test	If the SCSI target device is performing a self-test in the background mode (see 5.15.4.3), then the device server shall abort the self-test. If the SCSI target device is performing a self-test in the foreground mode, then the device server shall process the command as described in 5.15.4.2. [a] If the SCSI target device is not performing a self-test, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.
101b	Foreground short self-test	The device server shall start its short self-test (see 5.15.3) in the foreground mode (see 5.15.4.2).
110b	Foreground extended self-test	The device server shall start its extended self-test (see 5.15.3) in the foreground mode (see 5.15.4.2).
111b	Reserved	
[a] Device servers compliant with SPC-3 may terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.		

The page format (PF) bit (see table 286) specifies the format of any parameter list sent by the application client for a SEND DIAGNOSTIC command and may specify the format of the parameter data, if any, returned by the device server in response to a subsequent RECEIVE DIAGNOSTIC RESULTS command (see 6.24).

> NOTE 20 - Logical units compliant with SPC-2 may transfer more than one diagnostic page in the SEND DIAGNOSTIC command's parameter list and by doing so may request that more than one diagnostic page be sent in the RECEIVE DIAGNOSTIC RESULTS command's parameter data.

The self-test (SELFTEST) bit (see table 286) specifies whether the device server shall perform the default self-test (see 5.15.2).

A SCSI target device offline (DEVOFFL) bit set to one specifies that the device server may perform a default self-test (see 5.15.2) that affects any logical unit in the SCSI target device (e.g., by alteration of reservations, log parameters, or sense data). A DEVOFFL bit set to zero specifies that, after the device server has completed a default self-test specified in the SEND DIAGNOSTIC command, no logical unit shall exhibit any effects resulting from the device server's processing the SEND DIAGNOSTIC command that are detectable by any application client. If the SELFTEST bit is set to zero, the device server shall ignore the DEVOFFL bit.

A unit offline (UNITOFFL) bit set to one specifies that the device server may perform a default self-test (see 5.15.2) that affects the user accessible medium on the logical unit (e.g., write operations to the user accessible medium or repositioning of the medium on sequential access devices). A UNITOFFL bit set to zero specifies that, after the device server has completed a default self-test specified in the SEND DIAGNOSTIC command, the user accessible medium shall exhibit no effects resulting from the device server's processing the SEND DIAGNOSTIC command that are detectable by any application client. If the SELFTEST bit is set to zero, the device server shall ignore the UNITOFFL bit.

The PARAMETER LIST LENGTH field (see table 286) specifies the length in bytes of the parameter list that shall be transferred from the application client Data-Out Buffer to the device server. A parameter list length of zero specifies that no data shall be transferred. This condition shall not be considered an error.

The CONTROL byte is defined in SAM-6.

Table 286 defines:

  a) the combinations of values for the SELF-TEST CODE field, the PF bit, if supported, the SELFTEST bit, and
      the PARAMETER LIST LENGTH field; and
  b) under which conditions the DEVOFFL bit and the UNITOFFL bit, if supported, may be used and under
      which conditions these bits are ignored.

Table 286 – The meanings of the SELF-TEST CODE field, the PF bit, the SELFTEST bit, and the
PARAMETER LIST LENGTH field (part 1 of 4)

SELF-TEST CODE field	PF bit	SELF TEST bit	PARAMETER LIST LENGTH field	Description [a, b]
000b	0	0	0000h	The device server shall complete the command with GOOD status.
000b	0	0	>0000h	The device server shall transfer the amount of vendor specific parameter list specified by the PARAMETER LIST LENGTH field. If the parameter list is valid and requests that the device server perform a diagnostic operation [c], then: a) if the operation succeeds, the device server shall complete the command with GOOD status; b) if the operation fails, then the device server shall terminate the command with CHECK CONDITION status with the sense key set to HARDWARE ERROR and the additional sense code set to the appropriate value to describe the failure; and c) if parameter data is required to be returned by the device server for the operation, then a subsequent RECEIVE DIAGNOSTIC RESULTS command (see 6.24) determines the device server's response. If the parameter list is valid and does not request the device server to perform a diagnostic operation, then the device server processes the vendor specific data. A subsequent RECEIVE DIAGNOSTIC RESULTS command may be required for an application client to determine the device server's response. If the parameter list is not valid, the device server shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

  [a] Each description assumes that all other bits and fields in the CDB that are not defined for a particular
      case are valid. If, in any case, some other bit or field in the CDB is not valid, the device server shall
      terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST
      and the additional sense code set to INVALID FIELD IN CDB.
  [b] The device server shall ignore the DEVOFFL bit and the UNITOFFL bit in all cases where their use is not
      included in the description.
  [c] Before beginning any self-test, the device server shall:
      a) stop all running power condition timers;
      b) not stop any process that results in a background function occurring (e.g., not stop any timers or
          counters associated with background functions); and
      c) after completing this command, the device server shall initialize and start all operational (see 5.13.4)
          power condition timers.

Table 286 – The meanings of the SELF-TEST CODE field, the PF bit, the SELFTEST bit, and the PARAMETER LIST LENGTH field (part 2 of 4)

SELF-TEST CODE field	PF bit	SELF TEST bit	PARAMETER LIST LENGTH field	Description [a, b]
000b	0	1	0000h	The device server shall perform its default self-test, and if supported, use the values in the DEVOFFL bit and the UNITOFFL bit for processing the self-test. If the self-test succeeds, the device server shall complete the command with GOOD status. If the self-test fails, the device server shall terminate the command with CHECK CONDITION status with the sense key set to HARDWARE ERROR and the additional sense code set to the appropriate value to describe the failure.
000b	0	1	>0000h	The device server shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.

000b	1	0	0000h	The device server shall:
				  a) complete the command with GOOD status; and
				  b) if requested by a subsequent RECEIVE DIAGNOSTIC RESULTS command, then:
				    A) if the PF bit is supported by the device server, return a single diagnostic page (see 7.2) as specified by the command; or
				    B) if the PF bit is not supported by the device server, return vendor specific parameter data as specified by the command.

[a] Each description assumes that all other bits and fields in the CDB that are not defined for a particular case are valid. If, in any case, some other bit or field in the CDB is not valid, the device server shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.

[b] The device server shall ignore the DEVOFFL bit and the UNITOFFL bit in all cases where their use is not included in the description.

[c] Before beginning any self-test, the device server shall:
  a) stop all running power condition timers;
  b) not stop any process that results in a background function occurring (e.g., not stop any timers or counters associated with background functions); and
  c) after completing this command, the device server shall initialize and start all operational (see 5.13.4) power condition timers.

Table 286 – The meanings of the SELF-TEST CODE **field, the** PF **bit, the** SELFTEST **bit, and the** PARAMETER LIST LENGTH **field** (part 3 of 4)

SELF-TEST CODE field	PF bit	SELF TEST bit	PARAMETER LIST LENGTH field	Description [a, b]

000b	1	0	>0000h	The device server shall transfer the amount of parameter list specified by the PARAMETER LIST LENGTH field.
				If the PF bit is supported by the device server, then:
				  a) the parameter list shall be a single diagnostic page; and
				  b) if the specified parameter list length results in the truncation of the diagnostic page (e.g., the parameter list length is less than the page length indicated by the diagnostic page), then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.
				If the PF bit is not supported by the device server, the parameter list is vendor specific.
				If the parameter list is valid and requests that the device server perform a diagnostic operation [c], then:
				  a) if the operation succeeds, the device server shall complete the command with GOOD status;
				  b) if the operation fails, the device server shall terminate the command with CHECK CONDITION status with the sense key set to HARDWARE ERROR and the additional sense code set to the appropriate value to describe the failure; and
				  c) if parameter data is required to be returned by the device server for the operation, then a subsequent RECEIVE DIAGNOSTIC RESULTS command (see 6.24) determines the device server's response.
				If the parameter list is valid and does not request the device server to perform a diagnostic operation, then the device server processes the data as defined in 7.2. A subsequent RECEIVE DIAGNOSTIC RESULTS command may be required for an application client to determine the device server's response.
				If the parameter list is not valid, the device server shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

[a] Each description assumes that all other bits and fields in the CDB that are not defined for a particular case are valid. If, in any case, some other bit or field in the CDB is not valid, the device server shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.

[b] The device server shall ignore the DEVOFFL bit and the UNITOFFL bit in all cases where their use is not included in the description.

[c] Before beginning any self-test, the device server shall:
  a) stop all running power condition timers;
  b) not stop any process that results in a background function occurring (e.g., not stop any timers or counters associated with background functions); and
  c) after completing this command, the device server shall initialize and start all operational (see 5.13.4) power condition timers.

Table 286 – The meanings of the SELF-TEST CODE field, the PF bit, the SELFTEST bit, and the PARAMETER LIST LENGTH field (part 4 of 4)

SELF-TEST CODE field	PF bit	SELF TEST bit	PARAMETER LIST LENGTH field	Description [a, b]
000b	1	1	n/a	The device server shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.
>000b	0	0	0000h	The device server shall perform the operation defined in table 285. [c]
>000b	0	0	>0000h	The device server shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.
>000b	0	1	n/a	
>000b	1	0	0000h	The device server shall perform the operation defined in table 285. [c] If the device server supports the PF bit, the device server shall return a single diagnostic page as specified by the subsequent RECEIVE DIAGNOSTIC RESULTS command, if any. If the device server does not support the PF bit, the device server shall return vendor specific data for a subsequent RECEIVE DIAGNOSTIC RESULTS command, if any.
>000b	1	0	>0000h	The device server shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.
>000b	1	1	n/a	

[a] Each description assumes that all other bits and fields in the CDB that are not defined for a particular case are valid. If, in any case, some other bit or field in the CDB is not valid, the device server shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.

[b] The device server shall ignore the DEVOFFL bit and the UNITOFFL bit in all cases where their use is not included in the description.

[c] Before beginning any self-test, the device server shall:
   a) stop all running power condition timers;
   b) not stop any process that results in a background function occurring (e.g., not stop any timers or counters associated with background functions); and
   c) after completing this command, the device server shall initialize and start all operational (see 5.13.4) power condition timers.

6.40 SET AFFILIATION command

The SET AFFILIATION command (see table 287) requests that a subsidiary logical unit's device server become affiliated with the administrative logical unit that is associated with the LUN through which the SET AFFILIATION command was received as described in 5.8.7. If a SET AFFILIATION command is processed by a device server in a logical unit that is not a subsidiary logical unit, then the device server shall terminate the SET AFFILIATION command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST and the additional sense code set to NOT A SUBSIDIARY LOGICAL UNIT.

Table 287 – SET AFFILIATION command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (9Fh)							
1	Reserved			SERVICE ACTION (0Dh)				
2 ••• 9	Reserved							
10 11	Reserved							
12 13	(MSB)			PARAMETER LIST LENGTH				(LSB)
14	Reserved							
15	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 287 for the SET AFFILI-ATION command.

The SERVICE ACTION field is defined in 4.2.5.2 and shall be set as shown in table 287 for the SET AFFILIATION command.

The PARAMETER LIST LENGTH field is defined in 4.2.5.5.

The CONTROL byte is defined in SAM-6.

The format of the parameter list for the SET AFFILIATION command is shown in table 288.

Table 288 – SET AFFILIATION parameter list

Bit Byte	7	6	5	4	3	2	1	0
0 ••• 3				SET AFFILIATION PARAMETER DATA LENGTH (n-3)				
4 ••• 7				Reserved				
8 ••• 23				HOST BIND IDENTIFIER				
24 ••• n				ADMINISTRATIVE LU DESIGNATOR				

The SET AFFILIATION PARAMETER DATA LENGTH field specifies the number of bytes that follow in the parameter data.

The HOST BIND IDENTIFIER field specifies a host bind identifier (see 5.8.2) that identifies an application client. If the host bind identifier is set to FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFFh, the device server shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

If the host bind identifier is not in the saved set of host bind identifiers for the S_A binding pair, then the administrative logical unit's device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

The ADMINISTRATIVE LU DESIGNATOR field contains a designation descriptor (see 7.7.6.1) that specifies the administrative logical unit that is associated with the LUN through which the command was received. The subsidiary logical unit's device server shall terminate the SET AFFILIATION command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN PARAMETER LIST, if the designation descriptor in the ADMINISTRATIVE LU DESIGNATOR field does not contain:

a) the ASSOCIATION field set to 00b (i.e., logical unit);
b) the DESIGNATOR TYPE field set to:
    A) 2h (i.e., EUI);
    B) 3h (i.e., NAA);
    C) 8h (i.e., SCSI name string); or
    D) Ah (i.e., UUID);
    and
c) the DESIGNATOR field set to a value that specifies the administrative logical unit that is associated with the LUN through which the command was received.

6.41 SET IDENTIFYING INFORMATION command

The SET IDENTIFYING INFORMATION command (see table 289) requests the device server to set identifying information (see 5.7) in the logical unit to the value specified in the SET IDENTIFYING INFORMATION parameter list. This command uses the MAINTENANCE OUT CDB format (see 4.2.2.3.4). The SET IDENTIFYING INFORMATION command is an extension to the SET PERIPHERAL DEVICE/COMPONENT DEVICE IDENTIFIER service action of the MAINTENANCE OUT command defined in SCC-2.

Processing a SET IDENTIFYING INFORMATION command may require the enabling of a nonvolatile memory within the logical unit. If the nonvolatile memory is not ready, the device server shall terminate the command with CHECK CONDITION status, and not wait for the nonvolatile memory to become ready. The sense key shall be set to NOT READY and the additional sense code shall be set as described in table 304 (see 6.46). This information should allow the application client to determine the action required to cause the device server to become ready.

On successful completion of a SET IDENTIFYING INFORMATION command that changes identifying information saved by the logical unit, the device server shall establish a unit attention condition (see SAM-6) for the SCSI initiator port associated with every I_T nexus except the I_T nexus on which the SET IDENTIFYING INFORMATION command was received, with the additional sense code set to DEVICE IDENTIFIER CHANGED.

Table 289 – SET IDENTIFYING INFORMATION command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (A4h)							
1	Reserved			SERVICE ACTION (06h)				
2	Reserved							
3								
4	Restricted (see SCC-2)							
5								
6	(MSB)							
•••	PARAMETER LIST LENGTH							
9								(LSB)
10	IDENTIFYING INFORMATION TYPE							Reserved
11	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 289 for the SET IDENTIFYING INFORMATION command.

The SERVICE ACTION field is defined in 4.2.5.2 and shall be set as shown in table 289 for the SET IDENTIFYING INFORMATION command.

The PARAMETER LIST LENGTH field specifies the length in bytes of the identifying information that shall be transferred from the application client to the device server. A parameter list length of zero specifies that no data shall be transferred, and that subsequent REPORT IDENTIFYING INFORMATION commands shall return the IDENTIFYING INFORMATION LENGTH field set to zero for the specified identifying information type.

The IDENTIFYING INFORMATION TYPE field (see table 290) specifies the identifying information type to be set. If the specified identifying information type is not implemented by the device server, then the device server shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

Table 290 – IDENTIFYING INFORMATION TYPE field

Code	Description
0000000b	Logical unit identifying information (see 5.7). If the PARAMETER LIST LENGTH field is set to a value greater than the maximum length of the logical unit identifying information supported by the device server (see 5.7), then the device server shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.
0000010b	Logical unit text identifying information (see 5.7). If the PARAMETER LIST LENGTH field is set to a value greater than the maximum length of the logical unit text identifying information (see 5.7) supported by the device server, then the device server shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB. If the IDENTIFYING INFORMATION field does not contain a null-terminated (see 4.3.2) UTF-8 format string, then the device server shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN PARAMETER LIST.
xxxxxx1b	Restricted (see SCC-2)
All others	Reserved

The CONTROL byte is defined in SAM-6.

The SET IDENTIFYING INFORMATION parameter list (see table 291) contains the identifying information to be set by the device server.

Table 291 – SET IDENTIFYING INFORMATION parameter list

Bit Byte	7	6	5	4	3	2	1	0
0								
•••				IDENTIFYING INFORMATION				
n								

The IDENTIFYING INFORMATION field specifies the identifying information to be set for the specified identifying information type (see 5.7).

Upon successful completion of a SET IDENTIFYING INFORMATION command, the identifying information that is saved by the logical unit shall persist through logical unit resets, hard resets, power loss, I_T nexus losses, media format operations, and media replacement.

6.42 SET PRIORITY command

The SET PRIORITY command (see table 292) requests the device server to set the command priority (see SAM-6) for commands received on the specified I_T nexus. This command uses the MAINTENANCE OUT CDB format (see 4.2.2.3.4). The command priority set by this command shall remain in effect until one of the following occurs:

    a) another SET PRIORITY command is received;
    b) hard reset;
    c) logical unit reset; or
    d) power on.

The command priority set by this command shall not be affected by an I_T nexus loss.

Table 292 – SET PRIORITY command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (A4h)							
1	Reserved			SERVICE ACTION (0Eh)				
2	I_T_L NEXUS TO SET		Reserved					
3 ••• 5	Reserved							
6 ••• 9	(MSB) PARAMETER LIST LENGTH (LSB)							
10	Reserved							
11	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 292 for the SET PRIORITY command.

The SERVICE ACTION field is defined in 4.2.5.2 and shall be set as shown in table 292 for the SET PRIORITY command.

The I_T_L NEXUS TO SET field (see table 293) specifies the I_T_L nexus and the location of the priority value to be assigned to that I_T_L nexus.

Table 293 – I_T_L NEXUS TO SET field

Code	Description
00b	The priority for the I_T_L nexus associated with this command shall be set to the value contained in the PRIORITY TO SET field in the SET PRIORITY parameter list (see table 294). All fields in the SET PRIORITY parameter list except the PRIORITY TO SET field shall be ignored. If the parameter list length is zero, the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to PARAMETER LIST LENGTH ERROR.
01b	The priority for the I_T_L nexus specified by the logical unit that is processing this command, the RELATIVE TARGET PORT IDENTIFIER field, and the TransportID in the SET PRIORITY parameter list (see table 294) shall be set to the value specified by the PRIORITY TO SET field in the SET PRIORITY parameter list. If the parameter list length results in the truncation of the RELATIVE TARGET PORT IDENTIFIER field, the ADDITIONAL DESCRIPTOR LENGTH field, or the TransportID, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to PARAMETER LIST LENGTH ERROR. On successful completion of a SET PRIORITY command the device server shall establish a unit attention condition (see SAM-6) for the SCSI initiator port associated with the I_T nexus specified by the TransportID and the RELATIVE TARGET PORT IDENTIFIER field, with the additional sense code set to PRIORITY CHANGED.
10b	The priority value specified in the INITIAL COMMAND PRIORITY field of the Control Extension mode page (see 7.5.14) shall be used for all I_T_L nexuses associated with the logical unit that is processing this command regardless of any prior priority. The contents of the SET PRIORITY parameter list shall be ignored. On successful completion of a SET PRIORITY command the device server shall establish a unit attention condition (see SAM-6) for the SCSI initiator port associated with every other I_T_L nexus, with the additional sense code set to PRIORITY CHANGED.
11b	Reserved

The PARAMETER LIST LENGTH field specifies the length in bytes of the SET PRIORITY parameter list (see table 294) that shall be contained in the Data-Out Buffer. A parameter list length of zero specifies that the Data-Out Buffer shall be empty. This condition shall not be considered an error.

The CONTROL byte is defined in SAM-6.

The format of the parameter data for the SET PRIORITY command is shown in table 294.

Table 294 – SET PRIORITY parameter list

Bit Byte	7	6	5	4	3	2	1	0
0				Reserved		PRIORITY TO SET		
1				Reserved				
2	(MSB)			RELATIVE TARGET PORT IDENTIFIER				
3								(LSB)
4				Reserved				
5				Reserved				
6	(MSB)			ADDITIONAL LENGTH (n-7)				
7								(LSB)
8								
•••				TransportID				
n								

The PRIORITY TO SET field specifies the priority to be assigned to the I_T_L nexus specified by the I_T_L NEXUS TO SET field in the CDB. The value in the PRIORITY TO SET field shall be returned in subsequent REPORT PRIORITY commands (see 6.31) until one of the conditions described in this subclause occurs. A priority to set value of zero specifies the I_T_L nexus specified by the I_T_L NEXUS TO SET field shall be set to the value specified in the INITIAL COMMAND PRIORITY field of the Control Extension mode page (see 7.5.14). The contents of the I_T_L NEXUS TO SET field may specify that the PRIORITY TO SET field shall be ignored.

The RELATIVE TARGET PORT IDENTIFIER field (see 4.3.4) specifies the relative port identifier of the target port that is part of the I_T_L nexus for which the priority is to be set. The contents of the I_T_L NEXUS TO SET field may specify that the RELATIVE TARGET PORT IDENTIFIER field shall be ignored.

The ADDITIONAL LENGTH field specifies the number of bytes that follow in the SET PRIORITY parameter list (i.e., the size of the TransportID).

The TransportID specifies a TransportID (see 7.6.4) identifying the SCSI initiator port that is part of the I_T_L nexus for which the priority is to be set. The contents of the I_T_L NEXUS TO SET field may specify that the TRANSPORTID field shall be ignored.

6.43 SET TARGET PORT GROUPS command

The SET TARGET PORT GROUPS command (see table 295) requests the device server to set the primary target port asymmetric access state of all of the target ports in the specified primary target port groups and/or the secondary target port asymmetric access state of the specified target ports. This command uses the MAINTENANCE OUT CDB format (see 4.2.2.3.4). See 5.18 for details regarding the transition between target port asymmetric access states. This command is mandatory for all logical units that report in the standard INQUIRY data (see 6.7.2) that they support explicit asymmetric logical units access (i.e., the TPGS field is set to either 10b or 11b).

Additional processing of the SET TARGET PORT GROUPS command shall be performed as described in 5.18.2.2.4, if that command is processed by a subsidiary logical unit (see SAM-6):

  a) with the LU COLLECTION TYPE field (see 7.7.7) set to 001b (i.e., conglomerate collection); and
  b) based on a LUN that is associated with an administrative logical unit with which the subsidiary logical unit is not affiliated.

Table 295 – SET TARGET PORT GROUPS command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (A4h)							
1	Reserved			SERVICE ACTION (0Ah)				
2	Reserved							
•••								
5								
6	(MSB)							
•••	PARAMETER LIST LENGTH							
9								(LSB)
10	Reserved							
11	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 295 for the SET TARGET PORT GROUPS command.

The SERVICE ACTION field is defined in 4.2.5.2 and shall be set as shown in table 295 for the SET TARGET PORT GROUPS command.

The PARAMETER LIST LENGTH field specifies the length in bytes of the target port group management parameters that shall be transferred from the application client to the device server. A parameter list length of zero specifies that no data shall be transferred, and that no change shall be made in the target port asymmetric access state of any target port groups or target ports. If the specified parameter list length is not supported, the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

The CONTROL byte is defined in SAM-6.

The allowable values to which target port asymmetric access states may be set is vendor specific and should be reported in the REPORT TARGET PORT GROUP parameter data (see 6.34).

Primary target port groups that are not specified in a parameter list may change primary target port asymmetric access states as a result of the SET TARGET PORT GROUPS command. This shall not be considered an implicit target port asymmetric access state change.

If a SET TARGET PORT GROUPS command attempts to establish an invalid combination of target port asymmetric access states or attempts to establish an unsupported target port asymmetric access state, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

How a SET TARGET PORT GROUPS command is completed with success depends upon which of the following conditions apply:

a) if the transition is treated as a single indivisible event (see 5.18.2.6), the SET TARGET PORT GROUPS command shall not complete until the transition to the requested state has completed; or
b) if the transition is not treated as a single indivisible event (i.e., the device server supports other commands (see 5.18.2.6) when those commands are routed through a target port that is transitioning between target port asymmetric access states), then the SET TARGET PORT GROUPS command may complete before the transition into the requested state has completed.

How a SET TARGET PORT GROUPS command is terminated with an error depends upon which of the following conditions apply:

a) if the processing of a SET TARGET PORT GROUPS command requires the enabling of a nonvolatile memory and the nonvolatile memory is not ready, then the device server shall terminate the command with CHECK CONDITION status, rather than wait for the logical unit to become ready. The sense key shall be set to NOT READY and the additional sense code shall be set as described in table 304 (see 6.46); or
b) if a failure occurred before the transition was completed, the device server shall terminate the command with CHECK CONDITION status, with the sense key set to HARDWARE ERROR, and the additional sense code set to SET TARGET PORT GROUPS COMMAND FAILED.

If two SET TARGET PORT GROUPS commands are processed concurrently, the target port asymmetric access state change behavior is vendor specific. A SCSI target device should not process multiple SET TARGET PORT GROUPS commands concurrently.

The SET TARGET PORT GROUPS parameter data format is shown in table 296.

Table 296 – SET TARGET PORT GROUPS parameter list

Bit Byte	7	6	5	4	3	2	1	0
0 ••• 3	Reserved							
	Set target port group descriptor list							
4 ••• 7	Set target port group descriptor (see table 297) [first]							
	⋮							
n-3 ••• n	Set target port group descriptor (see table 297) [last]							

The format of the set target port group descriptor is defined in table 297.

Table 297 – Set target port group descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved				ASYMMETRIC ACCESS STATE			
1	Reserved							
2	(MSB)			TARGET PORT GROUP OR TARGET PORT				
3								(LSB)

If the ASYMMETRIC ACCESS STATE field (see table 298) specifies a primary target port asymmetric access state, then all the target ports in the specified target port group shall transition to the specified state (see 5.18.2.6). If

the ASYMMETRIC ACCESS STATE field specifies a secondary target port asymmetric access state, then the specified target port shall transition to the specified state.

Table 298 – ASYMMETRIC ACCESS STATE field

Value	State (see 5.18.2.5)	Type (see 5.18.2.1)
0h	Active/optimized	Primary
1h	Active/non-optimized	Primary
2h	Standby	Primary
3h	Unavailable	Primary
4h	Illegal Request [a]	
5h to Dh	Reserved	
Eh	Offline	Secondary
Fh	Illegal Request [a]	

[a] If the ASYMMETRIC ACCESS STATE field in any target port group descriptor contains 04h or Fh, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

If the ASYMMETRIC ACCESS STATE field (see table 298) specifies a primary target port asymmetric access state, then the TARGET PORT GROUP OR TARGET PORT field specifies a primary target port group for which the primary target port asymmetric access state shall be changed. If the ASYMMETRIC ACCESS STATE field specifies a secondary target port asymmetric access state, then the TARGET PORT GROUP OR TARGET PORT field specifies the relative target port identifier of the target port for which the secondary target port asymmetric access state shall be changed.

6.44 SET TIMESTAMP command

The SET TIMESTAMP command (see table 299) requests the device server to initialize a device clock (see 5.3) if the SCSIP bit is set to one in the Control Extension mode page (see 7.5.14). If the SCSIP bit is set to zero, the device server shall terminate the SET TIMESTAMP command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB. This command uses the MAINTENANCE OUT CDB format (see 4.2.2.3.4).

Table 299 – SET TIMESTAMP command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (A4h)							
1	Reserved			SERVICE ACTION (0Fh)				
2								
•••	Reserved							
5								
6	(MSB)							
•••				PARAMETER LIST LENGTH				
9								(LSB)
10	Reserved							
11	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 299 for the SET TIMESTAMP command.

The SERVICE ACTION field is defined in 4.2.5.2 and shall be set as shown in table 299 for the SET TIMESTAMP command.

The PARAMETER LIST LENGTH field specifies the length in bytes of the SET TIMESTAMP parameters that shall be transferred from the application client to the device server. A parameter list length of zero specifies that no data shall be transferred, and that no change shall be made to a device clock.

The CONTROL byte is defined in SAM-6.

The format for the parameter list for the SET TIMESTAMP command is shown in table 300.

Table 300 – SET TIMESTAMP parameter list

Bit Byte	7	6	5	4	3	2	1	0
0								
•••				Reserved				
3								
4	(MSB)							
•••				TIMESTAMP				
9								(LSB)
10								
11				Reserved				

The TIMESTAMP field specifies the value to which a device clock shall be initialized (see 5.3). The timestamp should be the number of milliseconds that have elapsed since midnight, 1 January 1970 UT. If the most significant byte in the TIMESTAMP field is greater than F0h, the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

On successful completion of a SET TIMESTAMP command the device server shall establish a unit attention condition for the SCSI initiator port associated with every I_T nexus except the I_T nexus on which the SET TIMESTAMP command was received (see SAM-6), with the additional sense code set to TIMESTAMP CHANGED.

6.45 TEST BIND command

The TEST BIND command (see table 301) requests that the device server return binding status information for the subsidiary logical unit that is processing the command using the specified host bind identifier (see 5.8.2). If a TEST BIND command is processed by a device server in a logical unit that is not a subsidiary logical unit, then the device server shall terminate the TEST BIND command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST and the additional sense code set to NOT A SUBSIDIARY LOGICAL UNIT.

If the specified host bind identifier is in the set of saved host bind identifiers for the S_A binding pair, then the device server shall complete the TEST BIND command with:

a) GOOD status with the sense key set to COMPLETED;
b) the additional sense code set to BIND COMPLETED;
c) the COMMAND-SPECIFIC INFORMATION field set as described in 5.8.8.1; and
d) the INFORMATION field set as described in 5.8.8.2.3 to describe the LUN that was used to access the subsidiary logical unit on the I_T_L nexus that received the TEST BIND command.

Table 301 – TEST BIND command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (9Fh)							
1	Reserved			SERVICE ACTION (0Bh)				
2 ••• 11	Reserved							
12	(MSB)		PARAMETER LIST LENGTH					
13								(LSB)
14	Reserved							
15	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 301 for the TEST BIND command.

The SERVICE ACTION field is defined in 4.2.5.2 and shall be set as shown in table 301 for the TEST BIND command.

The PARAMETER LIST LENGTH field is defined in 4.2.5.5.

The CONTROL byte is defined in SAM-6.

The format of the TEST BIND command parameter list is shown in table 302.

Table 302 – TEST BIND command parameter list

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
1				TEST BIND PARAMETER LIST LENGTH (n-3)				(LSB)
2								
•••				Reserved				
7								
8	(MSB)							
•••				HOST BIND IDENTIFIER				
23								(LSB)
24								
•••				SUBSIDIARY LU DESIGNATOR				
k								
k+1								
•••				Reserved				
n								

The TEST BIND PARAMETER LIST LENGTH field specifies the number of bytes that follow in the parameter list.

The HOST BIND IDENTIFIER field specifies a host bind identifier (see 5.8.2) that identifies an application client.

If the HOST BIND IDENTIFIER field is set to FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFFh, the device server shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

If the HOST BIND IDENTIFIER field is not set to one of saved host bind identifiers (see 5.8.2) for the S_A binding pair, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

The SUBSIDIARY LU DESIGNATOR field contains a designation descriptor (see 7.7.6.1) that specifies the subsidiary logical unit for the request. If the designation descriptor does not specify the subsidiary logical unit whose device server is processing this TEST BIND command, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

6.46 TEST UNIT READY command

The TEST UNIT READY command (see table 303) requests the device server to indicate whether the logical unit is ready. The device server shall not initiate a self-test as a result of processing this command. The device server shall complete a TEST UNIT READY command with GOOD status, if:

a) the I_T_L nexus on which that command is received is not affected by target port asymmetric access states (see 5.18.2.5); and
b) the logical unit is able to accept an appropriate medium access command without returning CHECK CONDITION status.

If the logical unit is unable to become operational or is in a state such that an application client action (e.g., a START STOP UNIT command (see SBC-5)) is required to make the logical unit ready, then the device server shall terminate a TEST UNIT READY command with CHECK CONDITION status, with the sense key set to NOT READY.

If the device server terminates a TEST UNIT READY command with CHECK CONDITION status, with the sense key set to NOT READY, and the additional sense code set to LOGICAL UNIT IS IN PROCESS OF BECOMING READY, then an estimated time to ready may be reported by setting the INFORMATION field in the sense data to an estimate of the time in milliseconds from the time that command was terminated until the time a TEST UNIT READY command is expected to be able to complete with GOOD status. See 4.4.4 for device server requirements regarding how values are returned in the INFORMATION field.

Table 303 – TEST UNIT READY command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (00h)							
1 ••• 4	Reserved							
5	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 303 for the TEST UNIT READY command.

The CONTROL byte is defined in SAM-6.

Table 304 defines the suggested CHECK CONDITION status responses to the TEST UNIT READY command. Other conditions (e.g., deferred errors or reservations) may result in other responses (e.g., GOOD status, CHECK CONDITION status, BUSY status, or RESERVATION CONFLICT status, each with or without other sense key and additional sense code values).

Table 304 – Preferred TEST UNIT READY responses (part 1 of 2)

Status	Sense Key	Additional Sense Code
CHECK CONDITION	ILLEGAL REQUEST	LOGICAL UNIT NOT SUPPORTED
CHECK CONDITION	ILLEGAL REQUEST	SUBSIDIARY LOGICAL UNIT NOT CONFIGURED

Table 304 – Preferred TEST UNIT READY responses (part 2 of 2)

Status	Sense Key	Additional Sense Code
CHECK CONDITION	NOT READY	LOGICAL UNIT DOES NOT RESPOND TO SELECTION
CHECK CONDITION	NOT READY	MEDIUM NOT PRESENT
CHECK CONDITION	NOT READY	LOGICAL UNIT NOT READY, CAUSE NOT REPORTABLE
CHECK CONDITION	NOT READY	LOGICAL UNIT IS IN PROCESS OF BECOMING READY
CHECK CONDITION	NOT READY	LOGICAL UNIT NOT READY, INITIALIZING COMMAND REQUIRED
CHECK CONDITION	NOT READY	LOGICAL UNIT NOT READY, MANUAL INTERVENTION REQUIRED
CHECK CONDITION	NOT READY	LOGICAL UNIT NOT READY, FORMAT IN PROGRESS
CHECK CONDITION	NOT READY	LOGICAL UNIT NOT READY, SANITIZE IN PROGRESS
CHECK CONDITION	NOT READY	LOGICAL UNIT NOT ACCESSIBLE, TARGET PORT IN STANDBY STATE
CHECK CONDITION	NOT READY	LOGICAL UNIT NOT ACCESSIBLE, TARGET PORT IN UNAVAILABLE STATE
CHECK CONDITION	NOT READY	LOGICAL UNIT NOT ACCESSIBLE, ASYMMETRIC ACCESS STATE TRANSITION
CHECK CONDITION	NOT READY	DEPOPULATION FAILED
CHECK CONDITION	NOT READY	DEPOPULATION IN PROGRESS
CHECK CONDITION	NOT READY	DEPOPULATION INTERRUPTED
CHECK CONDITION	NOT READY	DEPOPULATION RESTORATION FAILED
CHECK CONDITION	NOT READY	DEPOPULATION RESTORATION IN PROGRESS
CHECK CONDITION	NOT READY	DEPOPULATION RESTORATION INTERRUPTED

6.47 UNBIND command

The UNBIND command (see table 305) requests that the subsidiary logical unit's device server (see SAM-6) perform one or more unbind operations (see 5.8.10). If an UNBIND command is processed by a device server in a logical unit that is not a subsidiary logical unit, then the device server shall terminate the UNBIND command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST and the additional sense code set to NOT A SUBSIDIARY LOGICAL UNIT.

If the device server in a subsidiary logical unit supports the UNBIND command, then:

   a) the device server in the administrative logical unit for that logical unit conglomerate (see SAM-6) shall support the BIND command (see 6.2); and
   b) the device servers in all other subsidiary logical units in that logical unit conglomerate shall support the UNBIND command.

Table 305 – UNBIND command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (9Fh)							
1	Reserved			SERVICE ACTION (0Fh)				
2	Reserved							ALL CONG
3 ••• 11	Reserved							
12	(MSB)			PARAMETER LIST LENGTH				
13								(LSB)
14	Reserved							
15	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 305 for the UNBIND command.

The SERVICE ACTION field is defined in 4.2.5.2 and shall be set as shown in table 305 for the UNBIND command.

If the all conglomerates (ALL CONG) bit is set to one, the subsidiary logical unit is requested to be unbound from all conglomerates as described in 5.8.10. If the ALL CONG bit is set to zero, the subsidiary logical unit is requested to be unbound from one conglomerate as described in 5.8.10.

The PARAMETER LIST LENGTH field specifies the number of bytes of parameter data for the UNBIND command. A parameter list length of zero specifies that no parameter list is present. This shall not be considered an error.

The CONTROL byte is defined in SAM-6.

The format of the parameter list for the UNBIND command is shown in table 306.

Table 306 – UNBIND parameter list

Bit Byte	7	6	5	4	3	2	1	0
0 ••• **3**	(MSB)			UNBIND PARAMETER DATA LENGTH (n-3)				 (LSB)
4 ••• **7**				Reserved				
8 ••• **23**	(MSB)			HOST BIND IDENTIFIER				 (LSB)
24 ••• **k**				SUBSIDIARY LU DESIGNATOR				
k+1 **k+2**	(MSB)			INFORMATION STRING LENGTH (n-k+2)				 (LSB)
k+3 ••• **n**	(MSB)			INFORMATION STRING				 (LSB)

The UNBIND PARAMETER DATA LENGTH field specifies the number of bytes that follow in the parameter data.

The HOST BIND IDENTIFIER field specifies the host bind identifier (see 5.8.2) to be removed. If the host bind identifier matches an existing host bind identifier in the set of saved host bind identifiers for that S_A binding pair, then that binding is removed. If the host bind identifier does not match an existing host bind identifier in the set of saved host bind identifiers for that S_A binding pair, then the device server shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

If the HOST BIND IDENTIFIER field is set to FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFFh, the device server shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

The SUBSIDIARY LU DESIGNATOR field contains a designation descriptor (see 7.7.6.1) that specifies the logical unit to be unbound. If the designation descriptor does not specify the subsidiary logical unit whose device server is processing the UNBIND command, then the device server shall terminate the UNBIND command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

The INFORMATION STRING LENGTH field contains the length of the information string in bytes.

The INFORMATION STRING field contains a vendor specific byte encoded character string. The contents of the INFORMATION STRING field should be stored by the administrative logical unit's device server so that it may be read by means outside the scope of this standard.

6.48 WRITE ATTRIBUTE command

The WRITE ATTRIBUTE command (see table 307) requests the device server to write the specified attributes to medium auxiliary memory. Device servers that implement the WRITE ATTRIBUTE command shall also implement the READ ATTRIBUTE command (see 6.17). Application clients should send READ ATTRIBUTE commands prior to using this command to discover device server support for medium auxiliary memory.

Table 307 – WRITE ATTRIBUTE command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (8Dh)							
1	Reserved							WTC
2	Restricted (see SMC-3)							
3								
4								
5	LOGICAL VOLUME NUMBER							
6	Reserved							
7	PARTITION NUMBER							
8	Reserved							
9								
10	(MSB)							
•••			PARAMETER LIST LENGTH					
13								(LSB)
14	Reserved							
15	CONTROL							

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 307 for the WRITE ATTRIBUTE command.

The write-through cache (WTC) bit set to one specifies the attributes in the parameter list shall be synchronized with the medium auxiliary memory during the processing of the WRITE ATTRIBUTE command and GOOD status shall not be returned until the attributes have been synchronized with the medium auxiliary memory. The WTC bit is set to zero specifies no requirement related to the attributes in the parameter list being synchronized with the medium auxiliary memory during the processing of the WRITE ATTRIBUTE command.

The LOGICAL VOLUME NUMBER field specifies a logical volume (e.g., the medium auxiliary memory storage for one side of a double sided medium) within the medium auxiliary memory. The number of logical volumes of the medium auxiliary memory shall equal that of the attached medium. If the medium only has a single logical volume, then its logical volume number shall be zero.

The PARTITION NUMBER field specifies a partition (see SSC-5) within a logical volume. The number of partitions of the medium auxiliary memory shall equal that of the attached medium. If the medium only has a single partition, then its partition number shall be zero.

If the combination of logical volume number and partition number is not valid, the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

The PARAMETER LIST LENGTH field specifies the length in bytes of the parameter list contained in the Data-Out Buffer. A parameter list length of zero specifies that no parameter list is present; this shall not be considered an error. If the parameter list length results in the truncation of an attribute, the WRITE ATTRIBUTE command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to PARAMETER LIST LENGTH ERROR.

The CONTROL byte is defined in SAM-6.

The parameter list shall have the format shown in table 308. Attributes should be sent in ascending numerical order. If the attributes are not in order, then no attributes shall be changed and the device server shall terminate the WRITE ATTRIBUTE command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

Table 308 – WRITE ATTRIBUTE parameter list

Bit Byte	7	6	5	4	3	2	1	0
0 ••• 3	(MSB)			WRITE ATTRIBUTE PARAMETER DATA LENGTH (n-3)				(LSB)
	Attribute list							
4 •••				Attribute (see 7.4.1) [first]				
				⋮				
••• n				Attribute (see 7.4.1) [last]				

The WRITE ATTRIBUTE DATA LENGTH field should contain the number of bytes of attribute data and shall be ignored by the device server.

The format of the attributes is described in 7.4.1.

If there is not enough space to write the attributes to the medium auxiliary memory, then no attributes shall be changed and the device server shall terminate the WRITE ATTRIBUTE command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to AUXILIARY MEMORY OUT OF SPACE.

If the medium auxiliary memory is not accessible as a result of there being no medium present, then no attributes shall be changed and the device server shall terminate the WRITE ATTRIBUTE command with CHECK CONDITION status, with the sense key set to NOT READY, and the additional sense code set to MEDIUM NOT PRESENT.

If the medium is present but the medium auxiliary memory is not accessible, then no attributes shall be changed and the device server shall terminate the WRITE ATTRIBUTE command with CHECK CONDITION status, with the sense key set to MEDIUM ERROR, and the additional sense code set to LOGICAL UNIT NOT READY, AUXILIARY MEMORY NOT ACCESSIBLE.

If the medium auxiliary memory is not operational (e.g., bad checksum), the device server shall terminate the WRITE ATTRIBUTE command with CHECK CONDITION status, with the sense key set to MEDIUM ERROR, and the additional sense code set to AUXILIARY MEMORY WRITE ERROR.

If the WRITE ATTRIBUTE command parameter list contains an attribute with an ATTRIBUTE LENGTH field (see 7.4.1) set to zero, then one of the following actions shall occur:

   a) if the attribute state is unsupported or read only (see 5.9), then no attributes shall be changed and the device server shall terminate the WRITE ATTRIBUTE command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST;
   b) if the attribute state is read/write, the attribute shall be changed to the nonexistent state. This attribute shall not be returned in response to a READ ATTRIBUTE command and shall not be included in the parameter data returned by a READ ATTRIBUTE command with ATTRIBUTE LIST service action; or
   c) if the attribute state is nonexistent, the attribute in the WRITE ATTRIBUTE command parameter list shall be ignored; this shall not be considered an error.

No attributes shall be changed, the WRITE ATTRIBUTE command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST if the parameter list contains any of the following:

   a) an attempt to change an attribute in the read only state (see 5.9);
   b) an attribute with incorrect ATTRIBUTE LENGTH field (see 7.4.1) contents; or
   c) an attribute with unsupported ATTRIBUTE VALUE field (see 7.4.1) contents.

6.49 WRITE BUFFER command

6.49.1 WRITE BUFFER command introduction

The WRITE BUFFER command (see table 309) is used in conjunction with the READ BUFFER command for:

  a) testing logical unit buffer memory;
  b) testing the integrity of the service delivery subsystem;
  c) downloading microcode (see 5.5); and
  d) downloading application client error history (see 5.6).

Table 309 – WRITE BUFFER command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (3Bh)							
1	MODE SPECIFIC			MODE				
2	BUFFER ID							
3	(MSB)							
•••				BUFFER OFFSET				
5								(LSB)
6	(MSB)							
•••				PARAMETER LIST LENGTH				
8								(LSB)
9	CONTROL							

This command shall not alter any medium of the logical unit if the data mode is specified.

The OPERATION CODE field is defined in 4.2.5.1 and shall be set as shown in table 309 for the WRITE BUFFER command.

The usage of the MODE SPECIFIC field depends on the value in the MODE field.

The function of this command and the meaning of fields within the CDB depend on the contents of the MODE field. The MODE field is defined in table 310.

Table 310 – WRITE BUFFER MODE field (part 1 of 2)

Code	Description	Reference
00h	Obsolete	
01h	Vendor specific	6.49.2
02h	Data	6.49.3
03h	Reserved	
04h	Download microcode and activate	5.5 and 6.49.4
05h	Download microcode, save, and activate	5.5 and 6.49.5
06h	Download microcode with offsets and activate	5.5 and 6.49.6
07h	Download microcode with offsets, save, and activate	5.5 and 6.49.7

Table 310 – WRITE BUFFER MODE field (part 2 of 2)

Code	Description	Reference
08h to 09h	Reserved	
0Ah	Write data to echo buffer	6.49.8
0Bh to 0Ch	Reserved	
0Dh	Download microcode with offsets, select activation events, save, and defer activate	5.5 and 6.49.9
0Eh	Download microcode with offsets, save, and defer activate	5.5 and 6.49.10
0Fh	Activate deferred microcode	5.5 and 6.49.11
10h to 19h	Reserved	
1Ah	Obsolete	
1Bh	Obsolete	
1Ch	Download application client error history	5.6 and 6.49.12
1Dh to 1Fh	Reserved	

The MODE field may be processed as specifying a service action by the REPORT SUPPORTED OPERATION CODES command (see 6.32).

The CONTROL byte is defined in SAM-6.

6.49.2 Vendor specific mode (01h)

The meaning of the MODE SPECIFIC field, BUFFER ID field, BUFFER OFFSET field, and PARAMETER LIST LENGTH field are not specified by this standard.

6.49.3 Data mode (02h)

In this mode, the Data-Out Buffer contains buffer data destined for the logical unit. The BUFFER ID field identifies a specific buffer within the logical unit. The manufacturer assigns buffer ID codes to buffers within the logical unit. Buffer ID zero shall be supported. If more than one buffer is supported, then additional buffer ID codes shall be assigned contiguously, beginning with one. If an unsupported buffer ID code is selected, the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

The MODE SPECIFIC field is reserved.

The BUFFER OFFSET field specifies the location in the buffer to which the data is written. The application client should conform to the offset boundary requirements returned in the READ BUFFER descriptor (see 6.18.4). If the device server is unable to process the specified buffer offset, the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

The PARAMETER LIST LENGTH field specifies the maximum number of bytes that shall be transferred from the Data-Out Buffer to be stored in the specified buffer beginning at the buffer offset. The application client should specify a parameter list length plus the buffer offset that does not exceed the capacity of the specified buffer. The capacity of the buffer is indicated by the BUFFER CAPACITY field in the READ BUFFER descriptor (see

6.18.4). If the BUFFER OFFSET field and PARAMETER LIST LENGTH field specify a transfer in excess of the buffer capacity, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

6.49.4 Download microcode and activate mode (04h)

In this mode, microcode shall be transferred to the device server and activated (see 5.5).

The MODE SPECIFIC field is reserved.

The BUFFER ID field, BUFFER OFFSET field, and PARAMETER LIST LENGTH field are vendor specific.

6.49.5 Download microcode, save, and activate mode (05h)

In this mode, microcode shall be transferred to the device server, saved to nonvolatile storage, and activated (see 5.5) based on the setting of the ACTIVATE MICROCODE field in the Extended INQUIRY VPD page (see 7.7.7).

The MODE SPECIFIC field is reserved.

The BUFFER ID field, BUFFER OFFSET field, and PARAMETER LIST LENGTH field are vendor specific.

6.49.6 Download microcode with offsets and activate mode (06h)

In this mode, microcode shall be transferred to the device server using one or more WRITE BUFFER commands and activated (see 5.5).

The MODE SPECIFIC field is reserved.

The BUFFER ID field specifies a buffer within the logical unit. The manufacturer assigns buffer ID codes to buffers within the logical unit. A buffer ID value of zero shall be supported. If more than one buffer is supported, then additional buffer ID codes shall be assigned contiguously, beginning with one. If an unsupported buffer ID code is specified, the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

The BUFFER OFFSET field specifies the location in the buffer to which the microcode is written. The application client shall send only commands that conform to the offset boundary requirements returned in the READ BUFFER descriptor (see 6.18.4). If the device server is unable to process the specified buffer offset, the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

The PARAMETER LIST LENGTH field specifies the maximum number of bytes that shall be present in the Data-Out Buffer to be stored in the specified buffer beginning at the buffer offset. The application client should specify a parameter list length plus the buffer offset that does not exceed the capacity of the specified buffer. If the BUFFER OFFSET field and PARAMETER LIST LENGTH field specify a transfer in excess of the buffer capacity, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

6.49.7 Download microcode with offsets, save, and activate mode (07h)

In this mode, microcode shall be transferred to the device server using one or more WRITE BUFFER commands, saved to nonvolatile storage, and activated (see 5.5) based on the setting of the ACTIVATE MICROCODE field in the Extended INQUIRY VPD page (see 7.7.7).

The BUFFER ID field, BUFFER OFFSET field, and PARAMETER LIST LENGTH field are defined in the download microcode with offsets mode (see 6.49.6).

6.49.8 Write data to echo buffer mode (0Ah)

In this mode the device server transfers data from the application client and stores it in an echo buffer. An echo buffer is assigned in the same manner by the device server as it would for a write operation. Data shall be aligned on four-byte boundaries.

The MODE SPECIFIC field is reserved in this mode.

The BUFFER ID and BUFFER OFFSET fields shall be ignored in this mode.

> NOTE 21 - It is recommended that the logical unit assign echo buffers on a per I_T nexus basis to limit the number of exception conditions that may occur if there is more than one I_T nexus present.

Upon successful completion of a WRITE BUFFER command the data shall be preserved in the echo buffer unless there is an intervening command to any logical unit in which case the data may be changed.

The PARAMETER LIST LENGTH field specifies the maximum number of bytes that shall be transferred from the Data-Out Buffer to be stored in the echo buffer. The application client should specify a parameter list length that does not exceed the capacity of the echo buffer. The capacity of the echo buffer is indicated by the BUFFER CAPACITY field in the READ BUFFER echo buffer descriptor (see 6.18.6). If the PARAMETER LIST LENGTH field specifies a transfer in excess of the buffer capacity, the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

6.49.9 Download microcode with offsets, select activation, save, and defer activate mode (0Dh)

In this mode, microcode shall be transferred to the device server using one or more WRITE BUFFER commands, saved to nonvolatile storage, and considered deferred (see 5.5). The deferred microcode shall be activated and no longer considered deferred if a WRITE BUFFER command with the activate deferred microcode mode (0Fh) is processed (see 6.49.11).

The MODE SPECIFIC field (see table 311) specifies additional events that shall be used to activate the deferred microcode.

Table 311 – MODE SPECIFIC field

Bit	7	6	5	…
	PO_ACT	HR_ACT	VSE_ACT	…

The device server should:

a) use the MODE SPECIFIC field value contained in the WRITE BUFFER command with the BUFFER OFFSET field set to zero; and
b) terminate WRITE BUFFER commands with the BUFFER OFFSET field not set to zero if the MODE SPECIFIC field value is not equal to the MODE SPECIFIC field value received in the most recent WRITE BUFFER command with the BUFFER OFFSET field set to zero.

If all the MODE SPECIFIC field values contained in the WRITE BUFFER commands of a WRITE BUFFER sequence are not the same, then the device server may process the MODE SPECIFIC field in a vendor specific manner.

If the power on activate (PO_ACT) bit is set to one, then deferred microcode shall be activated and no longer considered deferred if a power on occurs. If the PO_ACT bit is set to zero, then deferred microcode shall not be activated if a power on occurs.

If the hard reset activate (HR_ACT) bit is set to one, then deferred microcode shall be activated and no longer considered deferred if a hard reset occurs. If the HR_ACT bit is set to zero, then deferred microcode shall not be activated if a hard reset occurs.

If the vendor specific event activate (VSE_ACT) bit is set to one, then deferred microcode shall be activated and no longer considered deferred if a vendor specific event occurs. If the VSE_ACT bit is set to zero, then deferred microcode shall not be activated if a vendor specific event occurs.

The supported activation events shall be reported in the POA_SUP bit, HRA_SUP bit, and VSA_SUP bit in the Extended INQUIRY VPD page (see 7.7.7). If the MODE SPECIFIC field specifies an activation event that is not supported (e.g., if the PO_ACT bit is set to one and the POA_SUP bit is set to zero), then the device server shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.

The BUFFER ID field, BUFFER OFFSET field, and PARAMETER LIST LENGTH field are defined in the download microcode with offsets mode (see 6.49.6).

6.49.10 Download microcode with offsets, save, and defer activate mode (0Eh)

In this mode, microcode shall be transferred to the device server using one or more WRITE BUFFER commands, saved to nonvolatile storage, and considered deferred (see 5.5).

The deferred microcode shall be activated and no longer considered deferred if any one of the following occurs:

a) a power on, if the PWROMACT bit (see 7.5.14) is set to zero;
b) a hard reset, if the HRDRMACT bit (see 7.5.14) is set to zero;
c) a START STOP UNIT command is processed (see SBC-5), if the SSUMACT bit (see 7.5.14) is set to zero;
d) a FORMAT UNIT command is processed (see SBC-5), if the FMTMACT bit (see 7.5.14) is set to zero; or
e) a WRITE BUFFER command with the activate deferred microcode mode (0Fh) is processed (see 6.49.11).

The MODE SPECIFIC field, BUFFER ID field, BUFFER OFFSET field, and PARAMETER LIST LENGTH field are defined in the download microcode with offsets mode (see 6.49.6).

6.49.11 Activate deferred microcode mode (0Fh)

In this mode, deferred microcode, if any, that has been saved using one of the modes list in this subclause shall be activated and no longer considered deferred (see 5.5). The modes that save deferred microcode are:

    a) the download microcode with offsets, select activation events, save, and defer activate mode (0Dh)
        (see 6.49.9); and
    b) the download microcode with offsets, save, and defer activate mode (0Eh) (see 6.49.10).

The MODE SPECIFIC field is reserved.

The the BUFFER ID field, the BUFFER OFFSET field, and PARAMETER LIST LENGTH field shall be ignored in this mode.

If there is no deferred microcode that has been saved using one of the modes list in this subclause, the device server shall terminate the WRITE BUFFER command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to COMMAND SEQUENCE ERROR.

6.49.12 Download application client error history mode (1Ch)

In this mode the device server transfers application client error history from the application client and stores it in the error history (see 5.6). The format of the application client error history parameter list is defined in table 312.

The MODE SPECIFIC field is reserved.

The BUFFER ID field and BUFFER OFFSET field shall be ignored in this mode.

Upon successful completion of a WRITE BUFFER command, the information contained in the application client error history parameter list shall be appended to the application client error history in a format determined by the logical unit.

The PARAMETER LIST LENGTH field specifies the length in bytes of the application client error history parameter list that shall be transferred from the application client to the device server. If the PARAMETER LIST LENGTH field specifies a transfer that exceeds the error history capacity, the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

The device server shall not return an error based on the contents of any of the field values defined in table 312 except:

    a)   the CLR bit;
    b)   the ERROR LOCATION LENGTH field; and
    c)   the APPLICATION CLIENT ERROR HISTORY LENGTH field.

Table 312 – Application client error history parameter list

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
•••			T10 VENDOR IDENTIFICATION					
7								(LSB)
8	(MSB)							
9			ERROR TYPE					(LSB)
10	Reserved							CLR
11	Reserved							
12	(MSB)							
•••			TIMESTAMP					
17								(LSB)
18			Reserved					
19								
20	Reserved				CODE SET			
21	ERROR LOCATION FORMAT							
22	(MSB)							
23			ERROR LOCATION LENGTH (m-25)					(LSB)
24	(MSB)							
25			APPLICATION CLIENT ERROR HISTORY LENGTH (n-m)					(LSB)
26	(MSB)							
•••			ERROR LOCATION					
m								(LSB)
m+1								
•••			APPLICATION CLIENT ERROR HISTORY					
n								

The T10 VENDOR IDENTIFICATION field contains eight bytes of left-aligned ASCII data (see 4.3.1) identifying the manufacturer providing the application client error history. The T10 vendor identification shall be one assigned by INCITS. A list of assigned T10 vendor identifications is in Annex F and on the T10 web site (http://www.t10.org).

The ERROR TYPE field (see table 313) specifies the error detected by the application client.

Table 313 – ERROR TYPE field

Code	Description
0000h	No error specified by the application client.
0001h	An unknown error was detected by the application client.
0002h	The application client detected corrupted data.
0003h	The application client detected a permanent error.
0004h	The application client detected a service response of SERVICE DELIVERY OR TARGET FAILURE (see SAM-6).
0005h to 7FFFh	Reserved
8000h to FFFFh	Vendor specific

If the CLR_SUP bit is set to one in the error history directory parameter data (see 6.18.8.2), a CLR bit set to one specifies that the device server shall:

a) clear the portions of the error history that the device server allows to be cleared; and
b) ignore any application client error history specified in the parameter list.

If the CLR_SUP bit is set to one in the error history directory parameter data, a CLR bit set to zero specifies that the device server shall:

a) not clear the error history; and
b) process all application client error history specified in the parameter list.

If the CLR_SUP bit is set to zero in the error history directory parameter data, the device server shall ignore the CLR bit.

The TIMESTAMP field should contain:

a) a time based on the timestamp reported by the REPORT TIMESTAMP command, if the device server supports a device clock (see 5.3);
b) the number of milliseconds that have elapsed since midnight, 1 January 1970 UT; or
c) zero, if the application client is not able to determine the UT of the log entry.

The CODE SET field contains a code set enumeration (see table 25) that indicates the format of the APPLICATION CLIENT ERROR HISTORY field.

The ERROR LOCATION FORMAT field (see table 314) specifies the format of the ERROR LOCATION field.

Table 314 – ERROR LOCATION FORMAT field

Code	Description
00h	No error history location specified by the application client.
01h	For block devices (see SBC-5 and RBC), the ERROR LOCATION field specifies the logical block address associated with the specified application client error history. For other device types, this code is reserved.
02h to 7Fh	Reserved
80h to FFh	Vendor specific

The ERROR LOCATION LENGTH field specifies the length of the ERROR LOCATION field. The ERROR LOCATION LENGTH field value shall be a multiple of four. An ERROR LOCATION LENGTH field set to zero specifies that there is no error location information.

The APPLICATION CLIENT ERROR HISTORY LENGTH field specifies the length of the APPLICATION CLIENT ERROR HISTORY field. The APPLICATION CLIENT ERROR HISTORY LENGTH field value shall be a multiple of four. An APPLICATION CLIENT ERROR HISTORY field set to zero specifies that there is no vendor specific information.

The ERROR LOCATION field specifies the location at which the application client detected the error, in the format specified by the ERROR LOCATION FORMAT field.

The APPLICATION CLIENT ERROR HISTORY field specifies vendor specific application client error history (see 5.6.1).

7 Parameters for all device types

7.1 Overview

Parameters for all device types are defined in this clause as follows:

  a) diagnostic parameters are defined in 7.2;
  b) log parameters are defined in 7.3;
  c) medium auxiliary memory attributes are defined in 7.4;
  d) mode parameters are defined in 7.5;
  e) protocol specific parameters are defined in 7.6; and
  f) vital product data parameters are defined in 7.7.

7.2 Diagnostic parameters

7.2.1 Summary of diagnostic page codes

The page code assignments for diagnostic pages are summarized in table 315.

Table 315 – Summary of diagnostic page codes

Diagnostic page description	Page code	Reference

Defined by SES-3 for:
  a) standalone enclosure services devices (i.e., logical units with the PERIPHERAL DEVICE TYPE field set to 0Dh in standard INQUIRY data (see 6.7.2)); and
  b) attached enclosure services devices (i.e., logical units with the ENCSERV bit set to one in standard INQUIRY data).
	01h to 2Fh	SES-3

Protocol Specific	3Fh	7.2.3
Supported Diagnostic Pages	00h	7.2.4
Restricted (see applicable command standard)	40h to 7Fh	
Vendor specific	80h to FFh	
Reserved	All other codes	
A numeric ordered listing of diagnostic page codes is provided in clause E.4.		

7.2.2 Diagnostic page format for all device types

This subclause describes the diagnostic page structure and the diagnostic pages that are applicable to all SCSI devices. Diagnostic pages specific to each device type are described in the command standard that applies to that device type.

A SEND DIAGNOSTIC command (see 6.39) with a PF bit set to one specifies that the SEND DIAGNOSTIC parameter list consists of a single diagnostic page and that the data returned by a subsequent RECEIVE DIAGNOSTIC RESULTS command with the PCV bit set to zero is described in 6.24. If the PF bit is supported in the SEND DIAGNOSTIC command (see 6.39), a SEND DIAGNOSTIC command with a PF bit set to one specifies that the subsequent RECEIVE DIAGNOSTIC RESULTS command shall use the diagnostic page format defined in table 316. A RECEIVE DIAGNOSTIC RESULTS command with a PCV bit set to one specifies that the device server return a diagnostic page using the format defined in table 316.

Table 316 – Diagnostic page

Bit Byte	7	6	5	4	3	2	1	0
0	PAGE CODE							
1	Page code specific							
2	(MSB)		PAGE LENGTH (n-3)					
3								(LSB)
4 ••• n	Diagnostic parameters							

Each diagnostic page defines:

a) a function or operation that the device server shall perform as a result of a SEND DIAGNOSTIC command; or
b) the information being returned as a result of a RECEIVE DIAGNOSTIC RESULTS command with the PCV bit equal to one.

The diagnostic parameters contain data that is formatted according to the page code specified.

The PAGE CODE field (see 7.2.1) identifies the diagnostic page.

The PAGE LENGTH field indicates the number of bytes that follow in the diagnostic parameters. If the application client sends a SEND DIAGNOSTIC command with a parameter list containing a PAGE LENGTH field that results in the truncation of any parameter, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

The diagnostic parameters are defined for each diagnostic page code. The diagnostic parameters within a diagnostic page may be defined differently in a SEND DIAGNOSTIC command than in a RECEIVE DIAGNOSTIC RESULTS command.

7.2.3 Protocol Specific diagnostic page

The Protocol Specific diagnostic page (see table 317) provides access to SCSI transport protocol specific diagnostic parameters.

Table 317 – Protocol Specific diagnostic page

Bit Byte	7	6	5	4	3	2	1	0
0	PAGE CODE (3Fh)							
1	Reserved				PROTOCOL IDENTIFIER			
2	(MSB)			PAGE LENGTH (n-3)				
3								(LSB)
4				SCSI transport protocol specific diagnostic parameters				
•••								
n								

The PAGE CODE field is described in 7.2.2, and shall be set to 3Fh to indicate a Protocol Specific diagnostic page follows.

The PROTOCOL IDENTIFIER field contains one of the values shown in table 483 (see 7.6.1) to identify the SCSI transport protocol standard that defines the SCSI transport protocol specific diagnostic parameters.

The PAGE LENGTH field specifies the length in bytes of the following supported page list.

The SCSI transport protocol specific diagnostic parameters are defined by the SCSI transport protocol standard that corresponds to the value in the PROTOCOL IDENTIFIER field.

7.2.4 Supported Diagnostic Pages diagnostic page

The Supported Diagnostic Pages diagnostic page (see table 318) returns the list of diagnostic pages supported by the device server. This diagnostic page shall be implemented if the device server implements the diagnostic page format option of the SEND DIAGNOSTIC command and RECEIVE DIAGNOSTIC RESULTS commands.

Table 318 – Supported Diagnostic Pages diagnostic page

Bit Byte	7	6	5	4	3	2	1	0
0	PAGE CODE (00h)							
1	Reserved							
2	(MSB)			PAGE LENGTH (n-3)				
3								(LSB)
4				SUPPORTED PAGE LIST				
•••								
n								

The definition of this diagnostic page for the SEND DIAGNOSTIC command includes only the first four bytes. This diagnostic page specifies that the device server shall make available the list of all supported diagnostic pages to be returned by a subsequent RECEIVE DIAGNOSTIC RESULTS command. If the PAGE LENGTH field is not zero, the device server shall terminate the SEND DIAGNOSTIC command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

The definition of this diagnostic page for the RECEIVE DIAGNOSTIC RESULTS command includes the list of diagnostic pages supported by the device server.

The PAGE CODE field is described in 7.2.2, and shall be set as shown in table 318 for Supported Diagnostics Pages diagnostic page.

The PAGE LENGTH field indicates the length in bytes of the supported page list.

The SUPPORTED PAGE LIST field shall contain a list of all diagnostic page codes, one per byte, supported by the device server in ascending order beginning with page code 00h. The supported page list may or may not include all the diagnostic pages that are able to be returned by the device server.

7.3 Log parameters

7.3.1 Summary of log page codes

The page code assignments for log pages are summarized in table 319.

Table 319 – Summary of log page codes (part 1 of 2)

Log page name	Page code	Subpage code	Reference
Application Client	0Fh	00h	7.3.4
Buffer Over-Run/Under-Run	01h	00h	7.3.5
Cache Memory Statistics	19h	20h	7.3.6
Command Duration Limits Statistics	19h	21h	7.3.7
Environmental Limits	0Dh	02h	7.3.8
Environmental Reporting	0Dh	01h	7.3.9
General Statistics and Performance	19h	00h	7.3.10
Group Statistics and Performance (1 to 31)	19h	01h to 1Fh	7.3.11
Informational Exceptions	2Fh	00h	7.3.12
Last *n* Deferred Errors or Asynchronous Events	0Bh	00h	7.3.13
Last *n* Error Events	07h	00h	7.3.14
Last *n* Inquiry Data Changed	0Bh	01h	7.3.15
Last *n* Mode Page Data Changed	0Bh	02h	7.3.16
Non-Medium Error	06h	00h	7.3.17
Power Condition Transitions	1Ah	00h	7.3.18
Protocol Specific Port [a]	18h	00h to FEh	7.3.19
Read Error Counters	03h	00h	7.3.20
Read Reverse Error Counters	04h	00h	7.3.21
Self-Test Results	10h	00h	7.3.22
Start-Stop Cycle Counter	0Eh	00h	7.3.23
Supported Log Pages	00h	00h	7.3.24
Supported Log Pages and Subpages	00h	FFh	7.3.25
Supported Subpages	01h to 3Fh	FFh	7.3.26
Temperature	0Dh	00h	7.3.27
Verify Error Counters	05h	00h	7.3.28
Write Error Counters	02h	00h	7.3.29
A numeric ordered listing of log pages codes and subpage codes is provided in clause E.5.			
[a] Each SCSI transport protocol standard may define a different name for these log pages.			

Table 319 – Summary of log page codes (part 2 of 2)

Log page name	Page code	Subpage code	Reference
Restricted (see applicable SCSI transport protocol standard)	08h to 0Ah	00h to FEh	
	0Ch	00h to FEh	
	11h to 17h	00h to FEh	
	1Bh to 2Eh	00h to FEh	
Vendor specific	30h to 3Eh	00h to FEh	
Reserved	All other codes		
A numeric ordered listing of log pages codes and subpage codes is provided in clause E.5.			
[a] Each SCSI transport protocol standard may define a different name for these log pages.			

7.3.2 Log page structure and log parameter structure for all device types

7.3.2.1 Log page structure

This subclause describes the log page structure that is applicable to all SCSI devices. Log pages specific to each device type are described in the command standard that applies to that device type. The LOG SELECT command (see 6.8) supports the ability to send zero or more log pages. The LOG SENSE command (see 6.9) returns the log page specified by the combination of the PAGE CODE field and SUBPAGE CODE field in the CDB.

Each log page begins with a four-byte page header followed by zero or more variable length log parameters defined for that log page. The log page format is shown in table 320.

Table 320 – Log page

Bit Byte	7	6	5	4	3	2	1	0
0	DS	SPF	PAGE CODE					
1	SUBPAGE CODE							
2	(MSB)		PAGE LENGTH (n-3)					
3								(LSB)
	Log parameter list							
4 ••• x+3	Log parameter (see 7.3.2.2) [first] (Length x)							
	⋮							
n-y+1 ••• n	Log parameter (see 7.3.2.2) [last] (Length y)							

For the LOG SENSE command (see 6.9), the DS bit indicates whether log parameters in this log page are saved if the SP bit is set to one in the CDB. If the DS bit is set to zero, the log parameters are saved if the SP bit is set to one. If the DS bit is set to one, the log parameters are not saved. For the LOG SELECT command (see 6.8), the disable save (DS) bit operates in conjunction with the PCR bit, the SP bit, the PC field, and the PARAMETER LIST LENGTH field in the CDB.

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

The PAGE CODE field indicates the number of the log page (see 7.3.1) that is being transferred.

The SUBPAGE CODE field indicates the subpage number of the log page (see 7.3.1) that is being transferred.

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

If the PARAMETER LIST LENGTH field in a LOG SELECT command contains zero, the meanings for the PCR bit, SP bit, and PC field are defined in 6.8.2.

If the PARAMETER LIST LENGTH field in a LOG SELECT command contains a non-zero value (i.e., if a parameter list is being sent with the LOG SELECT command), then table 321 defines the meaning for the combinations of values for:

     a)   the PCR bit, the SP bit, and the PC field in the LOG SELECT command (see 6.8.1);
     b)   the DS bit in the log page header (see table 320); and
     c)   the PARAMETER CODE field and the FORMAT AND LINKING field in each log parameter (see 7.3.2.2.1).

Table 321 – LOG SELECT PCR bit, SP bit, and DS bit meanings when parameter list length is not zero

PCR bit	SP bit	DS bit	Description
0b	0b	xb	The device server shall set the specified log parameters [a] to the values in the parameter list and shall not save those values to nonvolatile media.
0b	1b	0b	The device server shall set the specified log parameters [a] to the values in the parameter list and shall process the optional saving of log parameter values as follows: a) if default data counter values are specified (see table 157 in 6.8.1), then no values shall be saved; b) if values other than default data counter values are specified and the device server implements saving of the specified log parameters [a], then the device server shall save the values of the log parameters [a] specified in the parameter list to nonvolatile media; or c) if values other than default values are specified and the device server does not implement saving of one or more of the specified log parameters [a], then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.
0b	1b	1b	The device server shall set the specified log parameters [a] to the values in the parameter list and shall not save those values in the specified log page to nonvolatile media.
1b	xb	xb	The device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.
[a] The specified log parameters are determined by the PARAMETER CODE field contents (see 7.3.2.2.1) in the LOG SELECT parameter data as well as by the PC field contents (see table 157 in 6.8.1) in the LOG SELECT CDB.			

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

7.3.2.2 Log parameter structure

7.3.2.2.1 Log parameter structure introduction

Most log pages contain one or more data structures called log parameters (see table 322). Log parameters may be data counters of a particular event(s), the conditions under which certain operations were performed, or list parameters that contain a character string or binary description related to a particular event.

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

Table 322 – Log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
1				PARAMETER CODE				(LSB)
2	Parameter control byte (see 7.3.2.2.2)							
	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (n-3)							
4	(MSB)							
•••				PARAMETER VALUE				
n								(LSB)

The PARAMETER CODE field identifies the log parameter being transferred. The device server shall return the log parameters in a log page in ascending order based on the value in their PARAMETER CODE field.

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

The DU bit, TSD bit, and FORMAT AND LINKING field are collectively referred to as the parameter control byte. The bits and fields in the parameter control byte are described in 7.3.2.2.2.

The PARAMETER LENGTH field specifies the length in bytes of the PARAMETER VALUE field. If the application client specifies a parameter length that results in the truncation of the PARAMETER VALUE field, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

If the application client sends a value in a PARAMETER VALUE field that is outside the range supported by the logical unit, and rounding is performed for that parameter, then the device server may:

   a) round to an acceptable value and terminate the command as defined in 5.10; or
   b) terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

If the parameter data for one LOG SELECT command contains more than one log page and the log pages are not in ascending order by page code value then subpage code value, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

If the parameter data for one LOG SELECT command contains more than one log parameter in any one log page and the log parameters are not in ascending order by parameter code value, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

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

The SCSI target device may provide independent sets of log parameters for each logical unit or for each combination of logical units and I_T nexuses. If the SCSI target device does not support independent sets of log parameters and any log parameters are changed that affect other I_T nexuses, then the device server shall establish a unit attention condition (see SAM-6) for the SCSI initiator port associated with every I_T nexus except the I_T nexus on which the LOG SELECT command was received, with the additional sense code set to LOG PARAMETERS CHANGED.

7.3.2.2.2 Parameter control byte

7.3.2.2.2.1 Parameter control byte introduction

The bits and fields in the parameter control byte are described in 7.3.2.2.2.

For cumulative log parameter values, indicated by the PC field (see table 157 in 6.8.1) of the LOG SELECT command and LOG SENSE command, the disable update (DU) bit is defined as follows:

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

   NOTE 22 - While updating cumulative log parameter values, a device server may use volatile memory to hold these values until a LOG SELECT command or LOG SENSE command is received with an SP bit set to one or a vendor specific event occurs. As a result the updated cumulative log parameter values may be lost if a power cycle occurs.

If the PC field (see table 157 in 6.8.1) indicates that default values are being processed, then the device server shall:

a) set the DU bit to zero, if a LOG SENSE command is being processed; and
b) ignore the DU bit, if a LOG SELECT command is being processed.

Regardless of the value in the PC field, the device server shall process ASCII format list log parameters (see 7.3.2.2.2.4) and binary format list log parameters (see 7.3.2.2.2.5) by:

a) setting the DU bit to zero, if a LOG SENSE command is being processed; and
b) ignoring the DU bit, if a LOG SELECT command is being processed.

A target save disable (TSD) bit set to zero indicates that the logical unit implicitly saves the log parameter at vendor specific intervals. This implicit saving operation shall be done frequently enough to ensure that the cumulative parameter values retain statistical significance (i.e., across power cycles). A TSD bit set to one indicates that either the logical unit does not implicitly save the log parameter or implicit saving of the log parameter has been disabled individually by an application client setting the TSD bit to one. An application client may disable the implicit saving for all log parameters without changing any TSD bits using the GLTSD bit in the Control mode page (see 7.5.13).

The FORMAT AND LINKING field (see table 323) indicates the type of log parameter.

Table 323 – FORMAT AND LINKING field

Code	Log parameter type	Reference
00b	Bounded data counter	7.3.2.2.2.2
01b	ASCII format list	7.3.2.2.2.4
10b	Bounded data counter or unbounded data counter	7.3.2.2.2.2 or 7.3.2.2.2.3
11b	Binary format list	7.3.2.2.2.5

7.3.2.2.2.2 Parameter control byte values for bounded data counter parameters

The device server shall return parameter control byte values associated with LOG SENSE commands and process parameter control byte values associated with LOG SELECT commands as shown in table 324 for any log parameter that is defined to be a bounded data counter log parameter.

Table 324 – Parameter control byte values for bounded data counter parameters

Field or bit	Value associated with		Description
	LOG SENSE commands	**LOG SELECT commands**	
DU	0 or 1	0 or 1	If the DU bit is set to zero, the device server shall update the log parameter value to reflect all events that should be noted by that log parameter. If the DU bit is set to one, the device server shall not update the log parameter value except in response to a LOG SELECT command that specifies a new value for that log parameter.
TSD	0 or 1	0 or 1	If the TSD bit is set to zero, the device server shall save the log parameter to its medium at vendor specific intervals. If the TSD bit is set to one, the device server shall not save the log parameter to its medium.
FORMAT AND LINKING	00b or 10b	00b or 10b	The log parameter is a data counter (see table 323 in 7.3.2.2.2.1) and the handling of a log parameter that reaches its maximum value is described in this subclause.

If a LOG SELECT command contains a bounded data counter log parameter in which the parameter control byte values differ from those shown in table 324, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

Each bounded data counter log parameter contains one saturating counter that is:

  a) associated with one or more events; and
  b) incremented whenever one of these events occurs.

In a bounded data counter log parameter, if the counter has associated with it a vendor specific maximum value, then upon reaching this maximum value, the data counter shall not be incremented (i.e., its value does not wrap).

In a bounded data counter log parameter, if the counter reaches its maximum value (i.e., saturates), the device server shall:

a) set the DU bit to one;
b) handle other bounded data counter log parameters in the log page based on the contents of the FORMAT AND LINKING field in each other log parameter as follows:
    A) if the FORMAT AND LINKING field is set to 00b, then that other log parameter shall stop incrementing until reinitialized by a LOG SELECT command; or
    B) if the FORMAT AND LINKING field is set to 10b, then that other log parameter shall not stop incrementing, but may be reinitialized by a LOG SELECT command;
    and
c) not alter the handling of other log parameters in the log page that are:
    A) unbounded data counter log parameters (see 7.3.2.2.2.3);
    B) ASCII format list log parameters (see 7.3.2.2.2.4); and
    C) binary format list log parameters (see 7.3.2.2.2.5).

The processing of a command shall not be altered as a result of the counter in a bounded data counter log parameter reaching its maximum value (i.e., saturates). If the RLEC bit is set to one in the Control mode page (see 7.5.13) and the processing of a command encounters no exception conditions other than the counter in a bounded data counter log parameter reaching its maximum value, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to RECOVERED ERROR, and the additional sense code set to LOG COUNTER AT MAXIMUM.

7.3.2.2.2.3 Parameter control byte values for unbounded data counter parameters

The device server shall return parameter control byte values associated with LOG SENSE commands and process parameter control byte values associated with LOG SELECT commands as shown in table 325 for any log parameter that is defined to be an unbounded data counter log parameter.

Table 325 – Parameter control byte values for unbounded data counter parameters

Field or bit	Value associated with		Description
	LOG SENSE commands	LOG SELECT commands	
DU	0 or 1	0 or 1	If the DU bit is set to zero, the device server shall update the log parameter value or values to reflect all events that should be noted by that parameter. If the DU bit is set to one, the device server shall not update the log parameter value or values except in response to a LOG SELECT command that specifies a new value for the parameter.
TSD	0 or 1	0 or 1	If the TSD bit is set to zero, the device server shall save the log parameter to its medium at vendor specific intervals. If the TSD bit is set to one, the device server shall not save the log parameter to its medium.
FORMAT AND LINKING	10b	10b	The log parameter is a data counter for which saturation of another log parameter does not affect the incrementing of this log parameter (see table 323 in 7.3.2.2.2.1).

If a LOG SELECT command contains an unbounded data counter log parameter in which the parameter control byte values differ from those shown in table 325, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

Each unbounded data counter log parameter contains one or more saturating counters or wrapping counters. The description of each counter field in the log parameter defines when the device server modifies the contents of the counter that is transferred in that field.

Changes in an unbounded data counter (e.g., a counter reaching saturation or another maximum value) shall not affect the handling of other log parameters in the log page. The processing of a command and the status returned by that command shall not be altered as a result of a counter in an unbounded data counter log parameter saturating or reaching its maximum value.

The device server shall not change the value in the DU bit in an unbounded data counter log parameter unless requested to do so by a LOG SELECT command.

7.3.2.2.2.4 Parameter control byte values for ASCII format list log parameters

The device server shall return parameter control byte values associated with LOG SENSE commands and process parameter control byte values associated with LOG SELECT commands as shown in table 326 for any log parameter that is defined to be an ASCII format list log parameter.

Table 326 – Parameter control byte values for ASCII format list log parameters

Field or bit	Value associated with LOG SENSE commands	Value associated with LOG SELECT commands	Description
DU	0	ignored	The DU bit is not defined for list parameters.
TSD	0 or 1	0 or 1	If the TSD bit is set to zero, the device server shall save the log parameter to its medium at vendor specific intervals. If the TSD bit is set to one, the device server shall not save the log parameter to its medium.
FORMAT AND LINKING	01b	01b	The log parameter is an ASCII format list parameter (see table 323 in 7.3.2.2.2.1).

If a LOG SELECT command contains an ASCII format list log parameter in which the parameter control byte values differ from those shown in table 326, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

7.3.2.2.2.5 Parameter control byte values for binary format list log parameters

The device server shall return parameter control byte values associated with LOG SENSE commands and process parameter control byte values associated with LOG SELECT commands as shown in table 327 for any log parameter that is defined to be a binary format list log parameter.

Table 327 – Parameter control byte values for binary format list log parameters

Field or bit	Value associated with		Description
	LOG SENSE commands	LOG SELECT commands	
DU	0	ignored	The DU bit is not defined for list parameters.
TSD	0 or 1	0 or 1	If the TSD bit is set to zero, the device server shall save the log parameter to its medium at vendor specific intervals. If the TSD bit is set to one, the device server shall not save the log parameter to its medium.
FORMAT AND LINKING	11b	11b	The log parameter is an binary format list parameter (see table 323 in 7.3.2.2.2.1).

If a LOG SELECT command contains a binary format list log parameter in which the parameter control byte values differ from those shown in table 327, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

7.3.3 Resetting and setting log parameters

In a LOG SELECT command, an application client may specify that:

   a) all the log parameters in the specified log pages are to be reset (i.e., the PCR bit is set to one and the PARAMETER LIST LENGTH field is set to zero); or
   b) individual log parameters in the specified log pages are to be changed to specified new values (i.e., the PCR bit is set to zero and the PARAMETER LIST LENGTH field is not set to zero).

The device server handling of these requests to reset or change the cumulative value of a log parameter depends on the log parameter that is being reset or changed. The keywords that describe how the device server handles these requests are defined in table 328.

Table 328 – Keywords for resetting or changing log parameter cumulative values

Keyword	Device server handling when	
	PCR bit is set to one [a]	**PCR bit is set to zero** [b]
Always	Reset the log parameter cumulative value.	Change the log parameter cumulative value.
Reset Only	Reset the log parameter cumulative value.	If any changes are requested in the PARAMETER VALUE field of the log parameter cumulative value, then: a) terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST; and
Never	Do not reset the log parameter cumulative value. Table 159 (see 6.8.1) describes error conditions that may apply.	b) do not make any requested changes in any field in any log parameter cumulative value in any log page.

[a] If the PCR bit is set to one and the PARAMETER LIST LENGTH field is not set to zero, the device server shall terminate the LOG SELECT command (see table 321 in 7.3.2.1).

[b] If the PCR bit is set to zero and the PARAMETER LIST LENGTH field is set to zero, no log parameters are changed (see 6.8.2).

7.3.4 Application Client log page

7.3.4.1 Overview

Using the format shown in table 330, the Application Client log page provides a place for application clients to store information. The parameter codes for the Application Client log page are listed in table 329.

Table 329 – Application Client log page parameter codes

Parameter code	Description	Resettable or Changeable [a]	Reference	Support
0000h to 003Fh	General Usage Application Client	Always	7.3.4.2	Mandatory
0040h to 0FFFh				Optional
all others	Reserved			

[a] The keywords in this column – Always, Reset Only, and Never – are defined in 7.3.3.

The Application Client log page has the format shown in table 330.

Table 330 – Application Client log page

Bit Byte	7	6	5	4	3	2	1	0
0	DS	SPF (0b)	PAGE CODE (0Fh)					
1	SUBPAGE CODE (00h)							
2	(MSB)	PAGE LENGTH (n-3)						
3								(LSB)
	Application client log parameters							
4 •••	Application client log parameter (see 7.3.4.2) [first]							
	⋮							
••• n	Application client log parameter (see 7.3.4.2) [last]							

The DS bit, SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field are described in 7.3.2. The SPF bit, PAGE CODE field, and SUBPAGE CODE field shall be set as shown in table 330 for the Application Client log page.

Each application client log parameter contains the information described in 7.3.4.2.

7.3.4.2 General Usage Application Client log parameter

The General Usage Application Client log parameter has the format shown in table 331. This information may be used to describe the system configuration and system problems, but the specific definition of the data is application client specific.

Table 331 – General Usage Application Client log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)	PARAMETER CODE (see table 329)						
1								(LSB)
2	Parameter control byte – binary format list log parameter (see 7.3.2.2.2.5)							
	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (FCh)							
4 ••• 255	GENERAL USAGE PARAMETER BYTES							

The PARAMETER CODE field is described in 7.3.2.2.1, and shall be set as shown in table 329 for the General Usage Application Client log parameter.

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. These fields shall be set as described for a binary format list log parameter (see 7.3.2.2.2.5) for the General Usage Application Client log parameter.

The contents of the GENERAL USAGE PARAMETER BYTES field represent data sent to the device server in a previous LOG SELECT command. If a previous LOG SELECT command has not occurred, the contents of the GENERAL USAGE PARAMETER BYTES field are vendor specific.

7.3.5 Buffer Over-Run/Under-Run log page

7.3.5.1 Overview

Using the format shown in table 333, the Buffer Over-Run/Under-Run log page defines bounded data counters that record the number of buffer over-runs or under-runs detected by the device server. The parameter codes for the Buffer Over-Run/Under-Run log page are listed in table 332.

Table 332 – Buffer Over-Run/Under-Run log page parameter codes (part 1 of 2)

Parameter code [a]	Incremented once per:			Resettable or Changeable [b]	Reference	Support
	Over- or Under-run	Experienced by (or during)	Problem detected			
0000h	Under-run	Undefined	Undefined	Reset Only	7.3.5.2	At least one [c]
0001h	Over-run					
0020h	Under-run	A command				
0021h	Over-run					
0040h	Under-run	An I_T nexus				
0041h	Over-run					
0080h	Under-run	A unit of time [d]				
0081h	Over-run					
0002h	Under-run	Undefined	Service delivery subsystem busy	Reset Only	7.3.5.2	At least one [c]
0003h	Over-run					
0022h	Under-run	A command				
0023h	Over-run					
0042h	Under-run	An I_T nexus				
0043h	Over-run					
0082h	Under-run	A unit of time [d]				
0083h	Over-run					

[a] See SPC-2 for a description of how these parameter codes are derived.

[b] The keywords in this column – Always, Reset Only, and Never – are defined in 7.3.3.

[c] If the Buffer Over-Run/Under-Run log page is supported, at least one of the parameter codes listed in this table shall be supported.

[d] The size of the unit of time is vendor specific.

Table 332 – Buffer Over-Run/Under-Run log page parameter codes (part 2 of 2)

Parameter code [a]	Incremented once per:			Resettable or Changeable [b]	Reference	Support
	Over- or Under-run	Experienced by (or during)	Problem detected			
0004h	Under-run	Undefined	Transfer rate too slow	Reset Only	7.3.5.2	At least one [c]
0005h	Over-run					
0024h	Under-run	A command				
0025h	Over-run					
0044h	Under-run	An I_T nexus				
0045h	Over-run					
0084h	Under-run	A unit of time [d]				
0085h	Over-run					
all others	Reserved					

[a] See SPC-2 for a description of how these parameter codes are derived.

[b] The keywords in this column – Always, Reset Only, and Never – are defined in 7.3.3.

[c] If the Buffer Over-Run/Under-Run log page is supported, at least one of the parameter codes listed in this table shall be supported.

[d] The size of the unit of time is vendor specific.

A buffer over-run or under-run may occur if a SCSI initiator device does not transfer data to or from the logical unit's buffer fast enough to keep up with reading or writing the media. A buffer over-run condition may occur during a read operation if a buffer full condition prevents continued transfer of data from the media to the buffer. A buffer under-run condition may occur during a write operation if a buffer empty condition prevents continued transfer of data to the media from the buffer.

The Buffer Over-Run/Under-Run log page has the format shown in table 333.

Table 333 – Buffer Over-Run/Under-Run log page

Bit Byte	7	6	5	4	3	2	1	0
0	DS	SPF (0b)	PAGE CODE (01h)					
1	SUBPAGE CODE (00h)							
2	(MSB)			PAGE LENGTH (n-3)				
3								(LSB)
	Buffer Over-run/Under-run log parameter list							
4 •••				Buffer Over-run/Under-run log parameter (see 7.3.5.2) [first]				
	⋮							
••• n				Buffer Over-run/Under-run log parameter (see 7.3.5.2) [last]				

The DS bit, SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field are described in 7.3.2. The SPF bit, PAGE CODE field, and SUBPAGE CODE field shall be set as shown in table 333 for the Buffer Over-Run/Under-Run log page.

Each Buffer Over-run/Under-run log parameter contains the information described in 7.3.5.2.

7.3.5.2 Buffer Over-run/Under-run log parameter

The Buffer Over-run/Under-run log parameter has the format shown in table 334.

Table 334 – Buffer Over-run/Under-run log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			PARAMETER CODE (see table 332)				
1								(LSB)
2	Parameter control byte – bounded data counter log parameter (see 7.3.2.2.2.2)							
	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (n-3)							
4 ••• n	(MSB)			OVER-RUN/UNDER-RUN COUNTER				
								(LSB)

The PARAMETER CODE field is described in 7.3.2.2.1, and shall be set as shown in table 332 for the Buffer Over-run/Under-run log parameter log parameter.

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. These fields shall be set as described for a bounded data counter log parameter (see 7.3.2.2.2.2) for the Buffer Over-run/Under-run log parameter log parameter.

The PARAMETER LENGTH field is described in 7.3.2.2.1.

The OVER-RUN/UNDER-RUN COUNTER field contains the value for the counter described by the contents of the PARAMETER CODE field.

Each counter contains the total number of times buffer over-run or under-run conditions have occurred since the last time the counter was reset. The counter shall be incremented for each occurrence of a buffer under-run or over-run condition and may be incremented more than once for multiple occurrences during the processing of a single command.

7.3.6 Cache Memory Statistics log page

7.3.6.1 Overview

Using the format shown in table 337, the Cache Memory Statistics log page contains statistics and performance results identified by the parameter codes listed in table 335.

Table 335 – Cache Memory Statistics log page parameter codes

Parameter code	Description	Resettable or Changeable [a]	Reference	Support
0001h	Read Cache Memory Hits	Reset Only	7.3.6.2	At least one [b]
0002h	Reads To Cache Memory	Reset Only	7.3.6.3	
0003h	Write Cache Memory Hits	Reset Only	7.3.6.4	
0004h	Writes From Cache Memory	Reset Only	7.3.6.5	
0005h	Time From Last Hard Reset	Never	7.3.6.6	
0006h	Time Interval	Never	7.3.6.7	
all others	Reserved			
[a] The keywords in this column – Always, Reset Only, and Never – are defined in 7.3.3.				
[b] If the Cache Memory Statistics log page is supported, at least one of the parameter codes listed in this table shall be supported.				

The Cache Memory Statistics log page provides the following statistics and performance results associated with the addressed logical unit:

a) Cache Memory Statistics log parameters:
    A) number of read cache memory hits;
    B) number of reads to cache memory;
    C) number of write cache memory hits; and
    D) number of writes from cache memory;
b) Hard Reset log parameter:
    A) time from last hard reset (see SAM-6);
    and
c) Time Interval log parameter:
    A) time interval.

In the Cache Memory Statistics log page, read commands and write commands are those shown in table 336.

Table 336 – Cache Memory Statistics log page commands

Read commands [a]	Write commands [a]
READ(10) READ(12) READ(16) READ(32) PRE-FETCH(10) PRE-FETCH(16)	SYNCHRONIZE CACHE(10) SYNCHRONIZE CACHE(16) WRITE(10) WRITE(12) WRITE(16) WRITE(32) WRITE AND VERIFY(10) WRITE AND VERIFY(12) WRITE AND VERIFY(16) WRITE AND VERIFY(32)
[a] All commands in this column are defined in SBC-5.	

The Cache Memory Statistics log page has the format shown in table 337.

Table 337 – Cache Memory Statistics log page

Bit Byte	7	6	5	4	3	2	1	0
0	DS	SPF (1b)	PAGE CODE (19h)					
1	SUBPAGE CODE (20h)							
2	(MSB)	PAGE LENGTH (n-3)						
3								(LSB)
	Cache memory statistics log parameter list							
4 •••	Cache memory statistics log parameter (see table 335) [first]							
	⋮							
••• n	Cache memory statistics log parameter (see table 335) [last]							

The DS bit, SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field are described in 7.3.2. The SPF bit, PAGE CODE field, and SUBPAGE CODE field shall be set as shown in table 337 for the Cache Memory Statistics log page.

The contents of each cache memory statistics log parameter depends on the value in its PARAMETER CODE field (see table 335).

7.3.6.2 Read Cache Memory Hits log parameter

The Read Cache Memory Hits log parameter has the format shown in table 338.

Table 338 – Read Cache Memory Hits log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			PARAMETER CODE (0001h)				
1								(LSB)
2	Parameter control byte – bounded data counter log parameter (see 7.3.2.2.2.2)							
	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (08h)							
4	(MSB)			NUMBER OF READ CACHE MEMORY HITS				
•••								
11								(LSB)

The PARAMETER CODE field is described in 7.3.2.2.1, and shall be set as shown in table 338 for the Read Cache Memory Hits log parameter.

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. These fields shall be set as described for a bounded data counter log parameter (see 7.3.2.2.2.2) for the Read Cache Memory Hits log parameter.

The PARAMETER LENGTH field is described in 7.3.2.2.1, and shall be set as shown in table 338 for the Read Cache Memory Hits log parameter.

The NUMBER OF READ CACHE MEMORY HITS field indicates the number of read commands (see table 336 in 7.3.6.1) received on an I_T nexus that resulted in:

  a) user data being read from cache memory; and
  b) no user data read from the medium before the read command being processed is completed.

The NUMBER OF READ CACHE MEMORY HITS field shall not be modified as a result of any read command that contains an FUA bit (see SBC-5) set to one or an FUA_NV bit (see SBC-2) set to one.

The contents of the NUMBER OF READ CACHE MEMORY HITS field shall be set to zero as part of processing a hard reset condition (see SAM-6).

7.3.6.3 Reads To Cache Memory log parameter

The Reads To Cache Memory log parameter has the format shown in table 339.

Table 339 – Reads To Cache Memory log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			PARAMETER CODE (0002h)				
1								(LSB)
2	Parameter control byte – bounded data counter log parameter (see 7.3.2.2.2.2)							
	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (08h)							
4	(MSB)							
•••				NUMBER OF READS TO CACHE MEMORY				
11								(LSB)

The PARAMETER CODE field is described in 7.3.2.2.1, and shall be set as shown in table 339 for the Reads To Cache Memory log parameter.

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. These fields shall be set as described for a bounded data counter log parameter (see 7.3.2.2.2.2) for the Reads To Cache Memory log parameter.

The PARAMETER LENGTH field is described in 7.3.2.2.1, and shall be set as shown in table 339 for the Reads To Cache Memory log parameter.

The NUMBER OF READS TO CACHE MEMORY field indicates the number of read commands (see table 336 in 7.3.6.1) that move user data from the medium to cache memory.

The NUMBER OF READS TO CACHE MEMORY field shall not be modified as a result of any read command that contains an FUA bit (see SBC-5) set to one or an FUA_NV bit (see SBC-2) set to one.

The contents of the NUMBER OF READS TO CACHE MEMORY field shall be set to zero as part of processing a hard reset condition (see SAM-6).

7.3.6.4 Write Cache Memory Hits log parameter

The Write Cache Memory Hits log parameter has the format shown in table 340.

Table 340 – Write Cache Memory Hits log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			PARAMETER CODE (0003h)				
1								(LSB)
2	Parameter control byte – bounded data counter log parameter (see 7.3.2.2.2.2)							
	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (08h)							
4	(MSB)			NUMBER OF WRITES FROM CACHE MEMORY				
•••								
11								(LSB)

The PARAMETER CODE field is described in 7.3.2.2.1, and shall be set as shown in table 340 for the Write Cache Memory Hits log parameter.

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. These fields shall be set as described for a bounded data counter log parameter (see 7.3.2.2.2.2) for the Writes From Cache Memory log parameter.

The PARAMETER LENGTH field is described in 7.3.2.2.1, and shall be set as shown in table 340 for the Write Cache Memory Hits log parameter.

The NUMBER OF WRITES FROM CACHE MEMORY field indicates the number of write commands (see table 336 in 7.3.6.1) received on an I_T nexus that resulted in:

- a) user data being written to cache memory; and
- b) no user data written to the medium before the write command being processed is completed.

The NUMBER OF WRITES FROM CACHE MEMORY field shall not be modified as a result of any write command that contains an FUA bit (see SBC-5) set to one or an FUA_NV bit (see SBC-2) set to one.

The contents of the NUMBER OF WRITES FROM CACHE MEMORY field shall be set to zero as part of processing a hard reset condition (see SAM-6).

7.3.6.5 Writes From Cache Memory log parameter

The Writes From Cache Memory log parameter has the format shown in table 341.

Table 341 – Writes From Cache Memory log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			PARAMETER CODE (0004h)				
1								(LSB)
2	Parameter control byte – bounded data counter log parameter (see 7.3.2.2.2.2)							
	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (08h)							
4	(MSB)			NUMBER OF WRITES FROM CACHE MEMORY				
•••								
11								(LSB)

The PARAMETER CODE field is described in 7.3.2.2.1, and shall be set as shown in table 341 for the Writes From Cache Memory log parameter.

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. These fields shall be set as described for a bounded data counter log parameter (see 7.3.2.2.2.2) for the Writes From Cache Memory log parameter.

The PARAMETER LENGTH field is described in 7.3.2.2.1, and shall be set as shown in table 341 for the Writes From Cache Memory log parameter.

The NUMBER OF WRITES FROM CACHE MEMORY field indicates the number of write commands (see table 336 in 7.3.6.1) that move user data from cache memory to the medium.

The NUMBER OF WRITES FROM CACHE MEMORY field shall not be modified as a result of any write command that contains an FUA bit (see SBC-5) set to one or an FUA_NV bit (see SBC-2) set to one.

The contents of the NUMBER OF WRITES FROM CACHE MEMORY field shall be set to zero as part of processing a hard reset condition (see SAM-6).

7.3.6.6 Time From Last Hard Reset log parameter

The Time From Last Hard Reset log parameter has the format shown in table 342.

Table 342 – Time From Last Hard Reset log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			PARAMETER CODE (0005h)				
1								(LSB)
2	Parameter control byte – bounded data counter log parameter (see 7.3.2.2.2.2)							
	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (08h)							
4	(MSB)							
•••				LAST HARD RESET INTERVALS				
11								(LSB)

The PARAMETER CODE field is described in 7.3.2.2.1, and shall be set as shown in table 342 for the Time From Last Hard Reset log parameter.

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. These fields shall be set as described for a bounded data counter log parameter (see 7.3.2.2.2.2) for the Time From Last Hard Reset log parameter.

The PARAMETER LENGTH field is described in 7.3.2.2.1, and shall be set as shown in table 342 for the Time From Last Hard Reset log parameter.

The LAST HARD RESET INTERVALS field indicates the number of time intervals that have occurred since a hard reset was processed by the logical unit.

The time since a hard reset was processed by the logical unit is calculated as follows:

   time = (time intervals since last hard reset × time interval)

where:

   time intervals since last hard reset is the contents of the LAST HARD RESET INTERVALS field; and

   time interval is the value represented in the time interval descriptor of the Time Interval log parameter (see table 343 in 7.3.6.7).

7.3.6.7 Time Interval log parameter

The Time Interval log parameter has the format shown in table 343.

Table 343 – Time Interval log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			PARAMETER CODE				
1								(LSB)
2	Parameter control byte – binary format list log parameter (see 7.3.2.2.2.5)							
	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (08h)							
4 ••• 11	Time interval descriptor (see table 344)							

The PARAMETER CODE field is described in 7.3.2.2.1. A PARAMETER CODE field set to:

a) 0003h identifies the log parameter being transferred as the Time Interval log parameter in the General Statistics and Performance log page (see 7.3.10); or
b) 0006h identifies the log parameter being transferred as the Time Interval log parameter in the Cache Memory Statistics log page (see 7.3.6).

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. These fields shall be set as described for a binary format list log parameter (see 7.3.2.2.2.5) for the log parameters described in this subclause.

The PARAMETER LENGTH field is described in 7.3.2.2.1, and shall be set as shown in table 343 for the log parameters described in this subclause.

The time interval descriptor (see table 344) contains the time interval in seconds used in various time interval fields in:

a) the Time From Last Hard Reset log parameter (see 7.3.6.6);
b) the General Access Statistics and Performance log parameter (see 7.3.10.2);
c) the Force Unit Access Statistics and Performance log parameter (see 7.3.10.4);
d) the Group n Statistics and Performance log parameter (see 7.3.11.2); and
e) the Group n Force Unit Access Statistics and Performance log parameter (see 7.3.11.3).

Table 344 – Time interval descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
••• 3	EXPONENT							(LSB)
4	(MSB)							
••• 7	INTEGER							(LSB)

The EXPONENT field contains the negative power of 10 exponent to multiply with the INTEGER field (e.g., a value of 9 represents 10^{-9}).

When multiplied by the exponent, the INTEGER field contains the value that represents one time interval (e.g., a value of 5 in the INTEGER field and a value of 9 in the EXPONENT field represents a time interval of 5×10^{-9} seconds or 5 nanoseconds).

7.3.7 Command Duration Limits Statistics log page

7.3.7.1 Overview

Using the format shown in table 346, the Command Duration Limits Statistics log page contains log parameters (see table 345) that indicate the effects of the Command Duration Limit T2A mode page (see 7.5.11) and the Command Duration Limit T2B mode page (see 7.5.12).

Table 345 – Command Duration Limits Statistics log page parameter codes

Parameter code	Description	Resettable or Changeable [a]	Reference	Support
For the Command Duration Limit T2A mode page (see 7.5.11)				
0031h	First T2 command duration limit descriptor	Reset Only	7.3.7.2	see [b]
0032h	Second T2 command duration limit descriptor	Reset Only	7.3.7.2	see [b]
0033h	Third T2 command duration limit descriptor	Reset Only	7.3.7.2	see [b]
0034h	Fourth T2 command duration limit descriptor	Reset Only	7.3.7.2	see [b]
0035h	Fifth T2 command duration limit descriptor	Reset Only	7.3.7.2	see [b]
0036h	Sixth T2 command duration limit descriptor	Reset Only	7.3.7.2	see [b]
0037h	Seventh T2 command duration limit descriptor	Reset Only	7.3.7.2	see [b]
For the Command Duration Limit T2B mode page (see 7.5.12)				
0041h	First T2 command duration limit descriptor	Reset Only	7.3.7.2	see [b]
0042h	Second T2 command duration limit descriptor	Reset Only	7.3.7.2	see [b]
0043h	Third T2 command duration limit descriptor	Reset Only	7.3.7.2	see [b]
0044h	Fourth T2 command duration limit descriptor	Reset Only	7.3.7.2	see [b]
0045h	Fifth T2 command duration limit descriptor	Reset Only	7.3.7.2	see [b]
0046h	Sixth T2 command duration limit descriptor	Reset Only	7.3.7.2	see [b]
0047h	Seventh T2 command duration limit descriptor	Reset Only	7.3.7.2	see [b]
all others	Reserved			

[a] The keywords in this column – Always, Reset Only, and Never – are defined in 7.3.3.

[b] This log parameter shall be supported, if for this T2 command duration limit descriptor (see 7.5.11.2), any of the following fields have a non-zero default value or are changeable:
  a) the MAX INACTIVE TIME field; or
  b) the MAX ACTIVE TIME field.

The Command Duration Limits Statistics log page has the format shown in table 346.

Table 346 – Command Duration Limits Statistics log page

Bit Byte	7	6	5	4	3	2	1	0
0	DS	SPF (1b)	PAGE CODE (19h)					
1	SUBPAGE CODE (21h)							
2	(MSB)		PAGE LENGTH (n-3)					
3								(LSB)
	Command duration limits statistics log parameter list							
4 •••		Command duration limits statistics log parameters (see table 345) [first]						
	⋮							
••• n		Command duration limits statistics log parameters (see table 345) [last]						

The DS bit, SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field are described in 7.3.2.

The SPF bit, PAGE CODE field, and SUBPAGE CODE field shall be set as shown in table 346 for the Command Duration Limits Statistics log page.

The contents of each command duration limits statistics log parameter depends on the value in its PARAMETER CODE field (see table 345)

7.3.7.2 Command Duration Limits log parameter

The Command Duration Limits log parameter has the format shown in table 347. If a Command Duration Limits log parameter is supported, then at least one of the statistics shown in table 347 shall be supported. Each Command Duration Limits log parameter provides statistics for commands that were associated with a command duration limit mode page and T2 command duration limit descriptor (see 7.5.11.2).

Table 347 – Command Duration Limits log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			PARAMETER CODE (see table 345)				
1								(LSB)
2	Parameter control byte – unbounded data counter log parameter (see 7.3.2.2.2.3)							
	DU	Obsolete	TSD (1b)	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (10h)							
4	(MSB)							
•••				NUMBER OF INACTIVE TARGET MISS COMMANDS				
7								(LSB)
8	(MSB)							
•••				NUMBER OF ACTIVE TARGET MISS COMMANDS				
11								(LSB)
12	(MSB)							
•••				NUMBER OF INACTIVE TARGET AND ACTIVE TARGET				
15				MISS COMMANDS				(LSB)
16	(MSB)							
•••				NUMBER OF COMMANDS				
19								(LSB)

The PARAMETER CODE field is described in 7.3.2.2.1 and shall be as shown in table 347 for the Command Duration Limits log parameter.

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. The DU bit and FORMAT AND LINKING field shall be set as described for an unbounded data counter log parameter (see 7.3.2.2.2.3) for the Command Duration Limits log parameter. The TSD bit shall be set as shown in table 347 for a Command Duration Limits log parameter.

The PARAMETER LENGTH field is described in 7.3.2.2.1 and shall be set as shown in table 347 for the Command Duration Limits parameter.

The NUMBER OF INACTIVE TARGET MISS COMMANDS field indicates the number of commands for which the MAX INACTIVE TIME POLICY field (see 7.5.11.2) was processed.

The NUMBER OF ACTIVE TARGET MISS COMMANDS field indicates the number of commands for which the MAX ACTIVE TIME POLICY field (see 7.5.11.2) was processed.

The NUMBER OF INACTIVE TARGET AND ACTIVE TARGET MISS COMMANDS field indicates the sum of the number of commands for which the MAX INACTIVE TIME POLICY field was processed and the number of commands for which the MAX ACTIVE TIME POLICY field was processed.

The NUMBER OF COMMANDS field indicates the number of commands processed using the associated command duration limits descriptor.

7.3.8 Environmental Limits log page

7.3.8.1 Overview

Using the format shown in table 349, the Environmental Limits log page provides information about the environmental limits of the logical unit using the parameter codes listed in table 348.

The Environmental Reporting log page (see 7.3.9) shall be supported if the Environmental Limits log page is supported. Each log parameter in the Environmental Limits log page contains limits that are applied to the environmental measurement in the log parameter in the Environmental Reporting log page that has the same parameter code (e.g., log parameter 0000h in this log page is associated with log parameter 0000h in the Environmental Reporting log page).

Table 348 – Environmental Limits log page parameter codes

Parameter code	Description	Resettable or Changeable [a]	Reference	Support
0000h to 00FFh	Temperature Limits [c]	Always or Never [b]	7.3.8.2	Optional
0100h to 01FFh	Relative Humidity Limits [d]	Always or Never [b]	7.3.8.3	Optional
all others	Reserved			

[a] The keywords in this column – Always, Reset Only, and Never – are defined in 7.3.3.
[b] The device server may support either Always or Never. If supporting Always, then the device server may round each field up or down as defined in 5.10.
[c] If more than one Temperature Limits parameter is supported, each Temperature Limits parameter is associated with the temperature at a separate location.
[d] If more than one Relative Humidity Report parameter is supported, each Relative Humidity Limits parameter is associated with the relative humidity at a separate location.

The Environmental Limits log page has the format shown in table 349.

Table 349 – Environmental Limits log page

Bit Byte	7	6	5	4	3	2	1	0
0	DS	SPF (1b)	PAGE CODE (0Dh)					
1	SUBPAGE CODE (02h)							
2	(MSB)		PAGE LENGTH (n-3)					
3								(LSB)
	Environmental limits log parameter list							
4 •••		Environmental limits log parameter (see table 348) [first]						
	⋮							
••• n		Environmental limits log parameter (see table 348) [last]						

The DS bit, SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field are described in 7.3.2. The SPF bit, PAGE CODE field, and SUBPAGE CODE field shall be set as shown in table 349 for the Environmental Limits log page.

The contents of each environmental limits log parameter depends on the value in its PARAMETER CODE field (see table 348).

7.3.8.2 Temperature Limits log parameter

The Temperature Limits log parameter has the format shown in table 350.

Table 350 – Temperature Limits log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			PARAMETER CODE (see table 348)				
1								(LSB)
2	Parameter control byte – binary format list log parameter (see 7.3.2.2.2.5)							
	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (08h)							
4	HIGH CRITICAL TEMPERATURE LIMIT TRIGGER							
5	HIGH CRITICAL TEMPERATURE LIMIT RESET							
6	LOW CRITICAL TEMPERATURE LIMIT RESET							
7	LOW CRITICAL TEMPERATURE LIMIT TRIGGER							
8	HIGH OPERATING TEMPERATURE LIMIT TRIGGER							
9	HIGH OPERATING TEMPERATURE LIMIT RESET							
10	LOW OPERATING TEMPERATURE LIMIT RESET							
11	LOW OPERATING TEMPERATURE LIMIT TRIGGER							

The PARAMETER CODE field is described in 7.3.2.2.1 and shall be as shown in table 348 for the Temperature Limits log parameters.

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. These fields shall be set as described for a binary format list log parameter (see 7.3.2.2.2.5) for the Temperature Limits log parameters.

The PARAMETER LENGTH field is described in 7.3.2.2.1 and shall be set as shown in table 350 for the Temperature Limits log parameters.

The temperature values reported in the Temperature Limits log parameters indicate a temperature in degrees Celsius. Negative values shall be indicated by two's complement notation. A value of -128 (i.e., 80h) specifies that there is no limit.

The HIGH CRITICAL TEMPERATURE LIMIT TRIGGER field indicates the maximum temperature at this sensor for which the logical unit should be operated. If the EWASC bit is set to one in the Information Exceptions Control mode page (see SBC-5, SSC-5, or SMC-3) and the associated current temperature (see 7.3.9.2) is greater than the value in the HIGH CRITICAL TEMPERATURE LIMIT TRIGGER field, then the device server shall report an informational exception condition with the additional sense code set to WARNING - HIGH CRITICAL TEMPERATURE LIMIT EXCEEDED.

The HIGH CRITICAL TEMPERATURE LIMIT RESET field indicates the temperature at which the informational exception condition for a high critical temperature limit, if any, shall be cleared.

The LOW CRITICAL TEMPERATURE LIMIT RESET field indicates the temperature at which the informational exception condition for a low critical temperature limit, if any, shall be cleared.

The LOW CRITICAL TEMPERATURE LIMIT TRIGGER field indicates the minimum temperature at this sensor for which the logical unit should be operated. If the EWASC bit is set to one in the Information Exceptions Control mode page (see SBC-5, SSC-5, or SMC-3) and the associated current temperature (see 7.3.9.2) is less than the value in the LOW CRITICAL TEMPERATURE LIMIT TRIGGER field, then the device server shall report an informational exception condition with the additional sense code set to WARNING - LOW CRITICAL TEMPERATURE LIMIT EXCEEDED.

The HIGH OPERATING TEMPERATURE LIMIT TRIGGER field indicates the maximum temperature at this sensor for which the logical unit is capable of operating continuously without degrading the reliability beyond manufacturer accepted limits. If the EWASC bit is set to one in the Information Exceptions Control mode page (see SBC-5, SSC-5, or SMC-3) and the associated current temperature (see 7.3.9.2) is greater than the value of the HIGH OPERATING TEMPERATURE LIMIT TRIGGER field, then the device server shall report an informational exception condition with the additional sense code set to WARNING - HIGH OPERATING TEMPERATURE LIMIT EXCEEDED.

The HIGH OPERATING TEMPERATURE LIMIT RESET field indicates the temperature at which the informational exception condition for the associated high critical temperature limit, if any, shall be cleared.

The LOW OPERATING TEMPERATURE LIMIT RESET field indicates the temperature at which the informational exception condition for the associated low critical temperature limit, if any, shall be cleared.

The LOW OPERATING TEMPERATURE LIMIT TRIGGER field indicates the minimum temperature at this sensor for which the logical unit is capable of operating continuously without degrading the logical unit's reliability beyond manufacturer accepted limits. If the EWASC bit is set to one in the Information Exceptions Control mode page (see SBC-5, SSC-5, or SMC-3) and the associated current temperature (see 7.3.9.2) is less than the value of the LOW OPERATING TEMPERATURE LIMIT TRIGGER field, then the device server shall report an informational exception condition with the additional sense code set to WARNING - LOW OPERATING TEMPERATURE LIMIT EXCEEDED.

7.3.8.3 Relative Humidity Limits log parameter

The Relative Humidity Limits log parameter has the format shown in table 351.

Table 351 – Relative Humidity Limits log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			PARAMETER CODE (see table 348)				
1								(LSB)
2	Parameter control byte – binary format list log parameter (see 7.3.2.2.2.5)							
	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (08h)							
4	HIGH CRITICAL RELATIVE HUMIDITY LIMIT TRIGGER							
5	HIGH CRITICAL RELATIVE HUMIDITY LIMIT RESET							
6	LOW CRITICAL RELATIVE HUMIDITY LIMIT RESET							
7	LOW CRITICAL RELATIVE HUMIDITY LIMIT TRIGGER							
8	HIGH OPERATING RELATIVE HUMIDITY LIMIT TRIGGER							
9	HIGH OPERATING RELATIVE HUMIDITY LIMIT RESET							
10	LOW OPERATING RELATIVE HUMIDITY LIMIT RESET							
11	LOW OPERATING RELATIVE HUMIDITY LIMIT TRIGGER							

The PARAMETER CODE field is described in 7.3.2.2.1 and shall be as shown in table 348 for the Relative Humidity Limits log parameters.

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. These fields shall be set as described for a binary format list log parameter (see 7.3.2.2.2.5) for the Relative Humidity Limits log parameters.

The PARAMETER LENGTH field is described in 7.3.2.2.1 and shall be set as shown in table 351 for the Relative Humidity Limits log parameters.

The relative humidity limit values used in the Relative Humidity Limits log parameters are shown in table 352.

Table 352 – Relative humidity limit values

Value	Description
0 to 100	Relative humidity
101 to 254	Reserved
255	No relative humidity limit

The HIGH CRITICAL RELATIVE HUMIDITY LIMIT TRIGGER field indicates the maximum relative humidity at this sensor for which the logical unit should be operated. If the EWASC bit is set to one in the Information Exceptions Control mode page (see SBC-5, SSC-5, or SMC-3) and the associated current relative humidity (see 7.3.9.3) is greater than the value in the HIGH CRITICAL RELATIVE HUMIDITY LIMIT TRIGGER field, then the device server shall report an informational exception condition with the additional sense code set to WARNING - HIGH CRITICAL HUMIDITY LIMIT EXCEEDED.

The HIGH CRITICAL RELATIVE HUMIDITY LIMIT RESET field indicates the relative humidity at which the informational exception condition for a high critical relative humidity limit, if any, shall be cleared.

The LOW CRITICAL RELATIVE HUMIDITY LIMIT RESET field indicates the relative humidity at which the informational exception condition for a low critical relative humidity limit, if any, shall be cleared.

The LOW CRITICAL RELATIVE HUMIDITY LIMIT TRIGGER field indicates the minimum relative humidity at this sensor for which the logical unit should be operated. If the EWASC bit is set to one in the Information Exceptions Control mode page (see SBC-5, SSC-5, or SMC-3) and the associated current relative humidity (see 7.3.9.3) is less than the value in the LOW CRITICAL RELATIVE HUMIDITY LIMIT TRIGGER field, then the device server shall report an informational exception condition with the additional sense code set to WARNING - LOW CRITICAL HUMIDITY LIMIT EXCEEDED.

The HIGH OPERATING RELATIVE HUMIDITY LIMIT TRIGGER field indicates the maximum relative humidity at this sensor for which the logical unit is capable of operating continuously without degrading the reliability beyond manufacturer accepted limits. If the EWASC bit is set to one in the Information Exceptions Control mode page (see SBC-5, SSC-5, or SMC-3) and the associated current relative humidity (see 7.3.9.3) is greater than the value of the HIGH OPERATING RELATIVE HUMIDITY LIMIT TRIGGER field, then the device server shall report an informational exception condition with the additional sense code set to WARNING - HIGH OPERATING HUMIDITY LIMIT EXCEEDED.

The HIGH OPERATING RELATIVE HUMIDITY LIMIT RESET field indicates the relative humidity at which the informational exception condition for the associated high critical relative humidity limit, if any, shall be cleared.

The LOW OPERATING RELATIVE HUMIDITY LIMIT RESET field indicates the relative humidity at which the informational exception condition for the associated low critical relative humidity limit, if any, shall be cleared.

The LOW OPERATING RELATIVE HUMIDITY LIMIT TRIGGER field indicates the minimum relative humidity at this sensor for which the logical unit is capable of operating continuously without degrading the logical unit's reliability beyond manufacturer accepted limits. If the EWASC bit is set to one in the Information Exceptions Control mode page (see SBC-5, SSC-5, or SMC-3) and the associated current relative humidity (see 7.3.9.3) is less than the value of the LOW OPERATING RELATIVE HUMIDITY LIMIT TRIGGER field, then the device server shall report an informational exception condition with the additional sense code set to WARNING - LOW OPERATING HUMIDITY LIMIT EXCEEDED.

7.3.9 Environmental Reporting log page

7.3.9.1 Overview

Using the format shown in table 354, the Environmental Reporting log page provides information about the environmental conditions of the logical unit using the parameter codes listed in table 353.

Table 353 – Environmental Reporting log page parameter codes

Parameter code	Description	Resettable or Changeable [a]	Reference	Support
0000h to 00FFh	Temperature Report [c]	Never	7.3.9.2	At least one [b]
0100h to 01FFh	Relative Humidity Report [d]	Never	7.3.9.3	Optional
all others	Reserved			

[a] The keywords in this column – Always, Reset Only, and Never – are defined in 7.3.3.

[b] If the Environmental Reporting log page is supported, at least one of the parameter codes listed in this table shall be supported.

[c] If more than one Temperature Report parameter is supported, then each Temperature Report parameter represents the temperature at a separate location.

[d] If more than one Relative Humidity Report parameter is supported, then each Relative Humidity Report parameter represents the temperature at a separate location.

The Environmental Reporting log page has the format shown in table 354.

Table 354 – Environmental Reporting log page

Bit Byte	7	6	5	4	3	2	1	0
0	DS	SPF (1b)	PAGE CODE (0Dh)					
1	SUBPAGE CODE (01h)							
2	(MSB)	PAGE LENGTH (n-3)						
3								(LSB)
	Environmental reporting log parameter list							
4 •••		Environmental reporting log parameter (see table 353) [first]						
	⋮							
••• n		Environmental reporting log parameter (see table 353) [last]						

The DS bit, SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field are described in 7.3.2. The SPF bit, PAGE CODE field, and SUBPAGE CODE field shall be set as shown in table 354 for the Environmental Reporting log page.

The contents of each environmental reporting log parameter depends on the value in its PARAMETER CODE field (see table 353).

7.3.9.2 Temperature Report log parameter

The Temperature Report log parameter has the format shown in table 355.

Table 355 – Temperature Report log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			PARAMETER CODE (see table 353)				
1								(LSB)
2	Parameter control byte – binary format list log parameter (see 7.3.2.2.5)							
	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (08h)							
4	Reserved						OTV	
5	TEMPERATURE							
6	LIFETIME MAXIMUM TEMPERATURE							
7	LIFETIME MINIMUM TEMPERATURE							
8	MAXIMUM TEMPERATURE SINCE POWER ON							
9	MINIMUM TEMPERATURE SINCE POWER ON							
10	MAXIMUM OTHER TEMPERATURE							
11	MINIMUM OTHER TEMPERATURE							

The PARAMETER CODE field is described in 7.3.2.2.1 and shall be as shown in table 353 for the Temperature Report log parameters.

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. These fields shall be set as described for a binary format list log parameter (see 7.3.2.2.2.5) for the Temperature Report log parameters.

The PARAMETER LENGTH field is described in 7.3.2.2.1 and shall be set as shown in table 355 for the Temperature Report log parameters.

The other temperature value (OTV) field (see table 356) defines the contents of the MAXIMUM OTHER TEMPERATURE field and the MINIMUM OTHER TEMPERATURE field. If the RMB bit (see 6.7.2) is set to zero, the OTV field should be set to zero.

The temperature values reported in the Temperature Report log parameters indicate a temperature in degrees Celsius. Negative values shall be indicated by two's complement notation. A value of -128 (i.e., 80h) specifies that temperature is not valid.

The TEMPERATURE field indicates the most recently detected temperature by the temperature sensor associated with this log parameter.

The LIFETIME MAXIMUM TEMPERATURE field indicates the maximum temperature detected by the temperature sensor associated with this log parameter since the time of manufacture.

The LIFETIME MINIMUM TEMPERATURE field indicates the minimum temperature detected by the temperature sensor associated with this log parameter since the time of manufacture.

The MAXIMUM TEMPERATURE SINCE POWER ON field indicates the maximum temperature detected by the temperature sensor associated with this log parameter since the most recent power on.

The MINIMUM TEMPERATURE SINCE POWER ON field indicates the minimum temperature detected by the temperature sensor associated with this log parameter since the most recent power on.

The contents of the MAXIMUM OTHER TEMPERATURE field and the MINIMUM OTHER TEMPERATURE field are defined by the contents of the OTV field as shown in table 356.

Table 356 – OTV field effects on the MAXIMUM OTHER TEMPERATURE field and the MINIMUM OTHER TEMPERATURE field

Code	Description
00b	The MAXIMUM OTHER TEMPERATURE field and the MINIMUM OTHER TEMPERATURE field are reserved.

01b	The MAXIMUM OTHER TEMPERATURE field indicates the maximum temperature detected by the temperature sensor associated with this log parameter from the most recent time that the removable medium was mounted until:
	    a) the current time, if that medium has not been demounted; or
	    b) the time at which that medium was demounted.
	The MINIMUM OTHER TEMPERATURE field indicates the minimum temperature detected by the temperature sensor associated with this log parameter from the most recent time that the removable medium was mounted until:
	    a) the current time, if that medium has not been demounted; or
	    b) the time at which that medium was demounted.

all others	Reserved

7.3.9.3 Relative Humidity Report log parameter

The Relative Humidity Report log parameter has the format shown in table 357.

Table 357 – Relative Humidity Report log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			PARAMETER CODE (see table 353)				
1								(LSB)
2	Parameter control byte – binary format list log parameter (see 7.3.2.2.2.5)							
	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (08h)							
4	Reserved						ORHV	
5	RELATIVE HUMIDITY							
6	LIFETIME MAXIMUM RELATIVE HUMIDITY							
7	LIFETIME MINIMUM RELATIVE HUMIDITY							
8	MAXIMUM RELATIVE HUMIDITY SINCE POWER ON							
9	MINIMUM RELATIVE HUMIDITY SINCE POWER ON							
10	MAXIMUM OTHER RELATIVE HUMIDITY							
11	MINIMUM OTHER RELATIVE HUMIDITY							

The PARAMETER CODE field is described in 7.3.2.2.1 and shall be as shown in table 353 for the Relative Humidity Report log parameters.

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. These fields shall be set as described for a binary format list log parameter (see 7.3.2.2.2.5) for the Relative Humidity Report log parameters.

The PARAMETER LENGTH field is described in 7.3.2.2.1 and shall be set as shown in table 357 for the Relative Humidity Report log parameters.

The other relative humidity value (ORHV) field (see table 359) defines the contents of the MAXIMUM OTHER RELATIVE HUMIDITY field and the MINIMUM OTHER RELATIVE HUMIDITY field. If the RMB bit (see 6.7.2) is set to zero, the ORHV field should be set to zero.

The relative humidity reporting values used in the Relative Humidity Report log parameters are shown in table 358.

Table 358 – Relative humidity reporting values

Value	Description
0 to 100	Relative humidity
101 to 254	Reserved
255	No valid relative humidity

The RELATIVE HUMIDITY field indicates the most recently detected relative humidity for the humidity sensor associated with this log parameter.

The LIFETIME MAXIMUM RELATIVE HUMIDITY field indicates the maximum relative humidity detected by the humidity sensor associated with this log parameter since the time of manufacture.

The LIFETIME MINIMUM RELATIVE HUMIDITY field indicates the minimum relative humidity detected by the humidity sensor associated with this log parameter since the time of manufacture.

The MAXIMUM RELATIVE HUMIDITY SINCE POWER ON field indicates the maximum relative humidity detected by the humidity sensor associated with this log parameter since the most recent power on.

The MINIMUM RELATIVE HUMIDITY SINCE POWER ON field indicates the minimum relative humidity detected by the humidity sensor associated with this log parameter since the most recent power on.

The contents of the MAXIMUM OTHER TEMPERATURE field and the MINIMUM OTHER TEMPERATURE field are defined by the contents of the ORHV field as shown in table 359.

Table 359 – ORHV field effects on the MAXIMUM OTHER RELATIVE HUMIDITY field and the MINIMUM OTHER RELATIVE HUMIDITY field

Code	Description
00b	The MAXIMUM OTHER TEMPERATURE field and the MINIMUM OTHER TEMPERATURE field are reserved.
01b	The MAXIMUM MOUNTED RELATIVE HUMIDITY field indicates the maximum relative humidity detected by the humidity sensor associated with this log parameter from the most recent time that the removable medium was mounted until: a) the current time, if that medium has not been demounted; or b) the time at which that medium was demounted. The MINIMUM MOUNTED RELATIVE HUMIDITY field indicates the minimum relative humidity detected by the humidity sensor associated with this log parameter from the most recent time that the removable medium was mounted until: a) the current time, if that medium has not been demounted; or b) the time at which that medium was demounted.
all others	Reserved

7.3.10 General Statistics and Performance log pages

7.3.10.1 Overview

Using the format shown in table 362, the General Statistics and Performance log page collects statistics and performance information for all read CDBs and write CDBs based on the parameter codes listed in table 360.

Table 360 – General Statistics and Performance log page parameter codes

Parameter code	Description	Resettable or Changeable [a]	Reference	Support
0001h	General Access Statistics and Performance	Reset Only	7.3.10.2	Mandatory
0002h	Idle Time	Reset Only	7.3.10.3	Mandatory
0003h	Time Interval	Never	7.3.6.7	Mandatory
0004h	Force Unit Access Statistics and Performance	Reset Only	7.3.10.4	Optional
all others	Reserved			
[a] The keywords in this column – Always, Reset Only, and Never – are defined in 7.3.3.				

The General Statistics and Performance log page provides the following statistics and performance results associated to the addressed logical unit:

    a) Statistics and Performance log parameters:
        A) number of read commands;
        B) number of write commands;
        C) number of read logical blocks transferred by a target port;
        D) number of write logical blocks transferred by a target port;
        E) read command processing time;
        F) write command processing time;
        G) sum of the command weights of the read commands plus write commands; and
        H) sum of the weighted command time of the read commands plus write commands;
    b) Idle Time log parameter:
        A) idle time;
    c) Time Interval log parameter:
        A) time interval;
        and
    d) Force Unit Access Statistics and Performance log parameters:
        A) number of read commands with the FUA bit (see SBC-5) set to one;
        B) number of write commands with the FUA bit set to one;
        C) number of read commands with the FUA_NV bit (see SBC-2) set to one;
        D) number of write commands with the FUA_NV bit set to one;
        E) read command with the FUA bit set to one processing intervals;
        F) write command with the FUA bit set to one processing intervals;
        G) read command with the FUA_NV bit set to one processing intervals; and
        H) write command with the FUA_NV bit set to one processing intervals.

In the General Statistics and Performance log page and the Group Statistics and Performance (1 to 31) log pages (see 7.3.11), read commands and write commands are those shown in table 361.

Table 361 – Statistics and Performance log pages commands

Read commands [a]	Write commands [a]
POPULATE TOKEN READ(10) READ(12) READ(16) READ(32)	UNMAP WRITE(10) WRITE(12) WRITE(16) WRITE(32) WRITE AND VERIFY(10) WRITE AND VERIFY(12) WRITE AND VERIFY(16) WRITE AND VERIFY(32) WRITE ATOMIC (16) WRITE ATOMIC (32) WRITE SCATTERED (16) WRITE SCATTERED (32) WRITE STREAM (16) WRITE STREAM (32) WRITE USING TOKEN
[a] The operations performed by each of these commands are described in SBC-5.	

The General Statistics and Performance log page has the format shown in table 362.

Table 362 – General Statistics and Performance log page

Bit Byte	7	6	5	4	3	2	1	0
0	DS	SPF (0b)	PAGE CODE (19h)					
1	SUBPAGE CODE (00h)							
2	(MSB)	PAGE LENGTH (n-3)						
3								(LSB)
	General statistics and performance log parameter list							
4 •••	General statistics and performance log parameter (see table 360) [first]							
	⋮							
••• n	General statistics and performance log parameter (see table 360) [last]							

The DS bit, SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field are described in 7.3.2. The SPF bit, PAGE CODE field, and SUBPAGE CODE field shall be set as shown in table 362 for the General Statistics and Performance log page.

The contents of each general statistics and performance log parameter depends on the value in its PARAMETER CODE field (see table 360).

7.3.10.2 General Access Statistics and Performance log parameter

The General Access Statistics and Performance log parameter has the format shown in table 363.

Table 363 – General Access Statistics and Performance log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			PARAMETER CODE (0001h)				
1								(LSB)
2	Parameter control byte – unbounded data counter log parameter (see 7.3.2.2.2.3)							
	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (40h)							
4	(MSB)							
•••				NUMBER OF READ COMMANDS				
11								(LSB)
12	(MSB)							
•••				NUMBER OF WRITE COMMANDS				
19								(LSB)
20	(MSB)							
•••				NUMBER OF LOGICAL BLOCKS RECEIVED				
27								(LSB)
28	(MSB)							
•••				NUMBER OF LOGICAL BLOCKS TRANSMITTED				
35								(LSB)
36	(MSB)							
•••				READ COMMAND PROCESSING INTERVALS				
43								(LSB)
44	(MSB)							
•••				WRITE COMMAND PROCESSING INTERVALS				
51								(LSB)
52	(MSB)							
•••				WEIGHTED NUMBER OF READ COMMANDS PLUS WRITE COMMANDS				
59								(LSB)
60	(MSB)							
•••				WEIGHTED READ COMMAND PROCESSING PLUS WRITE COMMAND PROCESSING				
67								(LSB)

The PARAMETER CODE field is described in 7.3.2.2.1, and shall be set as shown in table 363 for the General Access Statistics and Performance log parameter.

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. These fields shall be set as described for an unbounded data counter log parameter (see 7.3.2.2.2.3) for the General Access Statistics and Performance log parameter.

The PARAMETER LENGTH field is described in 7.3.2.2.1, and shall be set as shown in table 363 for the General Access Statistics and Performance log parameter.

The NUMBER OF READ COMMANDS field indicates the number of read commands (see table 361 in 7.3.10.1) received by the logical unit.

The NUMBER OF WRITE COMMANDS field indicates the number of write commands (see table 361 in 7.3.10.1) received by the logical unit.

The NUMBER OF LOGICAL BLOCKS RECEIVED field indicates the number of logical blocks received by any SCSI target port for the logical unit as a result of write commands (see table 361 in 7.3.10.1).

The NUMBER OF LOGICAL BLOCKS TRANSMITTED field indicates the number of logical blocks transmitted by any SCSI target port for the logical unit as a result of read commands (see table 361 in 7.3.10.1).

The READ COMMAND PROCESSING INTERVALS field indicates the cumulative number of time intervals (see 7.3.6.7) spent by the logical unit processing read commands (see table 361 in 7.3.10.1).

The WRITE COMMAND PROCESSING INTERVALS field indicates the cumulative number of time intervals (see 7.3.6.7) spent by the logical unit processing write commands (see table 361 in 7.3.10.1).

If command priority is supported (see SAM-6), then the WEIGHTED NUMBER OF READ COMMANDS PLUS WRITE COMMANDS field indicates the cumulative command weight of the read commands and write commands (see table 361 in 7.3.10.1) processed by the logical unit.

Command weight is calculated as follows:

$$\text{command weight} = (360\,360 / \text{command priority})$$

where:

command priority is as defined in SAM-6. However, if the computed command priority is zero, then the command priority shall be set to seven (i.e., a mid-range command priority value).

If command priority is not supported, then the WEIGHTED NUMBER OF READ COMMANDS PLUS WRITE COMMANDS field shall be set to zero.

If command priority is supported (see SAM-6), then the WEIGHTED READ COMMAND PROCESSING PLUS WRITE COMMAND PROCESSING field indicates the cumulative weighted command time of the time intervals (see 7.3.6.7) spent processing read commands and write commands (see table 361 in 7.3.10.1) by the logical unit.

Weighted command time is calculated as follows:

$$\text{weighted command time} = (\text{time increments processing the command} \times \text{time interval}) \times (360\,360 / \text{command priority})$$

where:

time increments processing a command is the number of time intervals from the time the task manager places the command into a task set until the device server sends a SCSI transport protocol service response for the command;

time interval is the value represented in the TIME INTERVAL DESCRIPTOR field of the Time Interval log parameter (see 7.3.6.7); and

command priority is as defined in SAM-6. However, if the computed command priority is zero, then the command priority time shall be set to seven (i.e., a mid-range command priority value).

If command priority is not supported, then the WEIGHTED READ COMMAND PROCESSING PLUS WRITE COMMAND PROCESSING field shall be set to zero.

7.3.10.3 Idle Time log parameter

The Idle Time log parameter has the format shown in table 364.

Table 364 – Idle Time log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			PARAMETER CODE (0002h)				
1								(LSB)
2	Parameter control byte – unbounded data counter log parameter (see 7.3.2.2.2.3)							
	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (08h)							
4	(MSB)			IDLE TIME INTERVALS				
•••								
11								(LSB)

The PARAMETER CODE field is described in 7.3.2.2.1, and shall be set as shown in table 364 for the Idle Time log parameter.

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. These fields shall be set as described for an unbounded data counter log parameter (see 7.3.2.2.2.3) for the Idle Time log parameter.

The PARAMETER LENGTH field is described in 7.3.2.2.1, and shall be set as shown in table 364 for the Idle Time log parameter.

The IDLE TIME INTERVALS field indicates the cumulative number of idle times spent while there are no commands in the task set and there are no commands being processed by the logical unit.

Idle time is calculated as follows:

idle time = (time increments not processing commands $\times$ time interval)

where:

time increments not processing commands is the number of time intervals while there are no commands in the task set and the device server has sent a SCSI transport protocol service response for all commands being processed (i.e., there are no commands to be processed or being processed); and

time interval is the value represented in the time interval descriptor of the Time Interval log parameter (see 7.3.6.7).

7.3.10.4 Force Unit Access Statistics and Performance log parameter

The Force Unit Access Statistics and Performance log parameter has the format shown in table 365.

Table 365 – Force Unit Access Statistics and Performance log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
1				PARAMETER CODE (0004h)				(LSB)
2	Parameter control byte – unbounded data counter log parameter (see 7.3.2.2.2.3)							
	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3				PARAMETER LENGTH (40h)				
4	(MSB)							
•••				NUMBER OF READ FUA COMMANDS				
11								(LSB)
12	(MSB)							
•••				NUMBER OF WRITE FUA COMMANDS				
19								(LSB)
20	(MSB)							
•••				NUMBER OF READ FUA_NV COMMANDS				
27								(LSB)
28	(MSB)							
•••				NUMBER OF WRITE FUA_NV COMMANDS				
35								(LSB)
36	(MSB)							
•••				READ FUA COMMAND PROCESSING INTERVALS				
43								(LSB)
44	(MSB)							
•••				WRITE FUA COMMAND PROCESSING INTERVALS				
51								(LSB)
52	(MSB)							
•••				READ FUA_NV COMMAND PROCESSING INTERVALS				
59								(LSB)
60	(MSB)							
•••				WRITE FUA_NV COMMAND PROCESSING INTERVALS				
67								(LSB)

The PARAMETER CODE field is described in 7.3.2.2.1, and shall be set as shown in table 365 for the Force Unit Access Statistics and Performance log parameter.

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. These fields shall be set as described for an unbounded data counter log parameter (see 7.3.2.2.2.3) for the Force Unit Access Statistics and Performance log parameter.

The PARAMETER LENGTH field is described in 7.3.2.2.1, and shall be set as shown in table 365 for the Force Unit Access Statistics and Performance log parameter.

The NUMBER OF READ FUA COMMANDS field indicates the number of read commands (see table 361 in 7.3.10.1) with the FUA bit (see SBC-5) set to one received by the logical unit.

The NUMBER OF WRITE FUA COMMANDS field indicates the number of write commands (see table 361 in 7.3.10.1) with the FUA bit (see SBC-5) set to one received by the logical unit.

The NUMBER OF READ FUA_NV COMMANDS field indicates the number of read commands (see table 361 in 7.3.10.1) with the FUA_NV bit (see SBC-2) set to one received by the logical unit.

The NUMBER OF WRITE FUA_NV COMMANDS field indicates the number of write commands (see table 361 in 7.3.10.1) with the FUA_NV bit (see SBC-2) set to one received by the logical unit.

The READ FUA COMMAND PROCESSING INTERVALS field indicates the cumulative number of time intervals (see 7.3.6.7) spent by the logical unit processing read commands (see table 361 in 7.3.10.1) with the FUA bit (see SBC-5) set to one.

The WRITE FUA COMMAND PROCESSING INTERVALS field indicates the cumulative number of time intervals (see 7.3.6.7) spent by the logical unit processing write commands (see table 361 in 7.3.10.1) with the FUA bit (see SBC-5) set to one.

The READ FUA_NV COMMAND PROCESSING INTERVALS field indicates the cumulative number of time intervals (see 7.3.6.7) spent by the logical unit processing read commands (see table 361 in 7.3.10.1) with the FUA_NV bit (see SBC-2) set to one.

The WRITE FUA_NV COMMAND PROCESSING INTERVALS field indicates the cumulative number of time intervals (see 7.3.6.7) spent by the logical unit processing write commands (see table 361 in 7.3.10.1) with the FUA_NV bit (see SBC-2) set to one.

7.3.11 Group Statistics and Performance (1 to 31) log pages

7.3.11.1 Overview

Using the format shown in table 367, Group Statistics and Performance (1 to 31) log pages collect statistics and performance information for the group number specified in a read CDB or a write CDB based on the parameter codes listed in table 366.

Table 366 – Group Statistics and Performance log page parameter codes

Parameter code	Description	Resettable or Changeable [a]	Reference	Support
0001h	Group n Statistics and Performance	Reset Only	7.3.11.2	Mandatory
0004h	Group n Force Unit Access Statistics and Performance	Reset Only	7.3.11.3	Optional
all others	Reserved			
[a] The keywords in this column – Always, Reset Only, and Never – are defined in 7.3.3.				

The Group Statistics and Performance (1 to 31) log pages provide the following statistics and performance results associated to the addressed logical unit and the GROUP NUMBER field:

    a) Statistics and Performance log parameters:
        A) number of read commands;

          B)   number of write commands;
          C)   number of read logical blocks transferred by a target port;
          D)   number of write logical blocks transferred by a target port;
          E)   read command processing time; and
          F)   write command processing time;
        and
   b) Force Unit Access Statistics and Performance log parameters:
          A)   number of read commands with the FUA bit (see SBC-5) set to one;
          B)   number of write commands with the FUA bit set to one;
          C)   number of read commands with the FUA_NV bit (see SBC-2) set to one;
          D)   number of write commands with the FUA_NV bit set to one;
          E)   read command with the FUA bit set to one processing intervals;
          F)   write command with the FUA bit set to one processing intervals;
          G)   read command with the FUA_NV bit set to one processing intervals; and
          H)   write command with the FUA_NV bit set to one processing intervals.

In the Group Statistics and Performance (1 to 31) log pages, read commands and write commands are those shown in table 361 (see 7.3.10.1).

The Group Statistics and Performance (1 to 31) log pages provide logging of statistics and performance of read and write operations based on group numbers. There are 31 Group Statistics and Performance (1 to 31) log pages one for each group number. The statistics and performance information associated with each group number is collected in the corresponding Group Statistics and Performance (1 to 31) log page (e.g., operations associated with group number 16 are logged in the Group Statistics and Performance (16) log page).

Each Group Statistics and Performance (1 to 31) log page has the format shown in table 367.

Table 367 – Group Statistics and Performance (1 to 31) log page

Bit Byte	7	6	5	4	3	2	1	0
0	DS	SPF (1b)		PAGE CODE (19h)				
1	SUBPAGE CODE (01h to 1Fh) (see table 368) [a]							
2	(MSB)			PAGE LENGTH (n-3)				
3								(LSB)
	Group statistics and performance log parameter list							
4 •••			Group statistics and performance log parameter (see table 366) [first]					
	⋮							
••• n			Group statistics and performance log parameter (see table 366) [last]					

[a] The log parameter associated with the specific group number as specified by the value of n is collected in the corresponding log parameter (e.g., the count of read commands with the GROUP NUMBER field set to 9 is logged in the GROUP N NUMBER OF READ COMMANDS field in the Group n Statistics and Performance log parameter of the Group Statistics and Performance (9) log page).

The DS bit, SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field are described in 7.3.2. The SPF bit, PAGE CODE field, and SUBPAGE CODE field shall be set as shown in table 367 for the Group Statistics and Performance (1 to 31) log pages.

The SUBPAGE CODE field (see table 368) associates the Group Statistics and Performance (1 to 31) log page being transferred with the contents of the GROUP NUMBER field in a read command CDB or write command CDB (see table 361 in 7.3.10.1 and SBC-5).

Table 368 – Group Statistics and Performance (1 to 31) subpage codes (part 1 of 2)

Subpage code	Log page name [a]	Group number [b]
01h	Group Statistics and Performance (1)	00001b
02h	Group Statistics and Performance (2)	00010b
03h	Group Statistics and Performance (3)	00011b
04h	Group Statistics and Performance (4)	00100b
05h	Group Statistics and Performance (5)	00101b
06h	Group Statistics and Performance (6)	00110b
07h	Group Statistics and Performance (7)	00111b
08h	Group Statistics and Performance (8)	01000b
09h	Group Statistics and Performance (9)	01001b
0Ah	Group Statistics and Performance (10)	01010b
0Bh	Group Statistics and Performance (11)	01011b
0Ch	Group Statistics and Performance (12)	01100b
0Dh	Group Statistics and Performance (13)	01101b
0Eh	Group Statistics and Performance (14)	01110b
0Fh	Group Statistics and Performance (15)	01111b
10h	Group Statistics and Performance (16)	10000b
11h	Group Statistics and Performance (17)	10001b
12h	Group Statistics and Performance (18)	10010b
13h	Group Statistics and Performance (19)	10011b
14h	Group Statistics and Performance (20)	10100b
15h	Group Statistics and Performance (21)	10101b

[a] The statistics and performance information associated with a group number is collected in the corresponding Group Statistics and Performance (1 to 31) log page (e.g., operations associated with group number 10000b are logged in the Group Statistics and Performance (16) log page).

[b] The GROUP NUMBER field is from the read command CDB or the write command CDB (see table 361 in 7.3.10.1 and SBC-5).

Table 368 – Group Statistics and Performance (1 to 31) subpage codes (part 2 of 2)

Subpage code	Log page name [a]	Group number [b]
16h	Group Statistics and Performance (22)	10110b
17h	Group Statistics and Performance (23)	10111b
18h	Group Statistics and Performance (24)	11000b
19h	Group Statistics and Performance (25)	11001b
1Ah	Group Statistics and Performance (26)	11010b
1Bh	Group Statistics and Performance (27)	11011b
1Ch	Group Statistics and Performance (28)	11100b
1Dh	Group Statistics and Performance (29)	11101b
1Eh	Group Statistics and Performance (30)	11110b
1Fh	Group Statistics and Performance (31)	11111b

[a] The statistics and performance information associated with a group number is collected in the corresponding Group Statistics and Performance (1 to 31) log page (e.g., operations associated with group number 10000b are logged in the Group Statistics and Performance (16) log page).

[b] The GROUP NUMBER field is from the read command CDB or the write command CDB (see table 361 in 7.3.10.1 and SBC-5).

The contents of each group statistics and performance log parameter depends on the value in its PARAMETER CODE field (see table 366).

7.3.11.2 Group n Statistics and Performance log parameter

The Group n Statistics and Performance log parameter has the format shown in table 369.

Table 369 – Group n Statistics and Performance log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
1				PARAMETER CODE (0001h)				(LSB)
2	Parameter control byte – unbounded data counter log parameter (see 7.3.2.2.2.3)							
	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (30h)							
4	(MSB)							
•••				GROUP N NUMBER OF READ COMMANDS				
11								(LSB)
12	(MSB)							
•••				GROUP N NUMBER OF WRITE COMMANDS				
19								(LSB)
20	(MSB)							
•••				GROUP N NUMBER OF LOGICAL BLOCKS RECEIVED				
27								(LSB)
28	(MSB)							
•••				GROUP N NUMBER OF LOGICAL BLOCKS TRANSMITTED				
35								(LSB)
36	(MSB)							
•••				GROUP N READ COMMAND PROCESSING INTERVALS				
43								(LSB)
44	(MSB)							
•••				GROUP N WRITE COMMAND PROCESSING INTERVALS				
51								(LSB)

The PARAMETER CODE field is described in 7.3.2.2.1, and shall be set as shown in table 369 for the Group n Statistics and Performance log parameter.

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. These fields shall be set as described for an unbounded data counter log parameter (see 7.3.2.2.2.3) for the Group n Statistics and Performance log parameter.

The PARAMETER LENGTH field is described in 7.3.2.2.1, and shall be set as shown in table 369 for the Group n Statistics and Performance log parameter.

The GROUP N NUMBER OF READ COMMANDS field indicates the number of read commands (see table 361 in 7.3.10.1) received by the logical unit.

The GROUP N NUMBER OF WRITE COMMANDS field indicates the number of write commands (see table 361 in 7.3.10.1) received by the logical unit.

The GROUP N NUMBER OF LOGICAL BLOCKS RECEIVED field indicates the number of logical blocks received by any SCSI target port for the logical unit as a result of write commands (see table 361 in 7.3.10.1).

The GROUP N NUMBER OF LOGICAL BLOCKS TRANSMITTED field indicates the number of logical blocks transmitted by any SCSI target port for the logical unit as a result of read commands (see table 361 in 7.3.10.1).

The GROUP N READ COMMAND PROCESSING INTERVALS field indicates the cumulative number of time intervals spent by the logical unit processing read commands (see table 361 in 7.3.10.1). Time intervals are defined in the Time Interval log parameter (see 7.3.6.7) as returned in the Group Statistics and Performance log page (see 7.3.10).

The GROUP N WRITE COMMAND PROCESSING INTERVALS field indicates the cumulative number of time intervals spent by the logical unit processing write commands (see table 361 in 7.3.10.1). Time intervals are defined in the Time Interval log parameter (see 7.3.6.7) as returned in the Group Statistics and Performance log page (see 7.3.10).

7.3.11.3 Group n Force Unit Access Statistics and Performance log parameter

The Group n Force Unit Access Statistics and Performance log parameter has the format shown in table 370.

Table 370 – Group n Force Unit Access Statistics and Performance log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
1			PARAMETER CODE (0004h)					(LSB)
2	Parameter control byte – unbounded data counter log parameter (see 7.3.2.2.2.3)							
	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (40h)							
4	(MSB)							
•••			GROUP N NUMBER OF READ FUA COMMANDS					
11								(LSB)
12	(MSB)							
•••			GROUP N NUMBER OF WRITE FUA COMMANDS					
19								(LSB)
20	(MSB)							
•••			GROUP N NUMBER OF READ FUA_NV COMMANDS					
27								(LSB)
28	(MSB)							
•••			GROUP N NUMBER OF WRITE FUA_NV COMMANDS					
35								(LSB)
36	(MSB)							
•••			GROUP N READ FUA COMMAND PROCESSING INTERVALS					
43								(LSB)
44	(MSB)							
•••			GROUP N WRITE FUA COMMAND PROCESSING INTERVALS					
51								(LSB)
52	(MSB)							
•••			GROUP N READ FUA_NV COMMAND PROCESSING INTERVALS					
59								(LSB)
60	(MSB)							
•••			GROUP N WRITE FUA_NV COMMAND PROCESSING INTERVALS					
67								(LSB)

The PARAMETER CODE field is described in 7.3.2.2.1, and shall be set as shown in table 370 for the Group n Force Unit Access Statistics and Performance log parameter.

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. These fields shall be set as described for an unbounded data counter log parameter (see 7.3.2.2.2.3) for the Group n Force Unit Access Statistics and Performance log parameter.

The PARAMETER LENGTH field is described in 7.3.2.2.1, and shall be set as shown in table 370 for the Group n Force Unit Access Statistics and Performance log parameter.

The GROUP N NUMBER OF READ FUA COMMANDS field indicates the number of read commands (see table 361 in 7.3.10.1) with the FUA bit (see SBC-5) set to one received by the logical unit.

The GROUP N NUMBER OF WRITE FUA COMMANDS field indicates the number of write commands (see table 361 in 7.3.10.1) with the FUA bit (see SBC-5) set to one received by the logical unit.

The GROUP N NUMBER OF READ FUA_NV COMMANDS field indicates the number of read commands (see table 361 in 7.3.10.1) with the FUA_NV bit (see SBC-2) set to one received by the logical unit.

The GROUP N NUMBER OF WRITE FUA_NV COMMANDS field indicates the number of write commands (see table 361 in 7.3.10.1) with the FUA_NV bit (see SBC-2) set to one received by the logical unit.

The GROUP N READ FUA COMMAND PROCESSING INTERVALS field indicates the cumulative number of time intervals spent by the logical unit processing read commands (see table 361 in 7.3.10.1) with the FUA bit (see SBC-5) set to one. Time intervals are defined in the Time Interval log parameter (see 7.3.6.7) as returned in the Group Statistics and Performance log page (see 7.3.10).

The GROUP N WRITE FUA COMMAND PROCESSING INTERVALS field indicates the cumulative number of time intervals spent by the logical unit processing write commands (see table 361 in 7.3.10.1) with the FUA bit (see SBC-5) set to one. Time intervals are defined in the Time Interval log parameter (see 7.3.6.7) as returned in the Group Statistics and Performance log page (see 7.3.10).

The GROUP N READ FUA_NV COMMAND PROCESSING INTERVALS field indicates the cumulative number of time intervals spent by the logical unit processing read commands (see table 361 in 7.3.10.1) with the FUA_NV bit (see SBC-2) set to one. Time intervals are defined in the Time Interval log parameter (see 7.3.6.7) as returned in the Group Statistics and Performance log page (see 7.3.10).

The GROUP N WRITE FUA_NV COMMAND PROCESSING INTERVALS field indicates the cumulative number of time intervals spent by the logical unit processing write commands (see table 361 in 7.3.10.1) with the FUA_NV bit (see SBC-2) set to one. Time intervals are defined in the Time Interval log parameter (see 7.3.6.7) as returned in the Group Statistics and Performance log page (see 7.3.10).

7.3.12 Informational Exceptions log page

7.3.12.1 Overview

Using the format shown in table 372, the Informational Exceptions log page returns details about informational exception conditions identified by the parameter codes listed in table 371.

Table 371 – Informational Exceptions log page parameter codes

Parameter code	Description	Resettable or Changeable [a]	Reference	Support
0000h	Informational Exceptions General	Reset Only	7.3.12.2	Mandatory
0001h to FFFFh	Vendor specific			
[a] The keywords in this column – Always, Reset Only, and Never – are defined in 7.3.3.				

The Informational Exceptions log page has the format shown in table 372.

Table 372 – Informational Exceptions log page

Bit Byte	7	6	5	4	3	2	1	0
0	DS	SPF (0b)	PAGE CODE (2Fh)					
1	SUBPAGE CODE (00h)							
2	(MSB)		PAGE LENGTH (n-3)					
3								(LSB)
	Informational exceptions log parameter list							
4 •••			Informational exceptions log parameter (see table 371) [first]					
	⋮							
••• n			Informational exceptions log parameter (see table 371) [last]					

The DS bit, SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field are described in 7.3.2. The SPF bit, PAGE CODE field, and SUBPAGE CODE field shall be set as shown in table 372 for the Informational Exceptions log page.

The contents of each informational exceptions log parameter depends on the value in its PARAMETER CODE field (see table 371).

7.3.12.2 Informational Exceptions General log parameter

The Informational Exceptions General log parameter has the format shown in table 373.

Table 373 – Informational Exceptions General log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)		PARAMETER CODE (0000h)					
1								(LSB)
2	Parameter control byte – binary format list log parameter (see 7.3.2.2.2.5)							
	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (n-3)							
4	INFORMATIONAL EXCEPTION ADDITIONAL SENSE CODE							
5	INFORMATIONAL EXCEPTION ADDITIONAL SENSE CODE QUALIFIER							
6	MOST RECENT TEMPERATURE READING							
7 ••• n	Vendor specific							

The PARAMETER CODE field is described in 7.3.2.2.1, and shall be set as shown in table 373 for the Informational Exceptions General log parameter.

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. These fields shall be set as described for a binary format list log parameter (see 7.3.2.2.2.5) for the Informational Exceptions General log parameter.

The PARAMETER LENGTH field is described in 7.3.2.2.1. The parameter length shall be at least 04h.

If the INFORMATIONAL EXCEPTION ADDITIONAL SENSE CODE field is set to zero, no informational exception condition exists and contents of the INFORMATIONAL EXCEPTION ADDITIONAL SENSE CODE QUALIFIER field are unspecified. If the INFORMATIONAL EXCEPTION ADDITIONAL SENSE CODE field is set to a value other than zero, an informational exception condition exists that has an additional sense code indicated by INFORMATIONAL EXCEPTION ADDITIONAL SENSE CODE field and an ADDITIONAL SENSE CODE QUALIFIER field indicated by the INFORMATIONAL EXCEPTION ADDITIONAL SENSE CODE QUALIFIER field.

The MOST RECENT TEMPERATURE READING field indicates the temperature in degrees Celsius of the SCSI target device at the time the LOG SENSE command is performed. Temperatures equal to or less than zero degrees Celsius shall be indicated by a value of zero. If the device server is unable to detect a valid temperature as a result of a sensor failure or other condition, then the value returned shall be FFh. The temperature should be reported with an accuracy of plus or minus three Celsius degrees while the SCSI target device is operating at a steady state within the environmental limits specified for the SCSI target device.

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

7.3.13.1 Overview

Using the format shown in table 375, the Last *n* Deferred Errors or Asynchronous Events log page provides one or more Deferred Error or Asynchronous Event log parameters (see 7.3.13.2). The number of Deferred Error or Asynchronous Event log parameters supported (i.e., *n*) is vendor specific. The parameter codes for the Last *n* Deferred Errors or Asynchronous Events log page are listed in table 374.

Table 374 – Last *n* Deferred Errors or Asynchronous Events log page parameter codes

Parameter code	Description	Resettable or Changeable [a]	Reference	Support
0000h	Deferred Error or Asynchronous Event	Reset Only	7.3.13.2	Mandatory
0001h to FFFFh				Optional
[a] The keywords in this column – Always, Reset Only, and Never – are defined in 7.3.3.				

The Last *n* Deferred Errors or Asynchronous Events log page has the format shown in table 375.

Table 375 – Last *n* Deferred Errors or Asynchronous Events log page

Bit Byte	7	6	5	4	3	2	1	0
0	DS	SPF (0b)	PAGE CODE (0Bh)					
1	SUBPAGE CODE (00h)							
2	(MSB)	PAGE LENGTH (n-3)						
3								(LSB)
	Deferred Error or Asynchronous Event log parameter list							
4 •••		Deferred Error or Asynchronous Event log parameter (see 7.3.13.2) [first]						
	⋮							
••• **n**		Deferred Error or Asynchronous Event log parameter (see 7.3.13.2) [last]						

The DS bit, SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field are described in 7.3.2. The SPF bit, PAGE CODE field, and SUBPAGE CODE field shall be set as shown in table 375 for the Last *n* Deferred Errors or Asynchronous Events log page.

The contents of each deferred error or asynchronous event log parameter are described in 7.3.13.2. The device server shall assign parameter codes to log parameters as follows:

a) if the vendor specific number of supported deferred error or asynchronous event log parameters has not been exceeded, then the parameter code in each log parameter shall indicate the relative time at which the deferred error or asynchronous event occurred. A higher parameter code indicates that the deferred error or asynchronous event occurred at a more recent time; or

b) if the vendor specific number of supported deferred error or asynchronous event log parameters has been exceeded, then:

    A) the log parameter with the oldest data shall be overwritten with the newest data (i.e., after the highest supported parameter code is used, reporting wraps so that the next deferred error or asynchronous event is reported in the log parameter with parameter code zero); and

    B) if the RLEC bit is set to one in the Control mode page (see 7.5.13) and a LOG SELECT command that transfers the Last *n* Deferred Errors or Asynchronous Events log page completes without error, except for the parameter code being at its maximum value, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to RECOVERED ERROR, and the additional sense code set to LOG LIST CODES EXHAUSTED.

7.3.13.2 Deferred Error or Asynchronous Event log parameters

Each Deferred Error or Asynchronous Event log parameter has the format shown in table 376.

Table 376 – Deferred Error or Asynchronous Event log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			PARAMETER CODE (see table 374)				
1								(LSB)
2	Parameter control byte – binary format list log parameter (see 7.3.2.2.2.5)							
	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (n-3)							
4	SENSE DATA (see 4.4)							
•••								
n								

The PARAMETER CODE field is described in 7.3.2.2.1, and shall be set as shown in table 374 for the Deferred Error or Asynchronous Event log parameter.

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. These fields shall be set as described for a binary format list log parameter (see 7.3.2.2.2.5) for the Deferred Error or Asynchronous Event log parameter.

The PARAMETER LENGTH field is described in 7.3.2.2.1.

The SENSE DATA field contains the sense data (see 4.4) for a deferred error or asynchronous event that has occurred.

7.3.14 Last *n* Error Events log page

7.3.14.1 Overview

Using the format shown in table 378, the Last *n* Error Events log page provides one or more Error Event log parameters (see 7.3.14.2). The number of these Error Event log parameters supported (i.e., *n*) is vendor specific. The parameter codes for the Last *n* Error Events log page are listed in table 377.

Table 377 – Last *n* Error Events log page parameter codes

Parameter code	Description	Resettable or Changeable [a]	Reference	Support
0000h	Error Event	Reset Only	7.3.14.2	Mandatory
0001h to FFFFh				Optional
[a] The keywords in this column – Always, Reset Only, and Never – are defined in 7.3.3.				

The Last *n* Error Events log page has the format shown in table 378.

Table 378 – Last *n* Error Events log page

Bit Byte	7	6	5	4	3	2	1	0
0	DS	SPF (0b)	PAGE CODE (07h)					
1	SUBPAGE CODE (00h)							
2	(MSB)		PAGE LENGTH (n-3)					
3								(LSB)
	Error Event log parameter list							
4 •••	Error Event log parameter (see 7.3.14.2) [first]							
	⋮							
••• n	Error Event log parameter (see 7.3.14.2) [last]							

The DS bit, SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field are described in 7.3.2. The SPF bit, PAGE CODE field, and SUBPAGE CODE field shall be set as shown in table 378 for the Last *n* Error Events log page.

The contents of each error event log parameter is described are 7.3.14.2. The device server shall assign parameter codes to log parameters as follows:

a) if the vendor specific number of supported error event log parameters has not been exceeded, then the parameter code in each log parameter shall indicate the relative time at which the error event occurred. A higher parameter code indicates that the error event occurred later in time; or
b) if the vendor specific number of supported error event log parameters has been exceeded, then:
   A) the log parameter with the oldest data shall be overwritten with the newest data (i.e., after the highest supported parameter code is used, reporting wraps so that the next error event is reported in the log parameter with parameter code zero); and
   B) if the RLEC bit is set to one in the Control mode page (see 7.5.13) and a LOG SELECT command that transfers the Last *n* Error Events log page completes without error, except for the parameter code being at its maximum value, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to RECOVERED ERROR, and the additional sense code set to LOG LIST CODES EXHAUSTED.

7.3.14.2 Error Event log parameters

Each Error Event log parameter has the format shown in table 379.

Table 379 – Error Event log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			PARAMETER CODE (see table 377)				
1								(LSB)
2	Parameter control byte – ASCII format list log parameter (see 7.3.2.2.2.4)							
	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (n-3)							
4 ••• n	ERROR EVENT DATA							

The PARAMETER CODE field is described in 7.3.2.2.1, and shall be set as shown in table 377 for the Error Event log parameter.

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. These fields shall be set as described for a ASCII format list log parameter (see 7.3.2.2.2.4) for the Error Event log parameter.

The PARAMETER LENGTH field is described in 7.3.2.2.1.

The ERROR EVENT DATA field contains ASCII data (see 4.3.1) that may describe the error event. The contents of the ERROR EVENT DATA field are outside the scope of this standard.

7.3.15 Last *n* Inquiry Data Changed log page

7.3.15.1 Overview

If this log page is supported, the SCSI target device shall provide a single set of log parameters for each logical unit (e.g., not per I_T nexus).

Using the format shown in table 381, the Last *n* Inquiry Data Changed log page provides a Change List Generation Code log parameter (see 7.3.15.2) and zero or more Inquiry Data Changed Indicator log parameters (see 7.3.15.3). The number of Inquiry Data Changed Indicator log parameters supported (i.e., *n*) is vendor specific. The parameter codes for the Last *n* Inquiry Data Changed log page are listed in table 380.

Table 380 – Last *n* Inquiry Data Changed log page parameter codes

Parameter code	Description	Resettable or Changeable [a]	Reference	Support
0000h	Change List Generation Code	Reset Only	7.3.15.2	Mandatory
0001h to FFFFh	Inquiry Data Changed Indicator		7.3.15.3	Optional [b]
[a] The keywords in this column – Always, Reset Only, and Never – are defined in 7.3.3. [b] If this log page is supported, then at least one parameter shall be supported.				

Upon detection of a power on, hard reset, or logical unit reset, the device server shall set each changed generation number to zero in the Change List Generation Code log parameter and remove all parameters with a parameter code set to a non zero value from the log page.

Parameters shall not be affected by an I_T nexus loss.

The Last *n* Inquiry Data Changed log page has the format shown in table 381.

Table 381 – Last *n* Inquiry Data Changed log page

Bit Byte	7	6	5	4	3	2	1	0
0	DS	SPF (1b)	PAGE CODE (0Bh)					
1	SUBPAGE CODE (01h)							
2	(MSB)	PAGE LENGTH (m-3)						
3								(LSB)
	Inquiry data changed log parameter list							
4 •••	Inquiry data changed log parameter [first]							
	⋮							
••• **m**	Inquiry data changed log parameter [last]							

The DS bit, SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field are described in 7.3.2. The SPF bit, PAGE CODE field, and SUBPAGE CODE field shall be set as shown in table 381 for the Last *n* Inquiry Data Changed log page.

The first inquiry data changed log parameter shall contain a Change List Generation Code log parameter as described in 7.3.15.2. The contents of all subsequent inquiry data changed log parameters shall be Inquiry Data Changed Indicator log parameters as described in 7.3.15.3.

The parameter code value associated with an Inquiry Data Changed Indicator log parameter indicates the time order in which the change occurred. A lower parameter code indicates that the change occurred at a more recent time. The Inquiry Data Changed Indicator log parameter code values returned shall be numbered consecutively from 0001h (i.e., the most recent).

7.3.15.2 Change List Generation Code log parameter

The Change List Generation Code log parameter has the format shown in table 382.

Table 382 – Change List Generation Code log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			PARAMETER CODE (0000h)				
1								(LSB)
2	Parameter control byte – binary format list log parameter (see 7.3.2.2.2.5)							
	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (n-3)							
	Changed generation number parameter list							
4	(MSB)							
•••				Changed generation number [first]				
7								(LSB)
	⋮							
n-3	(MSB)							
•••				Changed generation number [last]				
n								(LSB)

The PARAMETER CODE field and PARAMETER LENGTH field are described in 7.3.2.2.1, and shall be set as shown in table 382 for the Change List Generation Code log parameter.

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. These fields shall be set as described for a binary format list log parameter (see 7.3.2.2.2.5) for the Change List Generation Code log parameter.

Each changed generation number is a 32-bit wrapping counter.

The first changed generation number (i.e., the lowest offset) shall contain the generation number associated with the Inquiry Data Changed Indicator log parameters (see 7.3.15.3).

The second changed generation number shall contain the generation number associated with the Mode Page Data Changed Indicator log parameters (see 7.3.16.2).

The device server shall increment the first changed generation number (i.e., associated with the Inquiry Data Changed Indicator log parameters) by one:

   a) for each changed VPD page (see 7.7); and
   b) if the standard Inquiry data (see 6.7.2) is changed.

The device server shall increment the second changed generation number (i.e., associated with the Mode Page Data Changed Indicator log parameters) by one for each changed mode page:

   a) that uses page_0 mode page format (see table 447); and
   b) that uses sub_page mode page format (see table 448).

7.3.15.3 Inquiry Data Changed Indicator log parameter

The Inquiry Data Changed Indicator log parameter has the format shown in table 383.

Table 383 – Inquiry Data Changed Indicator log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			PARAMETER CODE (see table 384)				
1								(LSB)
2	Parameter control byte – binary format list log parameter (see 7.3.2.2.2.5)							
	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (n-3)							
4	Reserved							VPD
5	CHANGED PAGE CODE							
6 ••• n	Reserved							

The PARAMETER CODE field and PARAMETER LENGTH field are described in 7.3.2.2.1, and shall be set as shown in table 383 for the Inquiry Data Changed Indicator log parameter.

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. These fields shall be set as described for a binary format list log parameter (see 7.3.2.2.2.5) for the Inquiry Data Changed Indicator log parameter.

The vital product data (VPD) bit indicates whether the changed information is in a vital product data (VPD) page (see 7.7) or in the standard Inquiry data. If the VPD bit is set to one, then a VPD page has changed and the CHANGED PAGE CODE field is valid. If the VPD bit is set to zero, then the standard Inquiry data (see 6.7.2) has changed and the CHANGED PAGE CODE field is reserved.

If the VPD bit is set to one, then the CHANGED PAGE CODE field indicates the page code of a vital product data (VPD) page that has changed.

7.3.16 Last *n* Mode Page Data Changed log page

7.3.16.1 Overview

If this log page is supported, the SCSI target device shall provide a single set of log parameters for each logical unit (e.g., not per I_T nexus).

Using the format shown in table 385, the Last *n* Mode Page Data Changed log page provides a Change List Generation Code log parameter (see 7.3.15.2) and zero or more Mode Page Data Changed Indicator log parameters (see 7.3.16.2). The number of Mode Page data changed log parameters supported (i.e., *n*) is vendor specific. The parameter codes for the Last *n* Mode Page Data Changed log page are listed in table 384.

Table 384 – Last *n* Mode Page Data Changed log page parameter codes

Parameter code	Description	Resettable or Changeable [a]	Reference	Support
0000h	Change List Generation Code	Reset Only	7.3.15.2	Mandatory
0001h to FFFFh	Mode Page Data Changed Indicator		7.3.16.2	Optional [b]
[a] The keywords in this column – Always, Reset Only, and Never – are defined in 7.3.3.				
[b] If this log page is supported, then at least one parameter shall be supported.				

Upon detection of a power on, hard reset, or logical unit reset, the device server shall set each changed generation number to zero in the Change List Generation Code log parameter and remove all Mode Page Data Changed Indicator log parameters from the log page.

The log parameters in this page shall not be affected by an I_T nexus loss.

The Last *n* Mode Page Data Changed log page has the format shown in table 385.

Table 385 – Last *n* Mode Page Data Changed log page

Bit Byte	7	6	5	4	3	2	1	0
0	DS	SPF (1b)	PAGE CODE (0Bh)					
1	SUBPAGE CODE (02h)							
2	(MSB)	PAGE LENGTH (m-3)						
3								(LSB)
	Mode page data changed log parameter list							
4 •••	Mode page data changed log parameter [first]							
	⋮							
••• m	Mode page data changed log parameter [last]							

The DS bit, SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field are described in 7.3.2. The SPF bit, PAGE CODE field, and SUBPAGE CODE field shall be set as shown in table 385 for the Last *n* Mode Page Data Changed log page.

The first mode page data changed log parameter shall contain a Change List Generation Code log parameter as described in 7.3.15.2. The contents of all subsequent mode page data changed log parameters shall be Mode Page Data Changed Indicator log parameters as described in 7.3.16.2.

The parameter code value associated with a Mode Page Data Changed Indicator log parameter indicates the time order in which the change occurred. A lower parameter code indicates that the change occurred at a more recent time. The Mode Page Data Changed Indicator parameter code values returned shall be numbered consecutively from 0001h (i.e., the most recent).

7.3.16.2 Mode Page Data Changed Indicator log parameter

The Mode Page Data Changed Indicator log parameter has the format shown in table 386.

Table 386 – Mode Page Data Changed Indicator log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
1			PARAMETER CODE (see table 384)					(LSB)
2	Parameter control byte – binary format list log parameter (see 7.3.2.2.2.5)							
	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (n-3)							
4	Reserved	SPF	MODE PAGE CODE					
5	SUBPAGE CODE							
6 ••• n	Reserved							

The PARAMETER CODE field and PARAMETER LENGTH field are described in 7.3.2.2.1, and shall be set as shown in table 386 for the Mode Page data changed log parameter.

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. These fields shall be set as described for a binary format list log parameter (see 7.3.2.2.2.5) for the Mode Page Data Changed log parameter.

The subpage format (SPF) bit indicates whether the SUBPAGE CODE field is valid. If the SPF bit is set to one, then the SUBPAGE CODE field is valid. If the SPF bit is set to zero, then the SUBPAGE CODE field is reserved.

The MODE PAGE CODE field indicates the page code for the mode page that changed.

If the SPF bit is set to one, then the SUBPAGE CODE field indicates the subpage code for the mode page that changed.

7.3.17 Non-Medium Error log page

7.3.17.1 Overview

Using the format shown in table 388, the Non-Medium Error log page provides for counting the occurrences of recoverable error events other than read (see 7.3.20), read reverse (see 7.3.21), verify (see 7.3.28), or write (see 7.3.29) failures. No discrimination among the various types of events is provided. Vendor specific discrimination may be provided through the vendor specific parameter codes. The parameter codes for the Non-Medium Error log page are listed in table 387.

Table 387 – Non-Medium Error log page parameter codes

Parameter code	Description	Resettable or Changeable [a]	Reference	Support
0000h	Non-Medium Error Count	Reset Only	7.3.17.2	Mandatory
8000h to FFFFh	Vendor specific error counts			
all others	Reserved			
[a] The keywords in this column – Always, Reset Only, and Never – are defined in 7.3.3.				

The Non-Medium Error log page has the format shown in table 388.

Table 388 – Non-Medium Error log page

Bit Byte	7	6	5	4	3	2	1	0
0	DS	SPF (0b)	PAGE CODE (06h)					
1	SUBPAGE CODE (00h)							
2	(MSB)	PAGE LENGTH (n-3)						
3								(LSB)
	Non-medium error log parameter list							
4 •••	Non-medium error log parameter (see table 387) [first]							
	⋮							
••• n	Non-medium error log parameter (see table 387) [last]							

The DS bit, SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field are described in 7.3.2. The SPF bit, PAGE CODE field, and SUBPAGE CODE field shall be set as shown in table 388 for the Non-Medium Error log page.

The contents of each non-medium error log parameter depends on the value in its PARAMETER CODE field (see table 387).

7.3.17.2 Non-Medium Error Count log parameter

The Non-Medium Error Count log parameter has the format shown in table 389.

Table 389 – Non-Medium Error Count log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			PARAMETER CODE (0000h)				
1								(LSB)
2	Parameter control byte – bounded data counter log parameter (see 7.3.2.2.2.2)							
	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (n-3)							
4	(MSB)							
•••				NON-MEDIUM ERROR COUNT				
n								(LSB)

The PARAMETER CODE field is described in 7.3.2.2.1, and shall be set as shown in table 389 for the Non-Medium Error Count log parameter.

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. These fields shall be set as described for a bounded data counter log parameter (see 7.3.2.2.2.2) for the Non-Medium Error Count log parameter.

The PARAMETER LENGTH field is described in 7.3.2.2.1.

The NON-MEDIUM ERROR COUNT field indicates the number of recoverable error events other than read, read reverse, verify, or write failures.

7.3.18 Power Condition Transitions log page

7.3.18.1 Overview

Using the format shown in table 391, the Power Condition Transitions log page provides a count of the occurrences of power condition transition events using the parameter codes listed in table 390.

Table 390 – Power Condition Transitions log page parameter codes

Parameter code	Description	Resettable or Changeable [a]	Reference	Support
0001h	Accumulated Transitions to active	Never	7.3.18.2	Mandatory
0002h	Accumulated Transitions to idle_a			At least one [b]
0003h	Accumulated Transitions to idle_b			
0004h	Accumulated Transitions to idle_c			
0008h	Accumulated Transitions to standby_z			
0009h	Accumulated Transitions to standby_y			
all others	Reserved			

[a] The keywords in this column – Always, Reset Only, and Never – are defined in 7.3.3.

[b] If the Power Condition Transitions log page is supported, at least one of these parameter codes shall be supported.

The Power Condition Transitions log page has the format shown in table 391.

Table 391 – Power Condition Transitions log page

Bit Byte	7	6	5	4	3	2	1	0
0	DS	SPF (0b)	PAGE CODE (1Ah)					
1	SUBPAGE CODE (00h)							
2	(MSB)	PAGE LENGTH (n-3)						
3								(LSB)
	Power condition transitions log parameter list							
4 •••	Power condition transitions log parameter (see table 390) [first]							
	⋮							
••• n	Power condition transitions log parameter (see table 390) [last]							

The DS bit, SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field are described in 7.3.2. The SPF bit, PAGE CODE field, and SUBPAGE CODE field shall be set as shown in table 391 for the Power Condition Transitions log page.

The contents of each power condition transitions log parameter depends on the value in its PARAMETER CODE field (see table 390).

7.3.18.2 Accumulated Transitions log parameter

The Accumulated Transitions log parameter has the format shown in table 392.

Table 392 – Accumulated Transitions log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			PARAMETER CODE (see table 390)				
1								(LSB)
2	Parameter control byte – binary format list log parameter (see 7.3.2.2.5)							
	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (04h)							
4	(MSB)			ACCUMULATED TRANSITIONS TO				
•••								
7								(LSB)

The PARAMETER CODE field is described in 7.3.2.2.1, and shall be set as shown in table 390 for the Accumulated Transitions log parameter.

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. These fields shall be set as described for a binary format list log parameter (see 7.3.2.2.5) for the Accumulated Transitions log parameter.

The PARAMETER LENGTH field is described in 7.3.2.2.1, and shall be set as shown in table 392 for the Accumulated Transitions log parameter.

The ACCUMULATED TRANSITIONS TO field contains a saturating counter that is incremented by one at a time defined by the contents of the PARAMETER CODE field as described in table 393. The time in the transition at which the count is incremented is vendor specific.

Table 393 – Accumulated Transitions parameter codes and saturating counters

Parameter code	Saturating counter incremented while the device server transitions from any other power condition to this power condition
0001h	active power condition (see 5.13.5)
0002h	idle_a power condition (see 5.13.6)
0003h	idle_b power condition (see 5.13.6)
0004h	idle_c power condition (see 5.13.6)
0008h	standby_z power condition (see 5.13.7)
0009h	standby_y power condition (see 5.13.7)

All values in the ACCUMULATED TRANSITIONS TO field are accumulated from the time the SCSI target device is manufactured.

7.3.19 Protocol Specific Port log page

7.3.19.1 Overview

Using the format shown in table 394, the Protocol Specific Port log page provides SCSI transport protocol specific parameters that are associated with the SCSI target ports in the SCSI target device. This log page may be implemented in any logical unit, including the TARGET LOG PAGES well known logical unit (see 8.3).

Protocol Specific Port log pages do not identify the information being logged using the PARAMETER CODE field in each log parameter. Instead, the SUBPAGE CODE field in the log page header (see table 394) serves as the indicator of what logged information is present. The PARAMETER CODE field identifies the SCSI Target Port to which the logged information applies.

The Protocol Specific Port log page has the format shown in table 394.

Table 394 – Protocol Specific Port log page

Bit Byte	7	6	5	4	3	2	1	0
0	DS	SPF	PAGE CODE (18h)					
1	SUBPAGE CODE (00h to FEh)							
2	(MSB)	PAGE LENGTH (n-3)						
3								(LSB)
	Protocol specific port log parameter list							
4 •••	Protocol specific port log parameter [first]							
	⋮							
••• n	Protocol specific port log parameter [last]							

The DS bit, SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field are described in 7.3.2. The SPF bit, PAGE CODE field, and SUBPAGE CODE field shall be set as shown in table 394 for the Protocol Specific Port log page.

The contents of each protocol specific port log parameter is defined by the corresponding SCSI transport protocol standard.

7.3.19.2 Generic protocol specific port log parameter

The generic format of a protocol specific port log parameter is shown in table 395.

Table 395 – Generic protocol specific port log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			PARAMETER CODE				
1								(LSB)
2	Parameter control byte – binary format list log parameter (see 7.3.2.2.2.5)							
	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (n-3)							
4	Reserved				PROTOCOL IDENTIFIER			
5	SCSI transport protocol specific							
•••								
n								

For the Generic protocol specific port log parameter, the PARAMETER CODE field is described in 7.3.2.2.1, and contains the relative target port identifier of the target port for which the parameter data applies.

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. These fields shall be set as described for a binary format list log parameter (see 7.3.2.2.2.5) for the Generic protocol specific port log parameter.

The PARAMETER LENGTH field is described in 7.3.2.2.1.

The PROTOCOL IDENTIFIER field contains one of the values shown in table 483 (see 7.6.1) to identify the SCSI transport protocol standard that defines the SCSI transport protocol specific data in this log parameter.

The SCSI transport protocol specific data is defined by the corresponding SCSI transport protocol standard.

7.3.20 Read Error Counter log page

7.3.20.1 Overview

The command standard that applies to the device type defines the operations that result in events that are reported in this log page.

Using the format shown in table 397, the Read Error Counter log page contains log parameters that report bounded data counters for detected events (e.g., total bytes processed) identified by the parameter codes listed in table 396.

Table 396 – Read Error Counter log page parameter codes

Parameter code	Description	Resettable or Changeable [a]	Reference	Support
0000h	Errors corrected without substantial delay [c]	Reset Only	7.3.20.2	At least one [b]
0001h	Errors corrected with possible delays [c]			
0002h	Total (e.g., rewrites or rereads) [c]			
0003h	Total errors corrected [c]			
0004h	Total times correction algorithm processed [c]			
0005h	Total bytes processed [c]			
0006h	Total uncorrected errors [c]			
8000h to FFFFh	Vendor specific			
all others	Reserved			

[a] The keywords in this column – Always, Reset Only, and Never – are defined in 7.3.3.

[b] If the Read Error Counter log page is supported, at least one of the parameter codes listed in this table shall be supported.

[c] The conditions that result in this error counter being modified are vendor specific. This counter should not be used to compare products because the products may define errors differently.

The Read Error Counter log page has the format shown in table 397.

Table 397 – Read Error Counter log page

Bit Byte	7	6	5	4	3	2	1	0
0	DS	SPF (0b)	PAGE CODE (03h)					
1	SUBPAGE CODE (00h)							
2	(MSB)		PAGE LENGTH (n-3)					
3								(LSB)
	Read Error Counter log parameter list							
4 •••	Read Error Counter log parameter (see 7.3.20.2) [first]							
	⋮							
••• n	Read Error Counter log parameter (see 7.3.20.2) [last]							

The DS bit, SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field are described in 7.3.2. The SPF bit, PAGE CODE field, and SUBPAGE CODE field shall be set as shown in table 397 for the Read Error Counter log page.

Each Read Error Counter log parameter contains the information described in 7.3.20.2.

7.3.20.2 Read Error Counter log parameter

The Read Error Counter log parameter has the format shown in table 398.

Table 398 – Read Error Counter log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			PARAMETER CODE (see table 396)				
1								(LSB)
2	Parameter control byte – bounded data counter log parameter (see 7.3.2.2.2.2)							
2	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (n-3)							
4	(MSB)			READ ERROR COUNTER				
•••								
n								(LSB)

The PARAMETER CODE field is described in 7.3.2.2.1, and shall be set as shown in table 396 for the Read Error Counter log parameter.

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. These fields shall be set as described for a bounded data counter log parameter (see 7.3.2.2.2.2) for the Read Error Counter log parameter.

The PARAMETER LENGTH field is described in 7.3.2.2.1.

The READ ERROR COUNTER field contains the value for the counter described by the contents of the PARAMETER CODE field.

7.3.21 Read Reverse Error Counters log page

7.3.21.1 Overview

The command standard that applies to the device type defines the operations that result in events that are reported in this log page.

Using the format shown in table 400, the Read Reverse Error Counters log page contains log parameters that report bounded data counters for detected events (e.g., total bytes processed) identified by the parameter codes listed in table 399.

Table 399 – Read Reverse Error Counters log page parameter codes

Parameter code	Description	Resettable or Changeable [a]	Reference	Support
0000h	Errors corrected without substantial delay [c]	Reset Only	7.3.21.2	At least one [b]
0001h	Errors corrected with possible delays [c]			
0002h	Total (e.g., rewrites or rereads) [c]			
0003h	Total errors corrected [c]			
0004h	Total times correction algorithm processed [c]			
0005h	Total bytes processed [c]			
0006h	Total uncorrected errors [c]			
8000h to FFFFh	Vendor specific			
all others	Reserved			

[a] The keywords in this column – Always, Reset Only, and Never – are defined in 7.3.3.

[b] If the Read Reverse Error Counters log page is supported, at least one of the parameter codes listed in this table shall be supported.

[c] The conditions that result in this error counter being modified are vendor specific. This counter should not be used to compare products because the products may define errors differently.

The Read Reverse Error Counters log page has the format shown in table 400.

Table 400 – Read Reverse Error Counters log page

Bit Byte	7	6	5	4	3	2	1	0
0	DS	SPF (0b)	PAGE CODE (04h)					
1	SUBPAGE CODE (00h)							
2	(MSB)	PAGE LENGTH (n-3)						
3								(LSB)
	Read Reverse Error Counter log parameter list							
4 •••	Read Reverse Error Counter log parameter (see 7.3.21.2) [first]							
	⋮							
••• n	Read Reverse Error Counter log parameter (see 7.3.21.2) [last]							

The DS bit, SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field are described in 7.3.2. The SPF bit, PAGE CODE field, and SUBPAGE CODE field shall be set as shown in table 400 for the Read Reverse Error Counters log page.

Each Read Reverse Error Counter log parameter contains the information described in 7.3.21.2.

7.3.21.2 Read Reverse Error Counter log parameter

The Read Reverse Error Counter log parameter has the format shown in table 401.

Table 401 – Read Reverse Error Counter log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			PARAMETER CODE (see table 399)				
1								(LSB)
2	Parameter control byte – bounded data counter log parameter (see 7.3.2.2.2.2)							
	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (n-3)							
4	(MSB)			READ REVERSE ERROR COUNTER				
•••								
n								(LSB)

The PARAMETER CODE field is described in 7.3.2.2.1, and shall be set as shown in table 399 for the Read Reverse Error Counter log parameter.

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. These fields shall be set as described for a bounded data counter log parameter (see 7.3.2.2.2.2) for the Read Reverse Error Counter log parameter.

The PARAMETER LENGTH field is described in 7.3.2.2.1.

The READ REVERSE ERROR COUNTER field contains the value for the counter described by the contents of the PARAMETER CODE field.

7.3.22 Self-Test Results log page

7.3.22.1 Overview

Using the format shown in table 403, the Self-Test Results log page reports the results from the 20 most recent self-tests (see 5.15). The parameter codes for the Self-Test Results log page are listed in table 402.

Table 402 – Self-Test Results log page parameter codes

Parameter code	Description	Resettable or Changeable [a]	Reference	Support
0001h to 0014h	Self-Test Results	Reset Only	7.3.22.2	Mandatory
all others	Reserved			
[a] The keywords in this column – Always, Reset Only, and Never – are defined in 7.3.3.				

The Self-Test Results log page has the format shown in table 403.

Table 403 – Self-Test Results log page

Bit Byte	7	6	5	4	3	2	1	0
0	DS	SPF (0b)	PAGE CODE (10h)					
1	SUBPAGE CODE (00h)							
2	(MSB)	PAGE LENGTH (0190h)						
3								(LSB)
	Self-Test Results log parameter list							
4 ••• 23	Self-Test Results log parameter [first]							
	⋮							
384 ••• 403	Self-Test Results log parameter [twentieth]							

The DS bit, SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field are described in 7.3.2. The SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field shall be set as shown in table 403 for the Self-Test Results log page.

The PARAMETER CODE field indicates the time at which the self-test has been performed with respect to other self-tests (i.e., 0001h indicates the most recent self-test, 0002h indicates the second most recent self-test, etc.). If fewer than 20 self-tests have been performed, then:

a) unused self-test log parameters shall have parameter code values higher than those of any used self-test log parameter; and
b) each unused self-test log parameter entry shall have the format shown in table 404.

Table 404 – Unused Self-Test Results log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			PARAMETER CODE (see table 402)				
1								(LSB)
2	Parameter control byte – binary format list log parameter (see 7.3.2.2.2.5)							
	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (10h)							
4	ZERO							
•••								
19								

The PARAMETER CODE field is described in 7.3.2.2.1, and shall be set as shown in table 402 for each Unused Self-Test Results log parameter.

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. These fields shall be set as described for a binary format list log parameter (see 7.3.2.2.2.5) for each Unused Self-Test Results log parameter.

The PARAMETER LENGTH field is described in 7.3.2.2.1, and shall be set as shown in table 404 for each Unused Self-Test Results log parameter.

The ZERO field is set to zero.

7.3.22.2 Self-Test Results log parameters

Each Self-Test Results log parameter has the format shown in table 405.

Table 405 – Self-Test Results log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			PARAMETER CODE (see table 402)				
1								(LSB)
2	Parameter control byte – binary format list log parameter (see 7.3.2.2.2.5)							
	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (10h)							
4	SELF-TEST CODE			Reserved	SELF-TEST RESULTS			
5	SELF-TEST NUMBER							
6	(MSB)			ACCUMULATED POWER ON HOURS				
7								(LSB)
8	(MSB)			ADDRESS OF FIRST FAILURE				
•••								
15								(LSB)
16	Reserved				SENSE KEY			
17	ADDITIONAL SENSE CODE							
18	ADDITIONAL SENSE CODE QUALIFIER							
19	Vendor specific							

The PARAMETER CODE field is described in 7.3.2.2.1, and shall be set as shown in table 402 for the Self-Test Results log parameter.

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. These fields shall be set as described for a binary format list log parameter (see 7.3.2.2.2.5) for the Self-Test Results log parameter.

The PARAMETER LENGTH field is described in 7.3.2.2.1, and shall be set as shown in table 405 for the Self-Test Results log parameter.

The SELF-TEST CODE field indicates the value in the SELF-TEST CODE field of the SEND DIAGNOSTIC command (see 6.39) that initiated this self-test.

Table 406 defines the content of the SELF-TEST RESULTS field.

Table 406 – SELF-TEST RESULTS field

Code	Description
0h	The self-test completed without error.
1h	The background self-test was aborted by the application client using a SEND DIAGNOSTIC command (see 6.39) with the SELF-TEST CODE field set to 100b (i.e., abort background self-test).
2h	The self-test routine was aborted by an application client using a method other than a SEND DIAGNOSTIC command with the SELF-TEST CODE field set to 100b (e.g., by a task management function, or by issuing an exception command as defined in 5.15.4).
3h	An unknown error occurred while the device server was processing the self-test and the device server was unable to complete the self-test.
4h	The self-test completed with a failure in a test segment, and the test segment that failed is not known.
5h	The first segment of the self-test failed.
6h	The second segment of the self-test failed.
7h	Another segment of the self-test failed and which test is indicated by the contents of the SELF-TEST NUMBER field.
8h to Eh	Reserved
Fh	The self-test is in progress.

The SELF-TEST NUMBER field identifies the self-test that failed and consists of either:

a) the number of the segment that failed during the self-test; or
b) the number of the test that failed and the number of the segment in which the test was run, using a vendor specific method for placing the two values in one field.

If the specific segment in which the failure occurred is not able to be identified, the SELF-TEST NUMBER field shall contain 00h.

The ACCUMULATED POWER ON HOURS field indicates the elapsed hours of powered on operation since manufacture at the time the self-test was completed. If the self-test is still in progress, the ACCUMULATED POWER ON HOURS field shall be set to zero. If the number of hours is greater than FFFFh, the ACCUMULATED POWER ON HOURS field shall be set to FFFFh.

The ADDRESS OF FIRST FAILURE field indicates information that locates the failure on the media. If the logical unit implements logical blocks, the content of the ADDRESS OF FIRST FAILURE field is the first logical block address where a self-test error occurred. This has no implication about the quality of any other logical block on the logical unit (e.g., the testing during which the error occurred may not have been performed in a sequential manner). This value shall not change (e.g., as the result of block reassignment). The content of the ADDRESS OF FIRST FAILURE field shall be FFFF FFFF FFFF FFFFh if no errors occurred during the self-test or if the error that occurred is not related to an identifiable media address.

The SENSE KEY field, ADDITIONAL SENSE CODE field, and ADDITIONAL SENSE CODE QUALIFIER field may contain a hierarchy of additional information relating to error or exception conditions that occurred during the self-test represented in the same format used by the sense data (see 4.4).

7.3.23 Start-Stop Cycle Counter log page

7.3.23.1 Overview

Using the format shown in table 408, the Start-Stop Cycle Counter log page provides information about manufacturing dates and cycle counts since date of manufacture using the parameter codes listed in table 407.

Table 407 – Start-Stop Cycle Counter log page parameter codes

Parameter code	Description	Resettable or Changeable [a]	Reference	Support
0001h	Date of Manufacture	Never	7.3.23.2	
0002h	Accounting Date	Always	7.3.23.3	
0003h	Specified Cycle Count Over Device Lifetime	Never	7.3.23.4	
0004h	Accumulated Start-Stop Cycles	Never	7.3.23.5	At least one [b]
0005h	Specified Load-Unload Count Over Device Lifetime	Never	7.3.23.6	
0006h	Accumulated Load-Unload Cycles	Never	7.3.23.7	
all others	Reserved			

[a] The keywords in this column – Always, Reset Only, and Never – are defined in 7.3.3.
[b] If the Start-Stop Cycle Counter log page is supported, at least one of the parameter codes listed in this table shall be supported.

The Start-Stop Cycle Counter log page has the format shown in table 408.

Table 408 – Start-Stop Cycle Counter log page

Bit Byte	7	6	5	4	3	2	1	0
0	DS	SPF (0b)	PAGE CODE (0Eh)					
1	SUBPAGE CODE (00h)							
2	(MSB)	PAGE LENGTH (n-3)						
3								(LSB)
	Start stop cycle log parameter list							
4 •••	Start stop cycle log parameter (see table 407) [first]							
	⋮							
••• n	Start stop cycle log parameter (see table 407) [last]							

The DS bit, SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field are described in 7.3.2. The SPF bit, PAGE CODE field, and SUBPAGE CODE field shall be set as shown in table 408 for the Start-Stop Cycle Counter log page.

7.3.23.2 Date of Manufacture log parameter

The Date of Manufacture log parameter has the format shown in table 409.

Table 409 – Date of Manufacture log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			PARAMETER CODE (0001h)				
1								(LSB)
2	Parameter control byte – ASCII format list log parameter (see 7.3.2.2.2.4)							
	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (06h)							
4	(MSB)			YEAR OF MANUFACTURE				
•••								
7								(LSB)
8	(MSB)			WEEK OF MANUFACTURE				
9								(LSB)

The PARAMETER CODE field is described in 7.3.2.2.1, and shall be set as shown in table 409 for the Date of Manufacture log parameter.

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. These fields shall be set as described for a ASCII format list log parameter (see 7.3.2.2.2.4) for the Date of Manufacture log parameter.

The PARAMETER LENGTH field is described in 7.3.2.2.1, and shall be set as shown in table 409 for the Date of Manufacture log parameter.

The YEAR OF MANUFACTURE field indicates the year in which the SCSI target device was manufactured and contains four numeric ASCII characters (e.g., 30h for zero and 39h for nine).

The WEEK OF MANUFACTURE field indicates the week of the year in which the SCSI target device was manufactured and contains two numeric ASCII characters.

7.3.23.3 Accounting Date log parameter

The Accounting Date log parameter has the format shown in table 410.

Table 410 – Accounting Date log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			PARAMETER CODE (0002h)				
1								(LSB)
2	Parameter control byte – ASCII format list log parameter (see 7.3.2.2.2.4)							
	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (06h)							
4	(MSB)			ACCOUNTING DATE YEAR				
•••								
7								(LSB)
8	(MSB)			ACCOUNTING DATE WEEK				
9								(LSB)

The PARAMETER CODE field is described in 7.3.2.2.1, and shall be set as shown in table 410 for the Accounting Date log parameter.

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. These fields shall be set as described for a ASCII format list log parameter (see 7.3.2.2.2.4) for the Accounting Date log parameter.

The PARAMETER LENGTH field is described in 7.3.2.2.1, and shall be set as shown in table 410 for the Accounting Date log parameter.

The ACCOUNTING DATE YEAR field indicates the year in which the SCSI target device was placed in service and contains four numeric ASCII characters (e.g., 30h for zero and 39h for nine).

The ACCOUNTING DATE WEEK field indicates the week of the year in which the SCSI target device was placed in service and contains two numeric ASCII characters.

A LOG SELECT command may be used to change the value of the ACCOUNTING DATE YEAR field and ACCOUNTING DATE WEEK field. If the Accounting Date log parameter is not yet set, then the value placed:

- a) in the ACCOUNTING DATE YEAR field shall be four ASCII space characters (i.e., 20h); and
- b) in the ACCOUNTING DATE WEEK field shall be two ASCII space characters (i.e., 20h).

The ACCOUNTING DATE YEAR field and ACCOUNTING DATE WEEK field shall not be checked for validity by the device server.

7.3.23.4 Specified Cycle Count Over Device Lifetime log parameter

The Specified Cycle Count Over Device Lifetime log parameter has the format shown in table 411.

Table 411 – Specified Cycle Count Over Device Lifetime log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
1				PARAMETER CODE (0003h)				(LSB)
2	Parameter control byte – binary format list log parameter (see 7.3.2.2.2.5)							
	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (04h)							
4	(MSB)							
•••				SPECIFIED CYCLE COUNT OVER DEVICE LIFETIME				
7								(LSB)

The PARAMETER CODE field is described in 7.3.2.2.1, and shall be set as shown in table 411 for the Specified Cycle Count Over Device Lifetime log parameter.

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. These fields shall be set as described for a binary format list log parameter (see 7.3.2.2.2.5) for the Specified Cycle Count Over Device Lifetime log parameter.

The PARAMETER LENGTH field is described in 7.3.2.2.1, and shall be set as shown in table 411 for the Specified Cycle Count Over Device Lifetime log parameter.

The contents of the SPECIFIED CYCLE COUNT OVER DEVICE LIFETIME field indicate the number of stop-start cycles that may be performed over the lifetime of the SCSI target device without degrading the SCSI target device's operation or reliability outside the limits specified by the manufacturer of the SCSI target device.

7.3.23.5 Accumulated Start-Stop Cycles log parameter

The Accumulated Start-Stop Cycles log parameter has the format shown in table 412.

Table 412 – Accumulated Start-Stop Cycles log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
1				PARAMETER CODE (0004h)				(LSB)
2	Parameter control byte – binary format list log parameter (see 7.3.2.2.2.5)							
	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (04h)							
4	(MSB)							
•••				ACCUMULATED START-STOP CYCLES				
7								(LSB)

The PARAMETER CODE field is described in 7.3.2.2.1, and shall be set as shown in table 412 for the Accumulated Start-Stop Cycles log parameter.

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. These fields shall be set as described for a binary format list log parameter (see 7.3.2.2.2.5) for the Accumulated Start-Stop Cycles log parameter.

The PARAMETER LENGTH field is described in 7.3.2.2.1, and shall be set as shown in table 412 for the Accumulated Start-Stop Cycles log parameter.

The contents of the ACCUMULATED START-STOP CYCLES field indicate the number of stop-start cycles the SCSI target device has detected since its date of manufacture. This saturating counter is incremented by one for each complete cycle. The time in the cycle at which the counter is incremented is vendor specific.

For rotating magnetic storage devices (see SBC-5), a single start-stop cycle is defined as an operational cycle that:

    a) begins with the disk spindle at rest;
    b) continues while the disk accelerates to its normal operational rotational rate;
    c) continues during the entire period the disk is rotating;
    d) continues as the disk decelerates toward a resting state; and
    e) ends when the disk is no longer rotating.

For devices without a spindle or with multiple spindles, the definition of a single start-stop cycle is vendor specific.

7.3.23.6 Specified Load-Unload Count Over Device Lifetime log parameter

The Specified Load-Unload Count Over Device Lifetime log parameter has the format shown in table 413.

Table 413 – Specified Load-Unload Count Over Device Lifetime log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			PARAMETER CODE (0005h)				
1								(LSB)
2	Parameter control byte – binary format list log parameter (see 7.3.2.2.2.5)							
	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (04h)							
4	(MSB)			SPECIFIED LOAD-UNLOAD COUNT OVER DEVICE LIFETIME				
•••								
7								(LSB)

The PARAMETER CODE field is described in 7.3.2.2.1, and shall be set as shown in table 413 for the Specified Load-Unload Count Over Device Lifetime log parameter.

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. These fields shall be set as described for a binary format list log parameter (see 7.3.2.2.2.5) for the Specified Load-Unload Count Over Device Lifetime log parameter.

The PARAMETER LENGTH field is described in 7.3.2.2.1, and shall be set as shown in table 413 for the Specified Load-Unload Count Over Device Lifetime log parameter.

The contents of the SPECIFIED LOAD-UNLOAD COUNT OVER DEVICE LIFETIME field indicate the number of load-unload cycles that may be performed over the lifetime of the SCSI target device without degrading the SCSI target device's operation or reliability outside the limits specified by the manufacturer of the SCSI target device.

7.3.23.7 Accumulated Load-Unload Cycles log parameter

The Accumulated Load-Unload Cycles log parameter has the format shown in table 414.

Table 414 – Accumulated Load-Unload Cycles log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			PARAMETER CODE (0006h)				
1								(LSB)
2	Parameter control byte – binary format list log parameter (see 7.3.2.2.2.5)							
	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (04h)							
4	(MSB)							
•••				ACCUMULATED LOAD-UNLOAD CYCLES				
7								(LSB)

The PARAMETER CODE field is described in 7.3.2.2.1, and shall be set as shown in table 414 for the Accumulated Load-Unload Cycles log parameter.

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. These fields shall be set as described for a binary format list log parameter (see 7.3.2.2.2.5) for the Accumulated Load-Unload Cycles log parameter.

The PARAMETER LENGTH field is described in 7.3.2.2.1, and shall be set as shown in table 414 for the Accumulated Load-Unload Cycles log parameter.

The contents of the ACCUMULATED LOAD-UNLOAD CYCLES field indicate the number of load-unload cycles the SCSI target device has detected since its date of manufacture. This saturating counter is incremented by one for each complete cycle. The time in the cycle at which the counter is incremented is vendor specific.

For rotating magnetic storage devices (see SBC-5), a single load-unload cycle is defined as an operational cycle that:

    a) begins with the heads unloaded from the medium;
    b) continues while the heads are loaded onto the spinning medium; and
    c) ends when the heads are unloaded from the medium.

The Accumulated Load-Unload Cycles log parameter is not applicable to rotating magnetic storage devices without unloadable heads.

7.3.24 Supported Log Pages log page

For the LOG SENSE command, the Supported Log Pages log page (see table 415) returns the list of log
pages supported by the logical unit. Logical units that implement the LOG SENSE command shall implement
this log page. This log page is not defined for the LOG SELECT command.

Table 415 – Supported Log Pages log page

Bit Byte	7	6	5	4	3	2	1	0
0	DS (0b)	SPF (0b)	PAGE CODE (00h)					
1	SUBPAGE CODE (00h)							
2	(MSB)		PAGE LENGTH (n-3)					
3								(LSB)
	Supported page descriptor list							
4	Supported page descriptor (see table 416) [first]							
	⋮							
n	Supported page descriptor (see table 416) [last]							

The DS bit, SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field are described in 7.3.2. The DS
bit, SPF bit, PAGE CODE field, and SUBPAGE CODE field shall be set as shown in table 415 for the Supported Log
Pages log page.

The supported page descriptor list shall contain a list of all log page codes (see table 416) with a subpage
code of zero supported by the logical unit in ascending order beginning with page code 00h. The supported
page descriptor list may or may not include all the log pages that are able to be returned by the device server.

Table 416 – Supported page descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved		PAGE CODE					

The PAGE CODE field indicates the number of a supported log page.

7.3.25 Supported Log Pages and Subpages log page

For the LOG SENSE command, the Supported Log Pages and Subpages log page (see table 417) returns the list of log pages and subpages supported by the logical unit. If log subpages are supported, this page shall be supported. This log page is not defined for the LOG SELECT command.

Table 417 – Supported Log Pages and Subpages log page

Bit Byte	7	6	5	4	3	2	1	0
0	DS (0b)	SPF (1b)	PAGE CODE (00h)					
1	SUBPAGE CODE (FFh)							
2	(MSB)		PAGE LENGTH (n-3)					
3								(LSB)
	Supported page/subpage descriptor list							
4	Supported page/subpage descriptor (see table 418) [first]							
5								
	⋮							
n-1	Supported page/subpage descriptor (see table 418) [last]							
n								

The DS bit, SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field are described in 7.3.2. The DS bit, SPF bit, PAGE CODE field, and SUBPAGE CODE field shall be set as shown in table 417 for the Supported Log Pages and Subpages log page. The supported page/subpage descriptor list (see table 418) shall be in ascending order sorted by page code then subpage code. The supported page/subpage descriptor list may or may not include all the log pages and subpages that are able to be returned by the device server.

Table 418 – Supported page/subpage descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved		PAGE CODE					
1	SUBPAGE CODE							

The PAGE CODE field indicates the number of a supported log page.

The SUBPAGE CODE field indicates the supported subpage number of a supported log page.

7.3.26 Supported Subpages log page

For the LOG SENSE command, the Supported Subpages log page (see table 419) returns the list of all subpage codes (i.e., 00h to FFh) that are supported by the logical unit for a specified page code. If log subpages are supported, this page shall be supported. This log page is not defined for the LOG SELECT command.

Table 419 – Supported Subpages log page

Bit Byte	7	6	5	4	3	2	1	0
0	DS (0b)	SPF (1b)	PAGE CODE					
1	SUBPAGE CODE (FFh)							
2	(MSB)		PAGE LENGTH (n-3)					
3								(LSB)
	Supported subpage descriptor list							
4	Supported subpage descriptor (see table 420) [first]							
5								
	⋮							
n-1	Supported subpage descriptor (see table 420) [last]							
n								

The DS bit, SPF bit, SUBPAGE CODE field, and PAGE LENGTH field are described in 7.3.2. The DS bit, SPF bit, and SUBPAGE CODE field shall be set as shown in table 419 for the Supported Subpages log page.

The PAGE CODE field (see 7.3.2) indicates the log page for which log page and subpage codes are being returned.

The supported subpage descriptor list (see table 420) shall be in ascending order sorted by page code then subpage code, and shall include a descriptor with subpage code 00h for any supported log page in which the SPF bit is set to zero. The supported subpage descriptor list may or may not include all the subpages that are able to be returned by the device server for a specified page code.

Table 420 – Supported subpage descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved		PAGE CODE					
1	SUBPAGE CODE							

The PAGE CODE field indicates the number of a supported log page. The page code is the same in the page header (see table 419) and in each supported subpage descriptor (see table 420).

The SUBPAGE CODE field indicates the supported subpage number of a supported log page.

7.3.27 Temperature log page

7.3.27.1 Overview

Using the format shown in table 422, the Temperature log page provides information about the current operating temperature of the SCSI target device using the parameter codes listed in table 421.

Table 421 – Temperature log page parameter codes

Parameter code	Description	Resettable or Changeable [a]	Reference	Support
0000h	Temperature	Never	7.3.27.2	Mandatory
0001h	Reference Temperature	Never	7.3.27.3	Optional
all others	Reserved			
[a] The keywords in this column – Always, Reset Only, and Never – are defined in 7.3.3.				

The Temperature log page has the format shown in table 422.

Table 422 – Temperature log page

Bit Byte	7	6	5	4	3	2	1	0
0	DS	SPF (0b)	PAGE CODE (0Dh)					
1	SUBPAGE CODE (00h)							
2	(MSB)	PAGE LENGTH (n-3)						
3								(LSB)
	Temperature log parameter list							
4 •••	Temperature log parameter (see table 421) [first]							
	⋮							
••• n	Temperature log parameter (see table 421) [last]							

The DS bit, SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field are described in 7.3.2. The SPF bit, PAGE CODE field, and SUBPAGE CODE field shall be set as shown in table 422 for the Temperature log page.

The contents of each temperature log parameter depends on the value in its PARAMETER CODE field (see table 421).

7.3.27.2 Temperature log parameter

The Temperature log parameter has the format shown in table 423.

Table 423 – Temperature log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			PARAMETER CODE (0000h)				
1								(LSB)
2	Parameter control byte – binary format list log parameter (see 7.3.2.2.2.5)							
	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (02h)							
4	Reserved							
5	TEMPERATURE							

The PARAMETER CODE field is described in 7.3.2.2.1, and shall be set as shown in table 423 for the Temperature log parameter.

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. These fields shall be set as described for a binary format list log parameter (see 7.3.2.2.2.5) for the Temperature log parameter.

The PARAMETER LENGTH field is described in 7.3.2.2.1, and shall be set as shown in table 423 for the Temperature log parameter.

The TEMPERATURE field indicates the temperature of the SCSI target device in degrees Celsius at the time the LOG SENSE command is performed. Temperatures equal to or less than zero degrees Celsius shall cause the TEMPERATURE field to be set to zero. If the device server is unable to detect a valid temperature because of a sensor failure or other condition, then the TEMPERATURE field shall be set to FFh. The temperature should be reported with an accuracy of plus or minus three Celsius degrees while the SCSI target device is operating at a steady state within its environmental limits.

7.3.27.3 Reference Temperature log parameter

The Reference Temperature log parameter has the format shown in table 424.

Table 424 – Reference Temperature log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			PARAMETER CODE (0001h)				
1								(LSB)
2	Parameter control byte – binary format list log parameter (see 7.3.2.2.2.5)							
	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (02h)							
4	Reserved							
5	REFERENCE TEMPERATURE							

The PARAMETER CODE field is described in 7.3.2.2.1, and shall be set as shown in table 424 for the Reference Temperature log parameter.

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. These fields shall be set as described for a binary format list log parameter (see 7.3.2.2.2.5) for the Reference Temperature log parameter.

The PARAMETER LENGTH field is described in 7.3.2.2.1, and shall be set as shown in table 424 for the Reference Temperature log parameter.

The REFERENCE TEMPERATURE field indicates the maximum reported sensor temperature in degrees Celsius at which the SCSI target device is capable of operating continuously without degrading the SCSI target device's operation or reliability beyond manufacturer accepted limits. If the device server is unable to return a reference temperature and the optional Reference Temperature log parameter is included in the Temperature log page, then REFERENCE TEMPERATURE field is set to FFh.

The reference temperature may change for vendor specific reasons.

7.3.28 Verify Error Counters log page

7.3.28.1 Overview

The command standard that applies to the device type defines the operations that result in events that are reported in this log page.

Using the format shown in table 426, the Verify Error Counters log page contains log parameters that report bounded data counters for detected events (e.g., total bytes processed) identified by the parameter codes listed in table 425.

Table 425 – Verify Error Counters log page parameter codes

Parameter code	Description	Resettable or Changeable [a]	Reference	Support
0000h	Errors corrected without substantial delay [c]	Reset Only	7.3.28.2	At least one [b]
0001h	Errors corrected with possible delays [c]			
0002h	Total (e.g., rewrites or rereads) [c]			
0003h	Total errors corrected [c]			
0004h	Total times correction algorithm processed [c]			
0005h	Total bytes processed [c]			
0006h	Total uncorrected errors [c]			
8000h to FFFFh	Vendor specific			
all others	Reserved			

[a] The keywords in this column – Always, Reset Only, and Never – are defined in 7.3.3.

[b] If the Verify Error Counters log page is supported, at least one of the parameter codes listed in this table shall be supported.

[c] The conditions that result in this error counter being modified are vendor specific. This counter should not be used to compare products because the products may define errors differently.

The Verify Error Counters log page has the format shown in table 426.

Table 426 – Verify Error Counters log page

Bit Byte	7	6	5	4	3	2	1	0
0	DS	SPF (0b)	PAGE CODE (05h)					
1	SUBPAGE CODE (00h)							
2	(MSB)	PAGE LENGTH (n-3)						
3								(LSB)
	Verify error counter log parameter list							
4 •••	Verify Error Counter log parameter (see 7.3.28.2) [first]							
	⋮							
••• n	Verify Error Counter log parameter (see 7.3.28.2) [last]							

The DS bit, SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field are described in 7.3.2. The SPF bit, PAGE CODE field, and SUBPAGE CODE field shall be set as shown in table 426 for the Verify Error Counters log page.

Each Verify Error Counter log parameter contains the information described in 7.3.28.2.

7.3.28.2 Verify Error Counter log parameter

The Verify Error Counter log parameter has the format shown in table 427.

Table 427 – Verify Error Counter log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)	PARAMETER CODE (see table 425)						
1								(LSB)
2	Parameter control byte – bounded data counter log parameter (see 7.3.2.2.2.2)							
	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (n-3)							
4 ••• n	(MSB)	VERIFY ERROR COUNTER						
								(LSB)

The PARAMETER CODE field is described in 7.3.2.2.1, and shall be set as shown in table 425 for the Verify Error Counter log parameter.

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. These fields shall be set as described for a bounded data counter log parameter (see 7.3.2.2.2.2) for the Verify Error Counter log parameter.

The PARAMETER LENGTH field is described in 7.3.2.2.1.

The VERIFY ERROR COUNTER field contains the value for the counter described by the contents of the PARAMETER CODE field.

7.3.29 Write Error Counters log page

7.3.29.1 Overview

The command standard that applies to the device type defines the operations that result in events that are reported in this log page.

Using the format shown in table 429, the Write Error Counters log page contains log parameters that report bounded data counters for detected events (e.g., total bytes processed) identified by the parameter codes listed in table 428.

Table 428 – Write Error Counters log page parameter codes

Parameter code	Description	Resettable or Changeable [a]	Reference	Support
0000h	Errors corrected without substantial delay [c]	Reset Only	7.3.29.2	At least one [b]
0001h	Errors corrected with possible delays [c]			
0002h	Total (e.g., rewrites or rereads) [c]			
0003h	Total errors corrected [c]			
0004h	Total times correction algorithm processed [c]			
0005h	Total bytes processed [c]			
0006h	Total uncorrected errors [c]			
8000h to FFFFh	Vendor specific			
all others	Reserved			

[a] The keywords in this column – Always, Reset Only, and Never – are defined in 7.3.3.

[b] If the Write Error Counters log page is supported, at least one of the parameter codes listed in this table shall be supported.

[c] The conditions that result in this error counter being modified are vendor specific. This counter should not be used to compare products because the products may define errors differently.

The Write Error Counters log page has the format shown in table 429.

Table 429 – Write Error Counters log page

Bit Byte	7	6	5	4	3	2	1	0
0	DS	SPF (0b)	PAGE CODE (02h)					
1	SUBPAGE CODE (00h)							
2	(MSB)	PAGE LENGTH (n-3)						
3								(LSB)
	Write error counter log parameter list							
4 •••		Write Error Counter log parameter (see 7.3.29.2) [first]						
	⋮							
••• n		Write Error Counter log parameter (see 7.3.29.2) [last]						

The DS bit, SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field are described in 7.3.2. The SPF bit, PAGE CODE field, and SUBPAGE CODE field shall be set as shown in table 429 for the Write Error Counters log page.

Each Write Error Counter log parameter contains the information described in 7.3.29.2.

7.3.29.2 Write Error Counter log parameter

The Write Error Counter log parameter has the format shown in table 430.

Table 430 – Write Error Counter log parameter

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			PARAMETER CODE (see table 428)				
1								(LSB)
2	Parameter control byte – bounded data counter log parameter (see 7.3.2.2.2.2)							
	DU	Obsolete	TSD	Obsolete			FORMAT AND LINKING	
3	PARAMETER LENGTH (n-3)							
4	(MSB)			WRITE ERROR COUNTER				
•••								
n								(LSB)

The PARAMETER CODE field is described in 7.3.2.2.1, and shall be set as shown in table 428 for the Write Error Counter log parameter.

The DU bit, TSD bit, and FORMAT AND LINKING field are described in 7.3.2.2.2.1. These fields shall be set as described for a bounded data counter log parameter (see 7.3.2.2.2.2) for the Write Error Counter log parameter.

The PARAMETER LENGTH field is described in 7.3.2.2.1.

The WRITE ERROR COUNTER field contains the value for the counter described by the contents of the PARAMETER CODE field.

7.4 Medium auxiliary memory attributes

7.4.1 Attribute format

Each medium auxiliary memory attribute shall be communicated between the application client and device server in the format shown in table 431. This format shall be used in the parameter data for the WRITE ATTRIBUTE command (see 6.48) and the READ ATTRIBUTE command (see 6.17). The MAM attribute format in this standard implies nothing about the physical representation of an attribute in the medium auxiliary memory.

Table 431 – MAM ATTRIBUTE

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
1				ATTRIBUTE IDENTIFIER				(LSB)
2	READ ONLY			Reserved			FORMAT	
3	(MSB)							
4				ATTRIBUTE LENGTH (n-4)				(LSB)
5								
•••				ATTRIBUTE VALUE				
n								

The ATTRIBUTE IDENTIFIER field contains a code value identifying the MAM attribute (see 7.4.2).

The READ ONLY bit indicates whether the MAM attribute is in the read only state (see 5.9). If the READ ONLY bit is set to one, the MAM attribute is in the read only state. If the READ ONLY bit is set to zero, the MAM attribute is not in the read only state.

The FORMAT field (see table 432) specifies the format of the data in the ATTRIBUTE VALUE field.

Table 432 – MAM attribute FORMAT field

Format	Name	Description
00b	BINARY	The ATTRIBUTE VALUE field contains binary data.
01b	ASCII	The ATTRIBUTE VALUE field contains left-aligned ASCII data (see 4.3.1).
10b	TEXT	The attribute contains textual data. The character set is as described in the TEXT LOCALIZATION IDENTIFIER attribute (see 7.4.2.4.7).
11b		Reserved

The ATTRIBUTE LENGTH field specifies the length in bytes of the ATTRIBUTE VALUE field.

The ATTRIBUTE VALUE field contains the:

a) current value of the MAM attribute for the READ ATTRIBUTE command (see 6.17); or
b) intended value of the MAM attribute for the WRITE ATTRIBUTE command (see 6.48).

7.4.2 Attribute identifier values

7.4.2.1 Introduction to attribute identifier values

The values in the ATTRIBUTE IDENTIFIER field (see 7.4.1) are assigned according to the MAM attribute type (see 5.9) and whether the MAM attribute is standard or vendor specific (see table 433).

Table 433 – MAM attribute identifier range assignments

Attribute Identifiers	Attribute Type	Standardized	Reference
0000h to 03FFh	Device	Yes	7.4.2.2
0400h to 07FFh	Medium	Yes	7.4.2.3
0800h to 0BFFh	Host	Yes	7.4.2.4
0C00h to 0FFFh	Device	Vendor specific	
1000h to 13FFh	Medium	Vendor specific	
1400h to 17FFh	Host	Vendor specific	
1800h to FFFFh	Reserved		

Device servers may process a WRITE ATTRIBUTE command containing standardized host type attribute identifier values (i.e., 0800h to 0BFFh) or vendor specific host type attribute identifier values (i.e., 1400h to 17FFh). Standardized host type attribute identifier values may be verified as described in 7.4.2.4.

7.4.2.2 Device type attributes

7.4.2.2.1 Overview

Device type attributes (see table 434) shall be maintained and updated by the device server while the medium and associated medium auxiliary memory are present. All supported device type attributes shall have a status of read only or unavailable (see 5.9).

Table 434 – Device type attributes (part 1 of 2)

Attribute Identifier	Name	Attribute Length (in bytes)	Format [a]	Reference
0000h	REMAINING CAPACITY IN PARTITION	8	BINARY	7.4.2.2.2
0001h	MAXIMUM CAPACITY IN PARTITION	8	BINARY	7.4.2.2.2
0002h	Restricted (see SSC-5)			
0003h	LOAD COUNT	8	BINARY	7.4.2.2.3
0004h	MAM SPACE REMAINING	8	BINARY	7.4.2.2.4
0005h to 0006h	Restricted (see SSC-5)			
0007h	INITIALIZATION COUNT	2	BINARY	7.4.2.2.5
0008h	VOLUME IDENTIFIER	32	ASCII	7.4.2.2.6
0009h	Restricted (see SSC-5)			
[a] See table 432 in 7.4.1.				

Table 434 – Device type attributes (part 2 of 2)

Attribute Identifier	Name	Attribute Length (in bytes)	Format [a]	Reference
000Ah to 0209h	Reserved			
020Ah	DEVICE VENDOR/SERIAL NUMBER AT LAST LOAD	40	ASCII	7.4.2.2.7
020Bh	DEVICE VENDOR/SERIAL NUMBER AT LOAD-1	40	ASCII	7.4.2.2.7
020Ch	DEVICE VENDOR/SERIAL NUMBER AT LOAD-2	40	ASCII	7.4.2.2.7
020Dh	DEVICE VENDOR/SERIAL NUMBER AT LOAD-3	40	ASCII	7.4.2.2.7
020Eh to 021Fh	Reserved			
0220h	TOTAL MEBIBYTES WRITTEN IN MEDIUM LIFE	8	BINARY	7.4.2.2.8
0221h	TOTAL MEBIBYTES READ IN MEDIUM LIFE	8	BINARY	7.4.2.2.8
0222h	TOTAL MEBIBYTES WRITTEN IN CURRENT/LAST LOAD	8	BINARY	7.4.2.2.9
0223h	TOTAL MEBIBYTES READ IN CURRENT/LAST LOAD	8	BINARY	7.4.2.2.9
0224h	LOGICAL POSITION OF FIRST ENCRYPTED BLOCK	8	BINARY	7.4.2.2.10
0225h	LOGICAL POSITION OF FIRST UNENCRYPTED BLOCK AFTER THE FIRST ENCRYPTED BLOCK	8	BINARY	7.4.2.2.11
0226h to 033Fh	Reserved			
0340h	MEDIUM USAGE HISTORY	90	BINARY	7.4.2.2.12
0341h	PARTITION USAGE HISTORY	60	BINARY	7.4.2.2.13
0342h to 03FFh	Reserved			
[a] See table 432 in 7.4.1.				

7.4.2.2.2 REMAINING CAPACITY IN PARTITION and MAXIMUM CAPACITY IN PARTITION

These MAM attributes are native capacities (i.e., assuming no data compression for the specified medium partition) expressed in units of mebibytes.

7.4.2.2.3 LOAD COUNT

This MAM attribute is a saturating counter that indicates how many times this medium has been fully loaded. This MAM attribute should not be reset to zero by any action of the device server.

7.4.2.2.4 MAM SPACE REMAINING

This MAM attribute indicates the space currently available in the medium auxiliary memory. The total medium auxiliary memory capacity is reported in the MAM CAPACITY attribute (see 7.4.2.3.5).

NOTE 23 - It is not always possible to utilize all of the available space in a given medium auxiliary memory implementation. Depending on the internal organization of the memory and the software that controls it, fragmentation issues have the potential to result in conditions where cause certain attribute sizes to not be fully accommodated as the medium auxiliary memory nears its maximum capacity.

7.4.2.2.5 INITIALIZATION COUNT

This MAM attribute is a saturating counter that indicates the number of times that a device server has logically formatted the medium. This value is cumulative over the life of the medium and shall not be reset to zero.

7.4.2.2.6 VOLUME IDENTIFIER

This MAM attribute indicates the current volume identifier (see SMC-3) of the medium. If the device server supports this MAM attribute but does not have access to the volume identifier, the device server shall report this MAM attribute with an attribute length value of zero.

7.4.2.2.7 DEVICE VENDOR/SERIAL NUMBER AT LAST LOAD, DEVICE VENDOR/SERIAL NUMBER AT LOAD –1, DEVICE VENDOR/SERIAL NUMBER AT LOAD –2 and DEVICE VENDOR/SERIAL NUMBER AT LOAD –3

These MAM attributes give a history of the last four device servers in which the medium has been loaded. The format of these MAM attributes is shown in table 435.

Table 435 – DEVICE VENDOR/SERIAL NUMBER attribute

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
•••				T10 VENDOR IDENTIFICATION				
7								(LSB)
8	(MSB)							
•••				PRODUCT SERIAL NUMBER				
39								(LSB)

The T10 VENDOR IDENTIFICATION field shall contain the T10 vendor identification bytes that the device server loading the medium returns in the Standard INQUIRY data (see 6.7.2) parameter data for an INQUIRY command (see 6.7).

The PRODUCT SERIAL NUMBER field contains ASCII data (see 4.3.1) that is a manufacturer assigned serial number. If the product serial number is not available, the PRODUCT SERIAL NUMBER field shall contain ASCII spaces (20h).

7.4.2.2.8 TOTAL MEBIBYTES WRITTEN IN MEDIUM LIFE and TOTAL MEBIBYTES READ IN MEDIUM LIFE

These MAM attributes indicate the total number of data mebibytes that are transferred to or from the medium, after any data compression has been applied, over the entire medium life. These values are cumulative and shall not be reset to zero.

7.4.2.2.9 TOTAL MEBIBYTES WRITTEN IN CURRENT/LAST LOAD and TOTAL MEBIBYTES READ IN CURRENT/LAST LOAD

These MAM attributes indicate the total number of data mebibytes that are transferred to or from the medium, after any data compression has been applied, during:

- a) the current load if the medium is currently loaded; or
- b) the last load if the medium is currently unloaded.

The device server should reset these MAM attributes to zero when the medium is loaded.

7.4.2.2.10 LOGICAL POSITION OF FIRST ENCRYPTED BLOCK

This MAM attribute indicates the first encrypted logical block, if any, in the partition specified by the PARTITION NUMBER field in the CDB, and shall be set to:

- a) FFFF FFFF FFFF FFFFh if there is no encrypted logical block in the partition specified by the PARTITION NUMBER field in the CDB;
- b) FFFF FFFF FFFF FFFEh if it is unknown whether there are any encrypted logical blocks in the partition specified by the PARTITION NUMBER field in the CDB; or
- c) the address of the first logical block in the partition specified by the PARTITION NUMBER field in the CDB that contains encrypted data.

7.4.2.2.11 LOGICAL POSITION OF FIRST UNENCRYPTED BLOCK AFTER THE FIRST ENCRYPTED BLOCK

If this MAM attribute is supported, the LOGICAL POSITION OF FIRST ENCRYPTED BLOCK (see 7.4.2.2.10) attribute shall be supported. This MAM attribute indicates the first unencrypted logical block, if any, in the partition specified by the PARTITION NUMBER field in the CDB after one or more encrypted logical blocks, and shall be set to:

- a) FFFF FFFF FFFF FFFFh if there is:
  - A) no encrypted logical block in the partition specified by the PARTITION NUMBER field in the CDB (i.e., if the value for the LOGICAL POSITION OF FIRST ENCRYPTED BLOCK attribute (see 7.4.2.2.10) is set to FFFF FFFF FFFF FFFFh); or
  - B) no unencrypted logical block in the partition specified by the PARTITION NUMBER field in the CDB after the address specified in the LOGICAL POSITION OF FIRST ENCRYPTED BLOCK attribute;
- b) FFFF FFFF FFFF FFFEh if it is unknown whether:
  - A) there are any encrypted logical blocks in the partition specified by the PARTITION NUMBER field in the CDB (i.e., the LOGICAL POSITION OF FIRST ENCRYPTED BLOCK attribute (see 7.4.2.2.10) is set to FFFF FFFF FFFF FFFEh); or
  - B) any logical block in the partition specified by the PARTITION NUMBER field in the CDB after the first encrypted logical block contains unencrypted data;

  or
- c) the address of the first logical block in the partition specified by the PARTITION NUMBER field in the CDB that contains unencrypted data and is located after the address specified in the LOGICAL POSITION OF FIRST ENCRYPTED BLOCK attribute.

7.4.2.2.12 MEDIUM USAGE HISTORY

This MAM attribute provides saturating counters (see table 436) for the entire medium. The value in each field is the sum for all partitions. If a field is not used, it should be set to zero.

Table 436 – MEDIUM USAGE HISTORY attribute (part 1 of 2)

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
•••				CURRENT AMOUNT OF DATA WRITTEN				
5								(LSB)
6	(MSB)							
•••				CURRENT WRITE RETRIES COUNT				
11								(LSB)
12	(MSB)							
•••				CURRENT AMOUNT OF DATA READ				
17								(LSB)
18	(MSB)							
•••				CURRENT READ RETRIES COUNT				
23								(LSB)
24	(MSB)							
•••				PREVIOUS AMOUNT OF DATA WRITTEN				
29								(LSB)
30	(MSB)							
•••				PREVIOUS WRITE RETRIES COUNT				
35								(LSB)
36	(MSB)							
•••				PREVIOUS AMOUNT OF DATA READ				
41								(LSB)
42	(MSB)							
•••				PREVIOUS READ RETRIES COUNT				
47								(LSB)
48	(MSB)							
•••				TOTAL AMOUNT OF DATA WRITTEN				
53								(LSB)
54	(MSB)							
•••				TOTAL WRITE RETRIES COUNT				
59								(LSB)
60	(MSB)							
•••				TOTAL AMOUNT OF DATA READ				
65								(LSB)
66	(MSB)							
•••				TOTAL READ RETRIES COUNT				
71								(LSB)

Table 436 – MEDIUM USAGE HISTORY attribute (part 2 of 2)

Bit Byte	7	6	5	4	3	2	1	0
72	(MSB)							
•••				LOAD COUNT				
77								(LSB)
78	(MSB)							
•••				TOTAL CHANGE PARTITION COUNT				
83								(LSB)
84	(MSB)							
•••				TOTAL PARTITION INITIALIZE COUNT				
89								(LSB)

The CURRENT AMOUNT OF DATA WRITTEN field indicates the amount of data written to the medium during this load of the medium. This value is expressed in mebibytes (see 3.5.2).

The CURRENT WRITE RETRIES COUNT field indicates the total number of times a write retry occurred during this load of the medium. [5]

The CURRENT AMOUNT OF DATA READ field indicates the amount of data read from the medium during this load of the medium. This value is expressed in mebibytes (see 3.5.2).

The CURRENT READ RETRIES COUNT field indicates the number of times a read retry occurred during this load of the medium.[5]

The PREVIOUS AMOUNT OF DATA WRITTEN field indicates the amount of data written to the medium during the previous load of the medium. This value is expressed in mebibytes (see 3.5.2).

The PREVIOUS WRITE RETRIES COUNT field indicates the total number of times a write retry occurred during the previous load of the medium.[5]

The PREVIOUS AMOUNT OF DATA READ field indicates the amount of data read from the medium during the previous load of the medium. This value is expressed in mebibytes (see 3.5.2).

The PREVIOUS READ RETRIES COUNT field indicates the number of times a read retry occurred during the previous load of the medium.[5]

The TOTAL AMOUNT OF DATA WRITTEN field indicates the amount of data written to the medium since the last time the medium was formatted. This value is expressed in mebibytes (see 3.5.2).

The TOTAL WRITE RETRIES COUNT field indicates the total number of times a write retry occurred since the last time the medium was formatted.[5]

The TOTAL AMOUNT OF DATA READ field indicates the amount of data read from the medium since the last time the medium was formatted. This value is expressed in mebibytes (see 3.5.2).

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5) The definition of a retry as counted by this MAM attribute field is outside the scope of this standard. This count should not be used to compare products because the products may define errors differently.

The TOTAL READ RETRIES COUNT field indicates the number of times a read retry occurred since the last time the medium was formatted.[5]

The LOAD COUNT field indicates the number of loads since the last time the medium was formatted. This count accumulates over the life of the medium but it is reset to zero after a medium format.

The TOTAL CHANGE PARTITION COUNT field indicates the number of times that switches between partitions have been performed on the medium. This count accumulates over the life of the medium but it is reset to zero after a medium format.

The TOTAL PARTITION INITIALIZE COUNT field indicates number of times that any of the partitions on the medium have been erased. This count accumulates over the life of the medium but it is reset to zero after a medium format.

7.4.2.2.13 PARTITION USAGE HISTORY

This MAM attribute provides saturating counters (see table 437) for the partition specified by the PARTITION NUMBER field in the CDB. If a field is not used, it should be set to zero.

Table 437 – PARTITION USAGE HISTORY attribute (part 1 of 2)

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
•••				CURRENT AMOUNT OF DATA WRITTEN				
3								(LSB)
4	(MSB)							
•••				CURRENT WRITE RETRIES COUNT				
7								(LSB)
8	(MSB)							
•••				CURRENT AMOUNT OF DATA READ				
11								(LSB)
12	(MSB)							
•••				CURRENT READ RETRIES COUNT				
15								(LSB)
16	(MSB)							
•••				PREVIOUS AMOUNT OF DATA WRITTEN				
19								(LSB)
20	(MSB)							
•••				PREVIOUS WRITE RETRIES COUNT				
23								(LSB)
24	(MSB)							
•••				PREVIOUS AMOUNT OF DATA READ				
27								(LSB)
28	(MSB)							
•••				PREVIOUS READ RETRIES COUNT				
31								(LSB)

Table 437 – PARTITION USAGE HISTORY attribute (part 2 of 2)

Bit Byte	7	6	5	4	3	2	1	0
32	(MSB)							
•••			TOTAL AMOUNT OF DATA WRITTEN					
35								(LSB)
36	(MSB)							
•••			TOTAL WRITE RETRIES COUNT					
39								(LSB)
40	(MSB)							
•••			TOTAL AMOUNT OF DATA READ					
43								(LSB)
44	(MSB)							
•••			TOTAL READ RETRIES COUNT					
47								(LSB)
48	(MSB)							
•••			LOAD COUNT					
51								(LSB)
52	(MSB)							
•••			CHANGE PARTITION COUNT					
55								(LSB)
56	(MSB)							
•••			PARTITION INITIALIZE COUNT					
59								(LSB)

The CURRENT AMOUNT OF DATA WRITTEN field indicates the amount of data written to the medium in the partition specified by the PARTITION NUMBER field in the CDB during this load of the medium. This value is expressed in mebibytes (see 3.5.2).

The CURRENT WRITE RETRIES COUNT field indicates the total number of times a write retry occurred in the partition specified by the PARTITION NUMBER field in the CDB during this load of the medium.[5]

The CURRENT AMOUNT OF DATA READ field indicates the amount of data read from the medium in the partition specified by the PARTITION NUMBER field in the CDB during this load of the medium. This value is expressed mebibytes (see 3.5.2).

The CURRENT READ RETRIES COUNT field indicates the number of times a read retry occurred in the partition specified by the PARTITION NUMBER field in the CDB during this load of the medium.[5]

The PREVIOUS AMOUNT OF DATA WRITTEN field indicates the amount of data written to the medium in the partition specified by the PARTITION NUMBER field in the CDB during the previous load of the medium. This value is expressed in mebibytes (see 3.5.2).

The PREVIOUS WRITE RETRIES COUNT field indicates the total number of times a write retry occurred in the partition specified by the PARTITION NUMBER field in the CDB during the previous load of the medium.[5]

The PREVIOUS AMOUNT OF DATA READ field indicates the amount of data read from the medium in the partition specified by the PARTITION NUMBER field in the CDB during the previous load of the medium. This value is expressed in mebibytes (see 3.5.2).

The PREVIOUS READ RETRIES COUNT field indicates the number of times a read retry occurred in the partition specified by the PARTITION NUMBER field in the CDB during the previous load of the medium.[5]

The TOTAL AMOUNT OF DATA WRITTEN field indicates the amount of data written to the medium in the partition specified by the PARTITION NUMBER field in the CDB since the last time the medium was formatted. This value is expressed in mebibytes (see 3.5.2).

The TOTAL WRITE RETRIES COUNT field indicates the total number of times a write retry occurred in the partition specified by the PARTITION NUMBER field in the CDB since the last time the medium was formatted.[5]

The TOTAL AMOUNT OF DATA READ field indicates the amount of data read from the medium in the partition specified by the PARTITION NUMBER field in the CDB since the last time the medium was formatted. This value is expressed in mebibytes (see 3.5.2).

The TOTAL READ RETRIES COUNT field indicates the number of times a read retry occurred in the partition specified by the PARTITION NUMBER field in the CDB since the last time the medium was formatted.[5]

The LOAD COUNT field indicates the number of loads in the partition specified by the PARTITION NUMBER field in the CDB since the last time the medium was formatted. This count accumulates over the life of the medium but it is reset to zero after a medium format.

The TOTAL CHANGE PARTITION COUNT field indicates the number of times that switches to the partition specified by the PARTITION NUMBER field in the CDB have been performed on the medium. This count accumulates over the life of the medium but it is reset to zero after a medium format.

The TOTAL PARTITION INITIALIZE COUNT field indicates number of times that the partition specified by the PARTITION NUMBER field in the CDB has been initialized. This count accumulates over the life of the medium but it is reset to zero after a medium format.

7.4.2.3 Medium type attributes

7.4.2.3.1 Overview

Medium type attributes (see table 438) are stored in the medium auxiliary memory by the manufacturer. The device server shall not alter medium type attributes. All supported medium type attributes shall have a status of read only or unavailable (see 5.9).

Table 438 – Medium type attributes

Attribute Identifier	Name	Attribute Length (in bytes)	Format [a]	Reference
0400h	MEDIUM MANUFACTURER	8	ASCII	7.4.2.3.2
0401h	MEDIUM SERIAL NUMBER	32	ASCII	7.4.2.3.3
0402h to 0405h	Restricted (see SSC-5)			
0406h	MEDIUM MANUFACTURE DATE	8	ASCII	7.4.2.3.4
0407h	MAM CAPACITY	8	BINARY	7.4.2.3.5
0408h	MEDIUM TYPE	1	BINARY	7.4.2.3.6
0409h	MEDIUM TYPE INFORMATION	2	BINARY	7.4.2.3.6
040Ah	NUMERIC MEDIUM SERIAL NUMBER	unspecified	unspecified	7.4.2.3.7
040Bh to 04FFh	Reserved			
0500h to 05FFh	Restricted (see SSC-5)			
0600h to 07FFh	Reserved			
[a] See table 432 in 7.4.1.				

7.4.2.3.2 MEDIUM MANUFACTURER

This MAM attribute contains eight bytes of left-aligned ASCII data (see 4.3.1) identifying the manufacturer of the media. The medium manufacturer shall be a T10 vendor identification assigned by INCITS. A list of assigned T10 vendor identifications is in Annex F and on the T10 web site (http://www.t10.org).

> NOTE 24 - The T10 web site (http://www.t10.org) provides a convenient means to request an identification code.

7.4.2.3.3 MEDIUM SERIAL NUMBER

This MAM attribute contains the manufacturer's serial number for the medium.

7.4.2.3.4 MEDIUM MANUFACTURE DATE

This MAM attribute contains the date of manufacture of the medium. The format is YYYYMMDD (i.e., four numeric ASCII characters for the year followed by two numeric ASCII characters for the month followed by two numeric ASCII characters for the day with no intervening spaces).

7.4.2.3.5 MAM CAPACITY

This MAM attribute is the total capacity of the medium auxiliary memory, in bytes.

7.4.2.3.6 MEDIUM TYPE and MEDIUM TYPE INFORMATION

These MAM attributes contain information about non-data media and other types of media. The MEDIUM TYPE INFORMATION attribute is interpreted according to the type of medium indicated by the MEDIUM TYPE (see table 439).

Table 439 – MEDIUM TYPE and MEDIUM TYPE INFORMATION attributes

MEDIUM TYPE	Description	MEDIUM TYPE INFORMATION
00h	Data medium	Reserved
01h	Cleaning medium	Maximum number of cleaning cycles permitted
02h to 7Fh	Reserved	Reserved
80h	Write-once medium	Reserved
81h to FFh	Reserved	Reserved

7.4.2.3.7 NUMERIC MEDIUM SERIAL NUMBER

This MAM attribute contains the manufacturer's serial number for the medium in a vendor specific format.

7.4.2.4 Host type attributes

7.4.2.4.1 Overview

Application clients may use the WRITE ATTRIBUTE command (see 6.48) and READ ATTRIBUTE command (see 6.17) to maintain the MAM attributes shown in table 440. All supported host type attributes shall have a status of nonexistent or read/write (see 5.9).

Table 440 – Host type attributes

Attribute Identifier	Name	Attribute Length (in bytes)	Format [a]	Reference
0800h	APPLICATION VENDOR	8	ASCII	7.4.2.4.2
0801h	APPLICATION NAME	32	ASCII	7.4.2.4.3
0802h	APPLICATION VERSION	8	ASCII	7.4.2.4.4
0803h	USER MEDIUM TEXT LABEL	160	TEXT	7.4.2.4.5
0804h	DATE AND TIME LAST WRITTEN	12	ASCII	7.4.2.4.6
0805h	TEXT LOCALIZATION IDENTIFIER	1	BINARY	7.4.2.4.7
0806h	BARCODE	32	ASCII	7.4.2.4.8
0807h	OWNING HOST TEXTUAL NAME	80	TEXT	7.4.2.4.9
0808h	MEDIA POOL	160	TEXT	7.4.2.4.10
0809h	PARTITION USER TEXT LABEL	16	ASCII	7.4.2.4.11
080Ah	LOAD/UNLOAD AT PARTITION	1	BINARY	7.4.2.4.12
080Bh	APPLICATION FORMAT VERSION	16	ASCII	7.4.2.4.13
080Ch to 081Fh	Restricted (see SSC-5)			
0820h	MEDIUM GLOBALLY UNIQUE IDENTIFIER	36	BINARY	7.4.2.4.14
0821h	MEDIA POOL GLOBALLY UNIQUE IDENTIFIER	36	BINARY	7.4.2.4.15
0822h to BFFh	Reserved			
[a] See table 432 in 7.4.1.				

7.4.2.4.2 APPLICATION VENDOR

This MAM attribute identifies the manufacturer of the application client (e.g., class driver or backup program) associated with use of the MAM. The MAM attribute value should be a T10 vendor identification assigned by INCITS. A list of assigned T10 vendor identifications is in Annex F and on the T10 web site (http://www.t10.org). This MAM attribute may provide inaccurate information if the application client does not update it.

> NOTE 25 - The T10 web site (http://www.t10.org) provides a convenient means to request an identification code.

7.4.2.4.3 APPLICATION NAME

This MAM attribute contains the name of the application client.

7.4.2.4.4 APPLICATION VERSION

This MAM attribute contains the version of the application client.

7.4.2.4.5 USER MEDIUM TEXT LABEL

This MAM attribute contains a user assigned label for the volume.

7.4.2.4.6 DATE & TIME LAST WRITTEN

This MAM attribute contains the time at which the application client last wrote to the medium auxiliary memory. The format is YYYYMMDDHHMM (i.e., four numeric ASCII characters for the year followed by two numeric ASCII characters for the month followed by two numeric ASCII characters for the day followed by two numeric ASCII characters between 00 and 24 for the hour followed by two numeric ASCII characters for the minute with no intervening spaces).

7.4.2.4.7 TEXT LOCALIZATION IDENTIFIER

This MAM attribute defines the character set (see table 441) used for MAM attributes with a TEXT format (see 7.4.1).

Table 441 – TEXT LOCALIZATION IDENTIFIER attribute values

Value	Meaning
00h	No code specified (ASCII)
01h	ISO/IEC 8859-1 (Europe, Latin America)
02h	ISO/IEC 8859-2 (Eastern Europe)
03h	ISO/IEC 8859-3 (SE Europe/miscellaneous)
04h	ISO/IEC 8859-4 (Scandinavia/Baltic)
05h	ISO/IEC 8859-5 (Cyrillic)
06h	ISO/IEC 8859-6 (Arabic)
07h	ISO/IEC 8859-7 (Greek)
08h	ISO/IEC 8859-8 (Hebrew)
09h	ISO/IEC 8859-9 (Latin 5)
0Ah	ISO/IEC 8859-10 (Latin 6)
0Bh to 7Fh	Reserved
80h	ISO/IEC 10646-1 (UCS-2BE)
81h	ISO/IEC 10646-1 (UTF-8)
82h to FFh	Reserved

7.4.2.4.8 BARCODE

This MAM attribute contains the barcode associated with the medium described by the MAM.

7.4.2.4.9 OWNING HOST TEXTUAL NAME

This MAM attribute indicates the host from which that USER MEDIUM TEXT LABEL (see 7.4.2.4.5) originates.

7.4.2.4.10 MEDIA POOL

This MAM attribute indicates the media pool to which this medium belongs.

7.4.2.4.11 PARTITION USER TEXT LABEL

This MAM attribute is a user assigned identifier for the partition specified by the PARTITION NUMBER field in the CDB.

7.4.2.4.12 LOAD/UNLOAD AT PARTITION

This MAM attribute indicates whether the media is capable of being loaded or unloaded at the partition specified by the PARTITION NUMBER field in the CDB. If loads and unloads are enabled for the specified partition, the value of this MAM attribute shall be one. If loads and unloads are not enabled for the specified partition, the value of this MAM attribute shall be zero. All attribute values other than zero and one are reserved. If LOAD/UNLOAD AT PARTITION is disabled, then loads and unloads are performed at the beginning of the media instead of at the specified partition. If this MAM attribute is in the nonexistent state (see 5.9), then the default action shall be to load and unload at the beginning of media.

7.4.2.4.13 APPLICATION FORMAT VERSION

This MAM attribute indicates the version of the format being used by the application that set this MAM attribute.

7.4.2.4.14 MEDIUM GLOBALLY UNIQUE IDENTIFIER

This MAM attribute contains a globally unique identifier for the medium that is assigned by the application identified in the APPLICATION NAME (see 7.4.2.4.3) attribute.

7.4.2.4.15 MEDIA POOL GLOBALLY UNIQUE IDENTIFIER

This MAM attribute contains a globally unique identifier for the media pool that is assigned by the application identified in the APPLICATION NAME (see 7.4.2.4.3) attribute.

7.5 Mode parameters

7.5.1 Mode parameters overview

Mode parameters consist of the mode parameter header, block descriptors, and mode pages. The mode parameters are transferred as the mode parameter list by the MODE SENSE and MODE SELECT commands.

7.5.2 Summary of mode page codes

The page code assignments for mode pages are summarized in table 442.

Table 442 – Summary of mode page codes (part 1 of 2)

Mode page name	Page code	Subpage code	Reference
Command Duration Limit A	0Ah	03h	7.5.9
Command Duration Limit B	0Ah	04h	7.5.10
Command Duration Limit T2A	0Ah	07h	7.5.11
Command Duration Limit T2B	0Ah	08h	7.5.12
Control	0Ah	n/a [a]	7.5.13
Control Extension	0Ah	01h	7.5.14
Disconnect-Reconnect	02h	n/a [a]	7.5.15
Extended	15h	01h to FEh	7.5.16
Extended Device Type Specific	16h	01h to FEh	7.5.17
Power Condition	1Ah	n/a [a]	7.5.18
Power Consumption	1Ah	01h	7.5.19
Protocol Specific Logical Unit	18h	n/a [a]	7.5.20
Protocol Specific Port	19h	n/a [a]	7.5.21
Restricted (see applicable SCSI transport protocol standard)	18h	01h to FEh	
	19h	01h to FEh	
A numeric ordered listing of mode page and subpage codes is provided in clause E.6.			

[a] Applicable only in the MODE SENSE command (see table 170 in 6.13).
[b] The use of these page codes and subpage codes is described in table 170 (see 6.13).
[c] The following page codes are obsolete: 09h.
[d] The following page codes are vendor specific: 00h. Page code 00h does not require a page format or a subpage code. Other vendor specific mode page codes may be defined in an applicable protocol standard or an applicable command standard.

Table 442 – Summary of mode page codes (part 2 of 2)

Mode page name	Page code	Subpage code	Reference
Restricted (see applicable command standard)	01h	00h to FEh	
	03h to 08h	00h to FEh	
	0Ah	F0h to FEh	
	0Bh to 14h	00h to FEh	
	1Ah	F0h to FEh	
	1Bh to 1Fh	00h to FEh	
	20h to 3Eh	00h to FEh	
Return all mode pages not including subpages [a]	3Fh [b]	00h [b]	6.13
Return all mode pages and subpages [a]	3Fh [b]	FFh [b]	6.13
Return all subpages for the specified mode page code [a]	00h to 3Eh [b]	FFh [b]	6.13
Obsolete [c]			
Vendor specific [d]			
Reserved	All other codes		
A numeric ordered listing of mode page and subpage codes is provided in clause E.6.			

[a] Applicable only in the MODE SENSE command (see table 170 in 6.13).
[b] The use of these page codes and subpage codes is described in table 170 (see 6.13).
[c] The following page codes are obsolete: 09h.
[d] The following page codes are vendor specific: 00h. Page code 00h does not require a page format or a subpage code. Other vendor specific mode page codes may be defined in an applicable protocol standard or an applicable command standard.

7.5.3 Mode page policies

Logical units shall share mode parameter header and block descriptor values across all I_T nexuses. I_T nexus loss shall not affect mode parameter header, block descriptor, and mode page values.

Each logical unit shall maintain current values and saved values of each mode page based on any of the policies listed in table 443. The mode page policy used for each mode page may be reported in the Mode Page Policy VPD page (see 7.7.9).

Table 443 – Mode page policies

Mode page policy	Number of mode page copies
Shared	One copy of the mode page that is shared by all I_T nexuses
Per target port	A separate copy of the mode page for each target port with each copy shared by all SCSI initiator ports
Per I_T nexus	A separate copy of the mode page for each I_T nexus

After a logical unit reset, each mode parameter header, block descriptor, and mode page shall revert to saved values if supported or default values if saved values are not supported.

7.5.4 Mode parameters overview

This subclause describes the mode parameter header, block descriptors, and mode pages used with MODE SELECT command (see 6.12) and MODE SENSE command (see 6.13) that are applicable to all SCSI devices. Subpages are identical to mode pages except that they include a SUBPAGE CODE field that further differentiates the mode page contents. Mode pages specific to each device type are described in the command standard that applies to that device type.

7.5.5 Mode parameter list format

The mode parameter list shown in table 444 contains a header, followed by zero or more block descriptors, followed by zero or more variable length mode pages. Parameter lists are defined for each device type.

Table 444 – Mode parameter list

Bit Byte	7	6	5	4	3	2	1	0
	Mode parameter header							
	Block descriptor(s)							
	Mode page(s) or vendor specific (e.g., page code set to zero)							

7.5.6 Mode parameter header format

The mode parameter header that is used by the MODE SELECT(10) command (see 6.12) and the MODE SENSE(10) command (see 6.13) is defined in table 445.

Table 445 – Mode parameter header(10)

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			MODE DATA LENGTH				
1								(LSB)
2	MEDIUM TYPE							
3	DEVICE-SPECIFIC PARAMETER							
4	Reserved							LONGLBA
5	Reserved							
6	(MSB)			BLOCK DESCRIPTOR LENGTH				
7								(LSB)

When using the MODE SENSE(10) command, the MODE DATA LENGTH field indicates the number of bytes that follow in the mode parameter list. When using the MODE SELECT(10) command, the MODE DATA LENGTH field is reserved.

The contents of the MEDIUM TYPE field are unique for each device type. Refer to the mode parameters subclause of the specific device type command standard for definition of these values. Some device types reserve this field.

The DEVICE-SPECIFIC PARAMETER field is unique for each device type. Refer to the mode parameters subclause of the specific device type command standard for definition of this field.

If the Long LBA (LONGLBA) bit is set to zero, the mode parameter block descriptor(s), if any, are each eight bytes long and have the format described in 7.5.7.1. If the LONGLBA bit is set to one, the mode parameter block descriptor(s), if any, are each 16 bytes long and have a format described in a command standard.

The BLOCK DESCRIPTOR LENGTH field indicates the length in bytes of all the block descriptors. It is equal to the number of block descriptors times eight if the LONGLBA bit is set to zero or times sixteen if the LONGLBA bit is set to one, and does not include the length of mode pages or vendor specific mode parameters (e.g., page code set to zero), if any, that may follow the last block descriptor. A block descriptor length of zero indicates that no block descriptors are included in the mode parameter list. This condition shall not be considered an error.

7.5.7 Mode parameter block descriptor formats

7.5.7.1 General block descriptor format

If the LONGLBA bit is set to zero (see 7.5.6), the mode parameter block descriptor format for all device types except direct access block devices (see SBC-5) is shown in table 446.

Table 446 – General mode parameter block descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DENSITY CODE							
1	(MSB)							
•••				NUMBER OF BLOCKS				
3								(LSB)
4	Reserved							
5	(MSB)							
•••				BLOCK LENGTH				
7								(LSB)

Block descriptors specify some of the medium characteristics for all or part of a logical unit. Each block descriptor, if any, contains a DENSITY CODE field, a NUMBER OF BLOCKS field, and a BLOCK LENGTH field. Block descriptor values are always current (i.e., saving is not supported). Whenever any block descriptor values are changed, the device server shall establish a unit attention condition (see SAM-6) for the SCSI initiator port associated with every I_T nexus except the I_T nexus on which the MODE SELECT command (see 6.12) was received, with the additional sense code set to MODE PARAMETERS CHANGED. Command standards may place additional requirements on the general mode parameter block descriptor. Requirements in the command standards that conflict with requirements defined in this subclause shall take precedence over the requirements defined in this subclause.

The DENSITY CODE field is unique for each device type. Refer to the mode parameters subclause of the specific device type command standard for definition of this field.

The NUMBER OF BLOCKS field specifies the number of logical blocks on the medium to which the DENSITY CODE field and BLOCK LENGTH field apply. A value of zero indicates that all of the remaining logical blocks of the logical unit shall have the medium characteristics specified.

If the number of logical blocks on the medium exceeds the maximum value that may be specified in the NUMBER OF BLOCKS field, then a value of FF FFFFh indicates that all of the remaining logical blocks of the logical unit shall have the medium characteristics specified.

There may be implicit association between mode parameters defined in the mode pages and block descriptors. In this case, the device server may change mode parameters not explicitly sent with the MODE SELECT command. A subsequent MODE SENSE command may be used to detect these changes.

> NOTE 26 - The number of remaining logical blocks may be unknown for some device types.

The BLOCK LENGTH field specifies the length in bytes of each logical block described by the block descriptor. For sequential access devices, a block length of zero indicates that the logical block size written to the medium is specified by the TRANSFER LENGTH field in the CDB (see SSC-5).

7.5.8 Mode page and subpage formats and page codes

The page_0 mode page format is defined in table 447.

Table 447 – Page_0 mode page

Bit Byte	7	6	5	4	3	2	1	0
0	PS	SPF (0b)	PAGE CODE					
1	PAGE LENGTH (n-1)							
2 ••• n	Mode parameters							

The sub_page mode page format is defined in table 448.

Table 448 – Sub_page mode page

Bit Byte	7	6	5	4	3	2	1	0
0	PS	SPF (1b)	PAGE CODE					
1	SUBPAGE CODE							
2	(MSB)	PAGE LENGTH (n-3)						
3								(LSB)
4 ••• n	Mode parameters							

Each mode page contains a PS bit, an SPF bit, a PAGE CODE field, a PAGE LENGTH field, and a set of mode parameters. The page codes are defined in this subclause and in the mode parameter subclauses in the

command standard for the specific device type. Each mode page with a SPF bit set to one contains a SUBPAGE CODE field.

A SubPage Format (SPF) bit set to zero indicates that the page_0 mode page format is being used. A SPF bit set to one indicates that the sub_page mode page format is being used.

When using the MODE SENSE command, a parameters saveable (PS) bit set to one indicates that the mode page may be saved by the logical unit in a nonvolatile, vendor specific location. A PS bit set to zero indicates that the device server is not able to save the supported mode parameters. When using the MODE SELECT command, the PS bit is reserved.

The PAGE CODE field and SUBPAGE CODE field (see 7.5.1) identify the format and parameters defined for that mode page. Page codes and subpage codes are defined as applying to all device types or as applying to a specific device type. The page codes and subpage codes that apply to a specific device type are defined in the command standard for that device type. Each subpage code is meaningful only in the context of its associated page code.

The device server shall use the page_0 mode page format only for mode pages associated with subpage code 00h (i.e., mode pages for which table 168 (see 6.13.1) requires the use of page_0 mode page format).

When using the MODE SENSE command, if page code 00h (i.e., vendor specific mode page) is implemented, the device server shall return that mode page last in response to a request to return all mode pages (e.g., a MODE SENSE command (see 6.13) with the PAGE CODE field set to 3Fh). When using the MODE SELECT command, this mode page should be sent last.

The PAGE LENGTH field specifies the length in bytes of the mode parameters that follow. If the parameter list in a MODE SELECT command (see 6.12) does not set the PAGE LENGTH field to the value that is returned for the mode page by a MODE SENSE command, then the device server shall terminate the MODE SELECT command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST. The logical unit may implement a mode page that is less than the full mode page length defined, provided no field is truncated and the PAGE LENGTH field correctly specifies the actual length implemented.

The mode parameters for each mode page are defined in the following subclauses or in the mode parameters subclause in the command standard for the specific device type. Mode parameters not implemented by the logical unit shall be set to zero.

7.5.9 Command Duration Limit A mode page

The Command Duration Limit A mode page (see table 449) provides controls for command duration limit (see SAM-6) that are applicable to all device types, for commands for which the REPORT SUPPORTED OPERATION CODES command parameter data RWCDLP bit and CDLP field (see 6.32) indicate the Command Duration Limit A mode page. The mode page policy (see 7.5.3) for this mode page should be per I_T nexus. The mode page policy may be shared. If a field in this mode page is changed while there is a command already in the task set, then the new value of the field shall not apply to that command.

If the QUEUE ALGORITHM MODIFIER field (see 7.5.13) is set to 0h (i.e., restricted reordering), then the device server shall process commands as described in 7.5.13 independent of the contents of the Command Duration Limit A mode page.

Table 449 – Command Duration Limit A mode page

Bit Byte	7	6	5	4	3	2	1	0
0	PS	SPF (1b)	PAGE CODE (0Ah)					
1	SUBPAGE CODE (03h)							
2	(MSB)							
3	PAGE LENGTH (0020h)							(LSB)
4 ••• 7	Reserved							
	Command duration limit descriptor list							
8 ••• 11	Command duration limit descriptor [first]							
12 ••• 15	Command duration limit descriptor [second]							
	⋮							
32 ••• 35	Command duration limit descriptor [last]							

The PS bit, SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field are described in 7.5.8.

The SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field shall be set as shown in table 449 for the Command Duration Limit A mode page.

Each command duration limit descriptor (see table 450) describes the command duration limit corresponding to the duration limit descriptor index in the CDB if the Command Duration Limit A mode page is indicated (see 5.2).

EXAMPLE – A duration limit descriptor value of 001b selects the command duration limit contained in the first command duration limit descriptor, a duration limit descriptor value of 010b selects the command duration limit contained in the second command duration limit descriptor, and a duration limit descriptor value of 111b selects the command duration limit contained in the seventh command limit duration descriptor.

Table 450 – Command duration limit descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	CDLUNIT			Reserved				
1	Reserved							
2	(MSB)			COMMAND DURATION LIMIT				
3								(LSB)

The CDLUNIT field (see table 451) specifies the time units for this command duration limit descriptor.

Table 451 – CDLUNIT field

Code	Description
000b	No duration limit is specified
100b	1 microsecond
101b	10 milliseconds
110b	500 milliseconds
all others	Reserved

A COMMAND DURATION LIMIT field set to a non-zero value specifies the command duration limit in units specified by the CDLUNIT field. A COMMAND DURATION LIMIT field set to zero specifies that no command duration limit is specified by the command duration limit descriptor. If the CDLUNIT field is set to 000b, the COMMAND DURATION LIMIT field shall be ignored.

7.5.10 Command Duration Limit B mode page

The Command Duration Limit B mode page (see table 452) provides controls for command duration limit (see SAM-6) that are applicable to all device types, for commands for which the REPORT SUPPORTED OPERATION CODES command parameter data RWCDLP bit and CDLP field (see 6.32) indicate the Command Duration Limit B mode page. The mode page policy (see 7.5.3) for this mode page should be per I_T nexus. The mode page policy may be shared. If a field in this mode page is changed while there is a command already in the task set, then the new value of the field shall not apply to that command.

If the QUEUE ALGORITHM MODIFIER field (see 7.5.13) is set to 0h (i.e., restricted reordering), then the device server shall process commands as described in 7.5.13 independent of the contents of the Command Duration Limit B mode page.

Table 452 – Command Duration Limit B mode page

Bit Byte	7	6	5	4	3	2	1	0
0	PS	SPF (1b)	PAGE CODE (0Ah)					
1	SUBPAGE CODE (04h)							
2	(MSB)	PAGE LENGTH (0020h)						
3								(LSB)
4 ••• 7	Reserved							
	Command duration limit descriptor list							
8 ••• 11	Command duration limit descriptor [first]							
12 ••• 15	Command duration limit descriptor [second]							
	⋮							
32 ••• 35	Command duration limit descriptor [last]							

The PS bit, SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field are described in 7.5.8.

The SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field shall be set as shown in table 452 for the Command Duration Limit B mode page.

Each command duration limit descriptor (see table 450) describes the command duration limit corresponding to the duration limit descriptor index in the CDB if the Command Duration Limit B mode page is indicated (see 5.2).

7.5.11 Command Duration Limit T2A mode page

7.5.11.1 Overview

The Command Duration Limit T2A mode page (see table 453) provides controls for command duration limit (see SAM-6) that are applicable to all device types, for commands for which the REPORT SUPPORTED OPERATION CODES command parameter data RWCDLP bit and CDLP field (see 6.32) indicate the Command Duration Limit T2A mode page. The mode page policy (see 7.5.3) for this mode page should be per I_T nexus. The mode page policy may be shared. If a field in this mode page is changed while there is a command already in the task set, then the new value of the field shall not apply to that command.

If the QUEUE ALGORITHM MODIFIER field (see 7.5.13) is set to 0h (i.e., restricted reordering), then the device server shall process commands as described in 7.5.13 independent of the contents of the Command Duration Limit T2A mode page.

Table 453 – Command Duration Limit T2A mode page

Bit Byte	7	6	5	4	3	2	1	0
0	PS	SPF (1b)	PAGE CODE (0Ah)					
1	SUBPAGE CODE (07h)							
2	(MSB)		PAGE LENGTH (00E4h)					
3								(LSB)
4 ••• 6	Reserved							
7	PERF VERSUS COMMAND DURATION GUIDELINES				Reserved			
	T2 command duration limit descriptor list							
8 ••• 39	T2 command duration limit descriptor [first]							
40 ••• 71	T2 command duration limit descriptor [second]							
	⋮							
200 ••• 231	T2 command duration limit descriptor [seventh]							

The PS bit, SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field are described in 7.5.8.

The SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field shall be set as shown in table 453 for the Command Duration Limit T2A mode page.

The PERF VERSUS COMMAND DURATION GUIDELINES field (see table 454) specifies the maximum percentage increase in average command completion times that are caused by actions that the device server performs based on the contents of the COMMAND DURATION GUIDELINE field in every T2 command duration limit descriptor (see 7.5.11.2) in the Command Duration Limit T2A mode page (see 7.5.11) and every T2 command

duration limit descriptor in the Command Duration Limit T2B mode page (see 7.5.12).

Table 454 – PERF VERSUS COMMAND DURATION GUIDELINES field

Code	Maximum percentage increase in average command completion times
0h	0%
1h	0.5%
2h	1.0%
3h	1.5%
4h	2.0%
5h	2.5%
6h	3%
7h	4%
8h	5%
9h	8%
Ah	10%
Bh	15%
Ch	20%
0Dh to 0Fh	Reserved

Each T2 command duration limit descriptor (see 7.5.11.2) describes the command duration limit information that corresponds to the duration limit descriptor index in the CDB if the Command Duration Limit T2A mode page is indicated (see 5.2).

7.5.11.2 T2 command duration limit descriptor

The T2 command duration limit descriptor (see table 455) describes the command duration limit information that corresponds to one duration limit descriptor index.

Table 455 – T2 command duration limit descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved				T2CDLUNITS			
1	Reserved							
2	(MSB)			MAX INACTIVE TIME				
3								(LSB)
4	(MSB)			MAX ACTIVE TIME				
5								(LSB)
6	MAX INACTIVE TIME POLICY				MAX ACTIVE TIME POLICY			
7	Reserved							
8	Reserved							
9								
10	(MSB)			COMMAND DURATION GUIDELINE				
11								(LSB)
12	Reserved							
13								
14	Reserved				COMMAND DURATION GUIDELINE POLICY			
15	Reserved							BYP_SEQ
16 ••• 31	Reserved							

The T2CDLUNITS field (see table 456) specifies the time units for the MAX INACTIVE TIME field, the MAX ACTIVE TIME field, and the COMMAND DURATION GUIDELINE field. The default value for the T2CDLUNITS field is the smallest value that the device server allows for time units. Parameter rounding (see 5.10) is not permitted for this value.

Table 456 – T2CDLUNITS field

Code	Description
0h	No value specified
6h	500 nanoseconds
8h	1 microsecond
Ah	10 milliseconds
Eh	500 milliseconds
all others	Reserved

The MAX INACTIVE TIME field specifies an upper limit on the time that elapses from the time at which the SCSI Command Received transport protocol service indication is invoked (see SAM-6) until the time at which the device server initiates actions to access, transfer, or act upon the specified data. A MAX INACTIVE TIME field set to a non-zero value specifies the time upper limit in units indicated by the T2CDLUNITS field. A MAX INACTIVE TIME field set to zero specifies that no time upper limit is specified by this T2 command duration limit descriptor. If the T2CDLUNITS field is set to 0h, the MAX INACTIVE TIME field shall be ignored. This value may be rounded as described in 5.10.

The MAX ACTIVE TIME field specifies an upper limit on the time that elapses from the time at which the device server initiates actions to access, transfer, or act upon the specified data until the time the device server returns status for the command. A MAX ACTIVE TIME field set to a non-zero value specifies the time upper limit in units specified by the T2CDLUNITS field. A MAX ACTIVE TIME field set to zero specifies that no time upper limit is specified by this T2 command duration limit descriptor. If the T2CDLUNITS field is set to 0h, the MAX ACTIVE TIME field shall be ignored. This value may be rounded as described in 5.10.

The MAX INACTIVE TIME POLICY field (see table 457) specifies the policy action taken if the max inactive time limit is not met (i.e., the time used to cause a command to become an enabled command exceeds the time specified by the MAX INACTIVE TIME field and the T2CDLUNITS field).

Table 457 – MAX INACTIVE TIME POLICY field

Code	Description
0h	The device server shall complete the command at the earliest possible time (i.e., do nothing based on the max inactive time limit not being met).
1h to Ch	Reserved
Dh	The device server shall complete the command with GOOD status, with the sense key set to COMPLETED and the sense code set to DATA CURRENTLY UNAVAILABLE.
Eh	Reserved
Fh	The device server shall terminate the command with CHECK CONDITION status, with the sense key set to ABORTED COMMAND and the additional sense code set to COMMAND TIMEOUT BEFORE PROCESSING.

The MAX ACTIVE TIME POLICY field (see table 458) specifies the policy action taken if the max active time limit is not met (i.e., the time used to process a command exceeds the time specified by the MAX ACTIVE TIME field and the T2CDLUNITS field).

Table 458 – MAX ACTIVE TIME POLICY field

Code	Description
0h	The device server shall complete the command at the earliest possible time (i.e., do nothing based on the max active time limit not being met).
1h to Ch	Reserved
Dh	The device server shall complete the command with GOOD status, with the sense key set to COMPLETED and the sense code set to DATA CURRENTLY UNAVAILABLE.
Eh	The device server shall terminate the command with CHECK CONDITION status, with the sense key set to ABORTED COMMAND and the additional sense code set to COMMAND TIMEOUT DURING PROCESSING or COMMAND TIMEOUT DURING PROCESSING DUE TO ERROR RECOVERY. If that command is a read command and any data has been transferred to the application client, then the device server may indicate the contiguous range of LBAs that have been transferred to the application client, starting with the LBA specified by that read command and ending with the LBA indicated by the value in the INFORMATION field of the sense data.
Fh	The device server shall terminate the command with CHECK CONDITION status, with the sense key set to ABORTED COMMAND and the additional sense code set to COMMAND TIMEOUT DURING PROCESSING.

The COMMAND DURATION GUIDELINE field specifies the preferred length of time for the completion of a command. The preferred length of time for the command completion is specified as the non-zero time in units indicated by the T2CDLUNITS field to be added to fastest time for completion of a read command for which the device server is able to return the requested data only by accessing the media. If the T2CDLUNITS field is set to 0h, the COMMAND DURATION GUIDELINE field shall be ignored. Parameter rounding (see 5.10) is not permitted for this value.

A COMMAND DURATION GUIDELINE field set to zero indicates that no command completion guidance is provided by this T2 command duration limit descriptor.

The combination of COMMAND DURATION GUIDELINE field and the T2CDLUNITS field (i.e., the command duration guideline) shall affect device server processing of a command that selects a T2 command duration limit descriptor as follows:

   a) the length of time with which the device server completes that command is:
       A) faster for smaller non-zero command duration guideline values; and
       B) slower for larger non-zero command duration guideline values,
       in comparison to the non-zero command duration guideline values specified by other T2 command duration limit descriptors; and
   b) larger magnitudes of the difference between the non-zero command duration guideline values in two different T2 command duration limit descriptors result in larger probabilities of differences between the length of time of command completions for the commands that select those descriptors.

EXAMPLE – A host may specify a set of command duration guidelines that is independent of a device server's performance characteristics by specifying 10 milliseconds as the command duration guideline in one or more T2 command duration limit descriptors as a method of associating them with the most rapid preferred command completion. For all other T2 command duration limit descriptors, the command duration guideline is specified as the preferred number of 10 millisecond intervals for command completion minus the average number of milliseconds in which a seek finishes for a hypothetical, average hard disk drive. If for any other T2 command duration limit descriptor, the computed command

duration limits guideline value is less than 10 milliseconds, then 10 milliseconds is used as the command duration guideline for that T2 command duration limit descriptor. The magnitude relationships computed in this way provide useful guidance to the device server.

The contents of the PERF VERSUS COMMAND DURATION GUIDELINES field (see 7.5.11.1) may affect the timing relationships between the processing commands based on the specified command duration guideline and the contents of the COMMAND DURATION GUIDELINE POLICY field.

The command duration guideline interacts with the processing of the COMMAND DURATION GUIDELINE POLICY field.

The COMMAND DURATION GUIDELINE POLICY field ((see table 459) specified the policy action taken if a non-zero COMMAND DURATION GUIDELINE field specifies a command duration guideline that the device is unable to achieve for a command.

Table 459 – COMMAND DURATION GUIDELINE POLICY field

Value	Description
0h	The device server shall complete that command at the earliest possible time consistent with the specified command duration guideline.
1h [a]	If the specified command duration guideline has not been achieved and the command duration guideline policy field is not in the seventh T2 command duration limit descriptor, then the device server shall continue processing that command using the command duration limits descriptor that has the next higher number.
2h	The device server shall continue processing that command as with no command duration limits descriptor being used.
3h to Ch	Reserved
Dh	The device server shall complete that command with GOOD status, with the sense key set to COMPLETED and the sense code set to DATA CURRENTLY UNAVAILABLE.
Eh	Reserved
Fh	The device server terminate that command with CHECK CONDITION status, with the sense key set to ABORTED COMMAND and the additional sense code set to COMMAND TIMEOUT BEFORE PROCESSING.
[a] If the COMMAND DURATION GUIDELINE POLICY field is set to this value in the seventh T2 command duration limit descriptor, then the device server shall terminate the MODE SELECT command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.	

A bypass sequestration (BYP_SEQ) bit set to zero specifies that the device server processes a command associated with this T2 command duration limit descriptor as a non-sequestered command or a sequestered command as described in 5.16. A BYP_SEQ bit set to one specifies that the device server processes a command associated with this T2 command duration limit descriptor as a non-sequestered command (see 5.16).

7.5.12 Command Duration Limit T2B mode page

The Command Duration Limit T2B mode page (see table 460) provides controls for command duration limit (see SAM-6) that are applicable to all device types, for commands for which the REPORT SUPPORTED OPERATION CODES command parameter data RWCDLP bit and CDLP field (see 6.32) indicate the Command

Duration Limit T2B mode page. The mode page policy (see 7.5.3) for this mode page should be per I_T nexus. The mode page policy may be shared. If a field in this mode page is changed while there is a command already in the task set, then the new value of the field shall not apply to that command.

If the QUEUE ALGORITHM MODIFIER field (see 7.5.13) is set to 0h (i.e., restricted reordering), then the device server shall process commands as described in 7.5.13 independent of the contents of the Command Duration Limit T2B mode page.

If the Command Duration Limit T2B mode page is supported, the Command Duration Limit T2A mode page (see 7.5.11) shall be supported.

Table 460 – Command Duration Limit T2B mode page

Bit Byte	7	6	5	4	3	2	1	0
0	PS	SPF (1b)	PAGE CODE (0Ah)					
1	SUBPAGE CODE (08h)							
2	(MSB)	PAGE LENGTH (00E4h)						
3								(LSB)
4 ••• 7	Reserved							
	T2 command duration limit descriptor list							
8 ••• 39	T2 command duration limit descriptor [first]							
40 ••• 71	T2 command duration limit descriptor [second]							
	⋮							
200 ••• 231	T2 command duration limit descriptor [seventh]							

The PS bit, SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field are described in 7.5.8.

The SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field shall be set as shown in table 460 for the Command Duration Limit T2B mode page.

Each T2 command duration limit descriptor (see 7.5.11.2) describes the command duration limit information that corresponds to the duration limit descriptor index in the CDB if the Command Duration Limit T2B mode page is indicated (see 5.2))

7.5.13 Control mode page

The Control mode page (see table 461) provides controls over SCSI features that are applicable to all device types (e.g., task set management and error logging). If a field in this mode page is changed while there is a command already in the task set, then whether the old or new value of the field applies to that command is outside the scope of this standard. The mode page policy (see 7.5.3) for this mode page shall be shared or per I_T nexus.

Table 461 – Control mode page

Bit Byte	7	6	5	4	3	2	1	0
0	PS	SPF (0b)	PAGE CODE (0Ah)					
1	PAGE LENGTH (0Ah)							
2	TST			TMF_ONLY	DPICZ	D_SENSE	GLTSD	RLEC
3	QUEUE ALGORITHM MODIFIER				NUAR	QERR		Obsolete
4	VS	RAC	UA_INTLCK_CTRL		SWP	Obsolete		
5	ATO	TAS	ATMPE	RWWP	SBLP	AUTOLOAD MODE		
6	Obsolete							
7								
8	(MSB)							
9	BUSY TIMEOUT PERIOD							(LSB)
10	(MSB)							
11	EXTENDED SELF-TEST COMPLETION TIME							(LSB)

The PS bit, SPF bit, PAGE CODE field, and PAGE LENGTH field are described in 7.5.8.

The SPF bit, PAGE CODE field, and PAGE LENGTH field shall be set as shown in table 461 for the Control mode page.

A task set type (TST) field (see table 462) specifies the type of task set in the logical unit.

Table 462 – Task set type (TST) field

Code	Description
000b	The logical unit maintains one task set for all I_T nexuses
001b	The logical unit maintains separate task sets for each I_T nexus
010b to 111b	Reserved

Regardless of the mode page policy (see 7.5.3) for the Control mode page, the shared mode page policy shall be applied to the TST field. If the most recent MODE SELECT changes the setting of this field, then the device server shall establish a unit attention condition (see SAM-6) for the SCSI initiator port associated with every I_T nexus except the I_T nexus on which the MODE SELECT command was received, with the additional sense code set to MODE PARAMETERS CHANGED.

The allow task management functions only (TMF_ONLY) bit set to zero specifies that the device server shall process commands with the ACA task attribute received on the faulted I_T nexus while an ACA condition is established (see SAM-6). A TMF_ONLY bit set to one specifies that the device server shall complete all

commands received on the faulted I_T nexus with an ACA ACTIVE status while an ACA condition is established.

A disable protection information check if protect field is zero (DPICZ) bit set to zero indicates that checking of protection information bytes is enabled. A DPICZ bit set to one indicates that checking of protection information is disabled on commands with:

    a) the RDPROTECT field (see SBC-5) set to zero;
    b) the VRPROTECT field (see SBC-5) set to zero; or
    c) the ORPROTECT field (see SBC-5) set to zero.

A descriptor format sense data (D_SENSE) bit set to zero specifies that the device server shall use fixed format sense data (see 4.4.3) when including sense data in the same I_T nexus transaction as the status. A D_SENSE bit set to one specifies that the device server shall use descriptor format sense data (see 4.4.2) when including sense data in the same I_T nexus transaction as the status, except as defined in 4.4.1. If an application client enables reporting of referrals in sense data (see SBC-5), then the application client should be able to handle up to 252 bytes of sense data.

A global logging target save disable (GLTSD) bit set to zero specifies that the logical unit implicitly saves, at vendor specific intervals, each log parameter in which the TSD bit (see 7.3) is set to zero. A GLTSD bit set to one specifies that the logical unit shall not implicitly save any log parameters.

A report log exception condition (RLEC) bit set to one specifies that the device server shall report log exception conditions as described in 7.3. A RLEC bit set to zero specifies that the device server shall not report log exception conditions.

The QUEUE ALGORITHM MODIFIER field (see table 463) specifies restrictions on the algorithm used for reordering commands having the SIMPLE task attribute (see SAM-6).

Table 463 – QUEUE ALGORITHM MODIFIER field

Code	Description
0h	**Restricted reordering:** The device server shall order the processing sequence of commands having the SIMPLE task attribute such that data integrity is maintained for that I_T nexus (i.e., if the transmission of new SCSI transport protocol requests is halted at any time, the final value of all data observable on the medium shall be the same as if all the commands had been processed with the ORDERED task attribute).
1h	**Unrestricted reordering allowed:** The device server may reorder the processing sequence of commands having the SIMPLE task attribute in any manner. Any data integrity exposures related to command sequence order shall be explicitly handled by the application client through the selection of appropriate commands and task attributes.
2h to 7h	Reserved
8h to Fh	Vendor specific

A no unit attention on release (NUAR) bit set to one specifies that the device server shall not establish a unit attention condition as described in 5.14.11.2.2. A NUAR bit set to zero specifies that the device server shall establish a unit attention condition as described in 5.14.11.2.2.

The queue error management (QERR) field (see table 464) specifies how the device server shall handle other commands as the result of one command being terminated with CHECK CONDITION status (see SAM-6). The task set type (see the TST field definition in this subclause) defines which other commands are affected. If the TST field equals 000b, then all commands from all I_T nexuses are affected. If the TST field equals 001b, then only commands from the same I_T nexus as the command that is terminated with CHECK CONDITION status are affected.

Table 464 – Queue error management (QERR) field

Code	Definition
00b	If an ACA condition is established, the affected commands in the task set shall resume after the ACA condition is cleared (see SAM-6). Otherwise, all commands other than the command terminated with CHECK CONDITION status shall be processed as if no error occurred.
01b	All the affected commands in the task set shall be aborted when the CHECK CONDITION status is returned. If the TAS bit is set to zero, the device server shall establish a unit attention condition (see SAM-6) for the SCSI initiator port associated with every I_T nexus that had commands aborted except for the I_T nexus on which the command was terminated with CHECK CONDITION status, with the additional sense code set to COMMANDS CLEARED BY ANOTHER INITIATOR. If the TAS bit is set to one, all affected commands in the task set for I_T nexuses other than the I_T nexus on which the command was terminated with CHECK CONDITION status shall be completed with TASK ABORTED status and no unit attention shall be established. For the I_T nexus on which the command was terminated with CHECK CONDITION status, no status shall be returned for the commands that are aborted.
10b	Reserved
11b	Affected commands in the task set belonging to the I_T nexus on which a command was terminated with CHECK CONDITION status shall be aborted as part of processing the command termination.

The report a check (RAC) bit provides control of reporting long busy conditions or CHECK CONDITION status. A RAC bit set to one specifies that the device server should return CHECK CONDITION status rather than returning BUSY status if the reason for returning BUSY status may persist for a longer time than that specified by the BUSY TIMEOUT PERIOD field. A RAC bit set to zero specifies that the device server may return BUSY status regardless of the length of time the reason for returning BUSY status may persist.

The unit attention interlocks control (UA_INTLCK_CTRL) field (see table 465) controls the clearing of unit attention conditions reported in the same I_T nexus transaction as a CHECK CONDITION status and whether returning a status of BUSY, TASK SET FULL, or RESERVATION CONFLICT results in the establishment of a unit attention condition (see SAM-6).

Table 465 – Unit attention interlocks control (UA_INTLCK_CTRL) field

Code	Definition
00b	The logical unit shall clear any unit attention condition reported in the same I_T nexus transaction as a CHECK CONDITION status and shall not establish a unit attention condition for a command that is completed with BUSY status, TASK SET FULL status, or RESERVATION CONFLICT status.
01b	Reserved
10b	The logical unit shall not clear any unit attention condition reported in the same I_T nexus transaction as a CHECK CONDITION status and shall not establish a unit attention condition for a command that is completed with BUSY status, TASK SET FULL status, or RESERVATION CONFLICT status.
11b	The logical unit shall not clear any unit attention condition reported in the same I_T nexus transaction as a CHECK CONDITION status and shall establish a unit attention condition for the SCSI initiator port associated with the I_T nexus on which the BUSY status, TASK SET FULL status, or RESERVATION CONFLICT status is being returned. Depending on the status, the additional sense code shall be set to PREVIOUS BUSY STATUS, PREVIOUS TASK SET FULL STATUS, or PREVIOUS RESERVATION CONFLICT STATUS. Until it is cleared by a REQUEST SENSE command, a unit attention condition shall be established only once for a BUSY status, TASK SET FULL status, or RESERVATION CONFLICT status regardless to the number of commands completed with one of those status codes.
The requirements for REQUEST SENSE processing of unit attention interlocks are defined in SAM-6.	

A software write protect (SWP) bit set to one specifies that the logical unit shall inhibit writing to the medium. If the SWP bit is changed from zero to one, any cached or buffered write data shall be written to the medium before enforcing the write protected condition. If the SWP bit is set to one, the device server shall terminate all commands that require writes to the medium with CHECK CONDITION status, with the sense key set to DATA PROTECT, and the additional sense code set to WRITE PROTECTED. If the SWP bit is set to zero, specifies logical unit may allow writing to the medium depending on other write inhibit mechanisms implemented by the logical unit.

If the device type's command standard defines a write protect (WP) bit in the DEVICE-SPECIFIC PARAMETER field in the mode parameter header, then:

    a)   if the SWP bit is set to one, the WP bit shall be set to one for subsequent MODE SENSE commands; and
    b)   if the SWP bit is set to zero, the value of the WP bit is device type specific.

For a list of commands affected by the SWP bit and details of the WP bit see the command standard for the specific device type.

An application tag owner (ATO) bit set to zero specifies that the device server may modify the contents of the LOGICAL BLOCK APPLICATION TAG field and, depending on the protection type, may modify the contents of the LOGICAL BLOCK REFERENCE TAG field (see SBC-5). If the ATO bit is set to one the device server shall not modify the LOGICAL BLOCK APPLICATION TAG field and, depending on the protection type, shall not modify the contents of the LOGICAL BLOCK REFERENCE TAG field.

A task aborted status (TAS) bit set to zero specifies that aborted commands shall be terminated by the device server without any response to the application client. A TAS bit set to one specifies that commands aborted by the actions of an I_T nexus other than the I_T nexus on which the command was received shall be completed with TASK ABORTED status. SAM-6 describes the effects of the TAS bit in detail.

An application tag mode page enabled (ATMPE) bit set to zero specifies that use of the Application Tag mode page (see SBC-5) is disabled and the contents of logical block application tags are outside the scope of the Application Tag mode page. An ATMPE bit set to one specifies that use of the Application Tag mode page is enabled.

If the ATMPE bit is set to one in a MODE SELECT command, the device server shall verify that the application tag descriptors in the Application Tag mode page (see SBC-5) contain valid current values and saved values if saving is implemented and saved values are available. If the Application Tag mode page contains an invalid combination, the device server shall terminate that MODE SELECT command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to APPLICATION TAG MODE PAGE IS INVALID.

If:

    a)   the ATMPE bit is set to one;
    b)   the ATO bit is set to one;
    c)   the value in the DPICZ bit allows protection information checking for the specified command; and
    d)   the APP_CHK bit is set to one in the Extended INQUIRY Data VPD page (see 7.7.7),

then knowledge of the value of the Application Tag shall come from the values in the Application Tag mode page as specified by the DPICZ bit.

A reject write without protection (RWWP) bit set to zero specifies that the device server shall process write commands that are specified to include user data without protection information (e.g., a WRITE(10) command with the WRPROTECT field set to 000b (see SBC-5)). A RWWP bit set to one specifies that the device server in a logical unit that has been formatted with protection information shall terminate with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB any write command that is specified to include user data without protection information.

A supported block lengths and protection information (SBLP) bit set to one specifies that the device server shall return the Supported Block Lengths and Protection Types VPD page (see SBC-5) and shall set the SPT field to 110b in the Extended INQUIRY Data VPD page (see 7.7.7). A SBLP bit set to zero specifies that the device server shall not return the Supported Block Lengths and Protection Types VPD page and shall not set the SPT field to 110b in the Extended INQUIRY Data VPD page. Changing the value of the SBLP bit results in the establishment of a unit attention condition as described in 6.7.1.

The AUTOLOAD MODE field specifies the action to be taken by a removable medium device server at the time when a medium is inserted. For devices other than removable medium devices, this field is reserved. Table 466 shows the usage of the AUTOLOAD MODE field.

Table 466 – AUTOLOAD MODE field

Code	Definition
000b	Medium shall be loaded for full access.
001b	Medium shall be loaded for medium auxiliary memory access only.
010b	Medium shall not be loaded.
011b to 111b	Reserved

The BUSY TIMEOUT PERIOD field specifies the maximum time, in 100 milliseconds increments, that the application client allows for the device server to return BUSY status for unanticipated conditions that are not a routine part of commands from the application client. This value may be rounded down as defined in 5.10. A 0000h value in this field is undefined by this standard. An FFFFh value in this field is defined as an unlimited time.

The EXTENDED SELF-TEST COMPLETION TIME field specifies advisory data that is the time in seconds that the device server requires to complete an extended self-test provided the device server is not interrupted by subsequent commands and no errors occur during processing of the self-test. The application client should expect this time to increase significantly if other commands are sent to the logical unit while a self-test is in progress or if errors occur during the processing of the self-test. Device servers supporting SELF-TEST CODE field values other than 000b for the SEND DIAGNOSTIC command (see 6.39) shall support the EXTENDED SELF-TEST COMPLETION TIME field. The EXTENDED SELF-TEST COMPLETION TIME field is not changeable. A value of FFFFh indicates that the extended self-test takes 65 535 seconds or longer. If the value is FFFFh, then refer to the EXTENDED SELF-TEST COMPLETION MINUTES field in the Extended INQUIRY Data VPD page (see 7.7.7).

7.5.14 Control Extension mode page

The Control Extension mode page (see table 467) provides controls over SCSI features that are applicable to all device types. The mode page policy (see 7.5.3) for this mode page shall be shared. If a field in this mode page is changed while there is a command already in the task set, then whether the old or new value of the field applies to that command is outside the scope of this standard.

Table 467 – Control Extension mode page

Bit Byte	7	6	5	4	3	2	1	0
0	PS	SPF (1b)		PAGE CODE (0Ah)				
1	SUBPAGE CODE (01h)							
2	(MSB)			PAGE LENGTH (001Ch)				
3								(LSB)
4	Reserved				DLC	TCMOS	SCSIP	IALUAE
5	Reserved				INITIAL COMMAND PRIORITY			
6	MAXIMUM SENSE DATA LENGTH							
7	NON-SEQUESTERED COMMANDS COUNT							
8	SEQUESTERED COMMANDS ORDERING							
9	PWROMACT	HRDRMACT	SSUMACT	FMTMACT	Reserved			
10 ••• 31	Reserved							

The PS bit, SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field are described in 7.5.8.

The SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field shall be set as shown in table 467 for the Control Extension mode page.

A device life control (DLC) bit set to one specifies that the SCSI target device shall not degrade performance of the logical unit in order to extend device life (e.g., manage endurance). A DLC bit set to zero specifies that the SCSI target device may degrade performance of the logical unit in order to extend device life.

A timestamp changeable by methods outside this standard (TCMOS) bit set to one specifies that a device clock (see 5.3) may be initialized by methods outside the scope of this standard. A TCMOS bit set to zero specifies that a device clock shall not be initialized by any method except the ones defined by this standard.

A SCSI precedence (SCSIP) bit set to one specifies that device clock initialization (see 5.3) specified by a SET TIMESTAMP command (see 6.44) shall take precedence over methods outside the scope of this standard. A SCSIP bit set to zero specifies that methods outside this standard may initialize a device clock and that the SET TIMESTAMP command shall be terminated as described in 6.44.

An implicit asymmetric logical unit access enabled (IALUAE) bit set to one specifies that implicitly managed transitions between primary target port asymmetric access states (see 5.18.2) are allowed. An IALUAE bit set to zero specifies that implicitly managed transitions between primary target port asymmetric access states are disallowed and indicates that implicitly managed transitions between primary target port asymmetric access states are disallowed or not supported.

The INITIAL COMMAND PRIORITY field specifies the priority that may be used as the command priority (see SAM-6) for commands received by the logical unit on any I_T nexus (i.e., on any I_T_L nexus) where a priority has not been modified by a SET PRIORITY command (see 6.42). If a MODE SELECT command specifies an initial command priority value that is different than the current initial command priority, then the device server shall set any priorities that have not be set with a SET PRIORITY command to a value different than the new initial command priority value to the new priority. The device server shall establish a unit attention condition for the SCSI initiator port associated with every I_T_L nexus that receives a new priority, with the additional sense code set to PRIORITY CHANGED.

The MAXIMUM SENSE DATA LENGTH field specifies the maximum number of bytes of sense data the device server shall include in the same I_T nexus transaction as the status. A MAXIMUM SENSE DATA LENGTH field set to zero specifies that there is no limit. The device server shall not include more sense data bytes in the same I_T nexus transaction as the status than the smaller of the length indicated by:

   a) the MAXIMUM SENSE DATA LENGTH field; and
   b) the MAXIMUM SUPPORTED SENSE DATA LENGTH field in the Extended INQUIRY VPD page (see 7.7.7).

A non-zero value in the NON-SEQUESTERED COMMANDS COUNT field specifies one of the conditions under which a sequestered command is able to become a non-sequestered command as described in 5.16.1. If the NON-SEQUESTERED COMMANDS COUNT field is set to zero, the device server processes all commands as non-sequestered commands.

If the number of non-sequestered commands that the device server is already processing is equal to or greater than the non-zero value in the NON-SEQUESTERED COMMANDS COUNT field at the initial time a read command or a write command enters the Enabled state (see SAM-6), then the device server processes that command as a sequestered command (see 5.16).

If the number of non-sequestered commands being processed by the device server becomes less than the value in the NON-SEQUESTERED COMMANDS COUNT field, then the device server transitions one sequestered command, if any, to a non-sequestered command as described in 5.16.1.

If the NON-SEQUESTERED COMMANDS COUNT field is modified by a MODE SELECT command, the results may be affected by parameter rounding (see 5.10).

The SEQUESTERED COMMANDS ORDERING field (see table 468) specifies how the device server selects a sequestered command, if any, to become a non-sequestered command (see 5.16.1). If the SEQUESTERED COMMANDS ORDERING field is modified by a MODE SELECT command, the results may be affected by parameter rounding. If a MODE SELECT command modifies the SEQUESTERED COMMANDS ORDERING field and the device server has no sequestered commands, then the modification shall affect all subsequent commands.

Table 468 – SEQUESTERED COMMANDS ORDERING **field**

Code	Description
00h	The sequestered command that has been known to the device server for the longest time shall be selected to become a non-sequestered command.
01h	The selection of a sequestered command to become a non-sequestered command shall be based on optimizing the I/O operations per second completed by the device server.
02h	The selection of a sequestered command to become a non-sequestered command shall be based on maximizing the I/O operations per second completed by the device server in a way that is consistent with applicable information from other sources (e.g., Command Duration Limit T2A mode page (see 7.5.11) fields including, the INACTIVE TIME LIMIT field, the COMMAND DURATION GUIDELINE field, and the PERF VERSUS COMMAND DURATION GUIDELINES field).
all others	Reserved

For a WRITE BUFFER command with the MODE field set to 0Eh (see 6.49.10), a power on deferred microcode activates (PWROMACT) bit set to zero indicates that deferred microcode (see 5.5) is activated as a result of a power on. A PWROMACT bit set to one indicates that deferred microcode is not activated as a result of a power on.

For a WRITE BUFFER command with the MODE field set to 0Eh, a hard reset deferred microcode activates (HRDRMACT) bit set to zero indicates that deferred microcode is activated as a result of a hard reset. A HRDRMACT bit set to one indicates that deferred microcode is not activated as a result of a hard reset.

For a WRITE BUFFER command with the MODE field set to 0Eh, a START STOP UNIT command deferred microcode activates (SSUMACT) bit set to zero indicates that deferred microcode is activated as a result of processing a START STOP UNIT command (see SBC-5). An SSUMACT bit set to one indicates that deferred microcode is not activated as a result of processing a START STOP UNIT command.

For a WRITE BUFFER command with the MODE field set to 0Eh, a FORMAT UNIT command deferred microcode activates (FMTMACT) bit set to zero indicates that deferred microcode is activated as a result of processing a FORMAT UNIT command (see SBC-5). An FMTMACT bit set to one indicates that deferred microcode is not activated as a result of processing a FORMAT UNIT command.

7.5.15 Disconnect-Reconnect mode page

The Disconnect-Reconnect mode page (see table 469) provides the application client the means to tune the performance of a service delivery subsystem. The mode page policy (see 7.5.3) for this mode page shall be shared or per target port. If the SCSI target device contains more than one target port, the mode page policy should be per target port.

The Disconnect-Reconnect mode page controls parameters that affect one or more target ports. The mode parameters that may be implemented are defined in the SCSI transport protocol standard for the target port. The MLUS bit (see 7.7.9) shall be set to one in the mode page policy descriptor for this mode page.

The mode parameters for a target port affect its behavior regardless of which SCSI initiator port is forming an I_T nexus with the target port. The mode parameters may be accessed by MODE SENSE commands (see 6.13) and MODE SELECT commands (see 6.12) directed to any logical unit accessible through the target port. If a mode parameter value is changed, all the device servers for all logical units accessible through the target port shall establish a unit attention condition for the SCSI initiator port associated with every I_T nexus that includes the target port except the I_T nexus on which the MODE SELECT command was received, with the additional sense code set to MODE PARAMETERS CHANGED.

If a mode parameter that is not appropriate for the specific SCSI transport protocol implemented by the target port is non-zero, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

An interconnect tenancy is a period of time during which a given pair of SCSI ports (i.e., a SCSI initiator port and a target port) are accessing the interconnect layer to communicate with each other (e.g., on arbitrated interconnects, a tenancy typically begins when a SCSI port successfully arbitrates for the interconnect and ends when the SCSI port releases the interconnect for use by other devices). Data and other information transfers take place during interconnect tenancies.

Table 469 – Disconnect-Reconnect mode page

Bit Byte	7	6	5	4	3	2	1	0
0	PS	SPF (0b)	PAGE CODE (02h)					
1	PAGE LENGTH (0Eh)							
2	BUFFER FULL RATIO							
3	BUFFER EMPTY RATIO							
4	(MSB)			BUS INACTIVITY LIMIT				
5								(LSB)
6	(MSB)			DISCONNECT TIME LIMIT				
7								(LSB)
8	(MSB)			CONNECT TIME LIMIT				
9								(LSB)
10	(MSB)			MAXIMUM BURST SIZE				
11								(LSB)
12	EMDP	FAIR ARBITRATION			DIMM	DTDC		
13	Reserved							
14	(MSB)			FIRST BURST SIZE				
15								(LSB)

The PS bit, SPF bit, PAGE CODE field, and PAGE LENGTH field are described in 7.5.8.

The SPF bit, PAGE CODE field, and PAGE LENGTH field shall be set as shown in table 469 for the Disconnect-Reconnect mode page.

The BUFFER FULL RATIO field specifies to the target port how full the buffer should be during read operations prior to requesting an interconnect tenancy. Target ports that do not implement the requested ratio should round down to the nearest implemented ratio as defined in 5.10.

The BUFFER EMPTY RATIO field specifies to the target port how empty the buffer should be during write operations prior to requesting an interconnect tenancy. Target ports that do not implement the requested ratio should round down to the nearest implemented ratio as defined in 5.10.

The buffer full ratio and the buffer empty ratio are numerators of a fractional multiplier that has 256 as its denominator. A value of zero indicates that the target port determines when to request an interconnect tenancy consistent with the disconnect time limit mode parameter. The buffer full ratio and the buffer empty ratio mode parameters are advisory to the target port.

EXAMPLE – Consider a target port with ten 512-byte buffers and a specified buffer full ratio of 3Fh. The formula is: INTEGER((ratio∕256)×number of buffers). Therefore in this example INTEGER((3Fh∕256)×10) = 2. During the read operations described in this example, the target port should request an interconnect tenancy whenever two or more buffers are full.

The BUS INACTIVITY LIMIT field specifies the maximum time that the target port is permitted to maintain an interconnect tenancy without data or information transfer. If the bus inactivity limit is exceeded, then the target port shall conclude the interconnect tenancy, within the restrictions placed on it by the applicable SCSI transport protocol. The contents of the DTDC field in this mode page also shall affect the duration of an interconnect tenancy. This value may be rounded as defined in 5.10. A value of zero specifies that there is no bus inactivity limit. Different SCSI transport protocols define different units of measure for the bus inactivity limit.

The DISCONNECT TIME LIMIT field specifies the minimum time that the target port shall wait between interconnect tenancies. This value may be rounded as defined in 5.10. A value of zero specifies that there is no disconnect time limit. Different SCSI transport protocols define different units of measure for the disconnect time limit.

The CONNECT TIME LIMIT field specifies the maximum duration of a single interconnect tenancy. If the connect time limit is exceeded, then the target port shall conclude the interconnect tenancy, within the restrictions placed on it by the applicable SCSI transport protocol. The contents of the DTDC field in this mode page also shall affect the duration of an interconnect tenancy. This value may be rounded as defined in 5.10. A value of zero specifies that there is no connect time limit. Different SCSI transport protocols define different units of measure for the connect time limit.

The MAXIMUM BURST SIZE field specifies the maximum amount of data that the target port shall transfer during a single data transfer operation. This value is expressed in increments of 512 bytes (i.e., a value of one means 512 bytes, two means 1 024 bytes, etc.). The relationship, if any, between data transfer operations and interconnect tenancies is defined in the individual SCSI transport protocol standards. A value of zero specifies there is no limit on the amount of data transferred per data transfer operation.

In terms of the SCSI transport protocol services (see SAM-6), the device server shall limit the Request Byte Count argument to the **Receive Data-Out** protocol service and the **Send Data-In** protocol service to the amount specified in the MAXIMUM BURST SIZE field.

The enable modify data pointers (EMDP) bit specifies whether or not the target port may transfer data out of order. If the EMDP bit is set to zero, the target port shall not transfer data out of order. If the EMDP bit is set to one, the target port is allowed to transfer data out of order.

The FAIR ARBITRATION field specifies whether the target port should use fair or unfair arbitration when requesting an interconnect tenancy. The field may be used to specify different fairness methods as defined in the individual SCSI transport protocol standards.

A disconnect immediate (DIMM) bit set to zero specifies that the target port may transfer data for a command during the same interconnect tenancy in which the SCSI target device receives the command. Whether or not the target port does so may depend upon the target port's internal algorithms, the rules of the applicable SCSI transport protocol, and settings of the other mode parameters in this mode page. A disconnect immediate (DIMM) bit set to one specifies that the target port shall not transfer data for a command during the same interconnect tenancy in which the SCSI target device receives the command.

The data transfer disconnect control (DTDC) field (see table 470) defines other restrictions on when multiple interconnect tenancies are permitted. A non-zero value in the DTDC field shall take precedence over other interconnect tenancy controls represented by other fields in this mode page.

Table 470 – Data transfer disconnect control (DTDC) field

Code	Description
000b	Data transfer disconnect control is not used. Interconnect tenancies are controlled by other fields in this mode page.
001b	All data for a command shall be transferred within a single interconnect tenancy.
010b	Reserved
011b	All data and the response for a command shall be transferred within a single interconnect tenancy.
100b to 111b	Reserved

The FIRST BURST SIZE field specifies the maximum amount of data that may be transferred to the target port for a command along with the command (i.e., the first burst). This value is expressed in increments of 512 bytes (i.e., a value of one means 512 bytes, two means 1 024 bytes, etc.). The meaning of a value of zero is SCSI transport protocol specific. SCSI transport protocols supporting this field shall provide an additional mechanism to enable and disable the first burst function.

In terms of the SCSI transport protocol services (see SAM-6), the **Receive Data-Out** protocol service shall transfer the first FIRST BURST SIZE amount of data during the first burst.

7.5.16 Extended mode page

The Extended mode page (see table 471) provides a means to specify subpages that are defined for all device types. Subpage code 00h is reserved. All Extended mode pages use the sub_page mode page format.

Table 471 – Extended mode page

Bit Byte	7	6	5	4	3	2	1	0
0	PS	SPF (1b)	PAGE CODE (15h)					
1	SUBPAGE CODE							
2	(MSB)		PAGE LENGTH (n-3)					
3								(LSB)
4 ••• n			Subpage specific mode parameters					

The PS bit, SPF bit, PAGE CODE field, and PAGE LENGTH field are described in 7.5.8.

The SPF bit and PAGE CODE field shall be set as shown in table 471 for the Extended mode page.

7.5.17 Extended Device Type Specific mode page

The Extended Device Type Specific mode page (see table 472) provides a means to specify subpages that are defined differently for each device type. Subpage code 00h is reserved in the MODE SENSE command (see 6.13). All Extended Device Type Specific mode pages use the sub_page mode page format.

Table 472 – Extended Device Type Specific mode page

Bit Byte	7	6	5	4	3	2	1	0
0	PS	SPF (1b)	PAGE CODE (16h)					
1	SUBPAGE CODE							
2	(MSB)		PAGE LENGTH (n-3)					
3								(LSB)
4 ••• n			Subpage specific mode parameters					

The PS bit, SPF bit, PAGE CODE field, and PAGE LENGTH field are described in 7.5.8.

The SPF bit and PAGE CODE field shall be set as shown in table 472 for the Extended Device Type Specific mode page.

7.5.18 Power Condition mode page

The Power Condition mode page provides an application client with a method to control the power condition of a logical unit (see 5.13).

The mode page policy (see 7.5.3) for this mode page shall be shared.

The logical unit shall use the values in the Power Condition mode page to control its power condition after a power on or a hard reset until a START STOP UNIT command (see SBC-5) setting a power condition is received.

Table 473 defines the Power Condition mode page.

Table 473 – Power Condition mode page

Bit Byte	7	6	5	4	3	2	1	0
0	PS	SPF (0b)	PAGE CODE (1Ah)					
1	PAGE LENGTH (26h)							
2	PM_BG_PRECEDENCE		Reserved					STANDBY_Y
3	Reserved				IDLE_C	IDLE_B	IDLE_A	STANDBY_Z
4	(MSB)							
•••			IDLE_A CONDITION TIMER					
7								(LSB)
8	(MSB)							
•••			STANDBY_Z CONDITION TIMER					
11								(LSB)
12	(MSB)							
•••			IDLE_B CONDITION TIMER					
15								(LSB)
16	(MSB)							
•••			IDLE_C CONDITION TIMER					
19								(LSB)
20	(MSB)							
•••			STANDBY_Y CONDITION TIMER					
23								(LSB)
24								
•••			Reserved					
38								
39	CCF IDLE		CCF STANDBY		CCF STOPPED		Reserved	

The PS bit, SPF bit, PAGE CODE field, and PAGE LENGTH field are described in 7.5.8.

The SPF bit, PAGE CODE field, and PAGE LENGTH field shall be set as shown in table 473 for the Power Condition mode page.

The PM_BG_PRECEDENCE field (see table 474) specifies the interactions between background functions and power management.

Table 474 – PM_BG_PRECEDENCE field

Code	Description
00b	Vendor specific
01b	Performing background functions take precedence over maintaining low power conditions as follows: a) if the logical unit is in a low power condition as the result of a power condition timer associated with that condition expiring, then: 1) the logical unit shall change from that power condition, if necessary, to the power condition required to perform the background function, if: a) a timer associated with a background scan operation expires, and that function is enabled (see SBC-5); or b) an event occurs to initiate a device specific background function, and that function is enabled (see 5.4); 2) the logical unit shall perform the background function(s) based on the definitions in this standard and other command standards (e.g., if the device server receives a command while performing a background function, then the logical unit shall suspend the function to process the command); 3) if more than one condition is met to initiate a background function, then: a) all initiated background functions shall be performed; and b) the order of performing the functions is vendor specific; and 4) after all initiated background functions have been completed, the device server shall check to see if any power condition timers have expired. If any power condition timer has expired, then the logical unit shall change to the power condition associated with the highest priority timer that has expired; or b) if the logical unit is performing a background function, and a power condition timer expires, then the logical unit shall perform all initiated background functions before the logical unit changes to a power condition associated with a timer that has expired.
10b	Maintaining low power conditions take precedence over performing background functions as follows: a) if the logical unit is in a low power condition, then the logical unit shall not change from that power condition to perform a background function; b) the device server may perform any initiated and enabled background function based on the definitions in this standard or other command standards, if all of the following are true: A) a condition is met to initiate a background function; B) that background function is enabled; C) the logical unit changes to a power condition in which the background function may be performed (e.g., the device server processes a medium access command causing the logical unit to change its power condition to continue processing that command); and D) all outstanding application client requests have been completed; or c) if the logical unit is performing a background function, and a power condition timer expires that causes a change to a power condition in which the logical unit is unable to continue performing the background function, then the logical unit shall: A) suspend the background function; and B) change to the power condition associated with the timer that expired.
11b	Reserved

The behavior of the idle condition timer and standby condition timer controlled by this mode page is defined in the power condition overview (see 5.13.1) and the power condition state machine (see 5.13.9).

If the STANDBY_Y bit is set to one, the standby_y condition timer is enabled. If the STANDBY_Y bit is set to zero, the device server shall ignore the standby_y condition timer.

If the IDLE_C bit is set to one, the idle_c condition timer is enabled. If the IDLE_C bit is set to zero, the device server shall ignore the idle_c condition timer.

If the IDLE_B bit is set to one, the idle_b condition timer is enabled. If the IDLE_B bit is set to zero, the device server shall ignore the idle_b condition timer.

If the IDLE_A bit is set to one, the idle_a condition timer is enabled. If the IDLE_A bit is set to zero, the device server shall ignore the idle_a condition timer.

If the STANDBY_Z bit is set to one, the standby_z condition timer is enabled. If the STANDBY_Z bit is set to zero, the device server shall ignore the standby_z condition timer.

If any of the power condition enable bits (e.g., the IDLE_C bit or the STANDBY_Y bit) are set to zero and are not changeable (see 6.13.3), then the device server does not implement the power condition timer associated with that enable bit (see table 65 in 5.13.9.1).

The IDLE_A CONDITION TIMER field specifies the initial value, in 100 millisecond increments, for the idle_a power condition timer (see 5.13.9.1). This value may be rounded up or down to the nearest implemented time as defined in 5.10.

The STANDBY_Z CONDITION TIMER field specifies the initial value, in 100 millisecond increments, for the standby_z power condition timer (see 5.13.9.1). This value may be rounded up or down to the nearest implemented time as defined in 5.10.

The IDLE_B CONDITION TIMER field specifies the initial value, in 100 millisecond increments, for the idle_b power condition timer (see 5.13.9.1). This value may be rounded up or down to the nearest implemented time as defined in 5.10.

The IDLE_C CONDITION TIMER field specifies the initial value, in 100 millisecond increments, for the idle_c power condition timer (see 5.13.9.1). This value may be rounded up or down to the nearest implemented time as defined in 5.10.

The STANDBY_Y CONDITION TIMER field specifies the initial value, in 100 millisecond increments, for the standby_y power condition timer (see 5.13.9.1). This value may be rounded up or down to the nearest implemented time as defined in 5.10.

The CHECK CONDITION if from idle_c (CCF IDLE) field is defined in table 475.

Table 475 – CCF IDLE field

Code	Description
00b	Obsolete
01b	If the transition was from an idle_c power condition, returning CHECK CONDITION status is disabled. [a]
10b	If the transition was from an idle_c power condition, returning CHECK CONDITION status is enabled. [a]
11b	Reserved
[a] For direct access block devices see the Active_Wait state in SBC-5 for the definition of command processing in that state. For devices that are not direct access block devices, see the Active_Wait state in this standard (i.e., see 5.13.9.6) for the definition of command processing in that state.	

The CHECK CONDITION if from standby (CCF STANDBY) field is defined in table 476.

Table 476 – CCF STANDBY field

Code	Description
00b	Obsolete
01b	If the transition was from a standby power condition, returning CHECK CONDITION status is disabled. [a]
10b	If the transition was from a standby power condition, returning CHECK CONDITION status is enabled. [a]
11b	Reserved
[a] For direct access block devices see the Active_Wait state and the Idle_Wait state in SBC-5 for the definition of command processing in those states. For devices that are not direct access block devices, see the Active_Wait state in this standard (i.e., see 5.13.9.6) for the definition of command processing in that state.	

The CHECK CONDITION if from stopped (CCF STOPPED) field is defined in table 477.

Table 477 – CCF STOPPED field

Code	Description
00b	Obsolete
01b	If the transition was from a stopped power condition, returning CHECK CONDITION status is disabled. [a]
10b	If the transition was from a stopped power condition, returning CHECK CONDITION status is enabled. [a]
11b	Reserved
[a] For direct access block devices see the Active_Wait state, the Idle_Wait state description and the Standby_Wait state in SBC-5 for the definition of command processing in those states.	

7.5.19 Power Consumption mode page

The Power Consumption mode page (see table 478) provides a method to set the power consumption level while in the active power condition (see 5.13.5) to:

a) a relative power consumption level (see 5.13.2.2); or
b) a maximum power consumption level (see 5.13.2.2) that is based on the contents of the power consumption descriptors in the Power Consumption VPD page (see 7.7.11).

The mode page policy (see 7.5.3) for this mode page shall be shared.

Table 478 – Power Consumption mode page

Bit Byte	7	6	5	4	3	2	1	0
0	PS	SPF (1b)	PAGE CODE (1Ah)					
1	SUBPAGE CODE (01h)							
2	(MSB)	PAGE LENGTH (000Ch)						
3								(LSB)
4	Reserved							
5								
6	Reserved						ACTIVE LEVEL	
7	POWER CONSUMPTION IDENTIFIER							
8	Reserved							
•••								
15								

The PS bit, SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field are described in 7.5.8.

The SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field shall be set as shown in table 478 for the Power Consumption mode page.

The ACTIVE LEVEL field (see table 479) specifies the relative active power consumption level, in any.

Table 479 – ACTIVE LEVEL field

Code	Description
00b	The active power consumption level is specified by the POWER CONSUMPTION IDENTIFIER field.
01b	Highest relative active power consumption level
10b	Intermediate relative active power consumption level
11b	Lowest relative active power consumption level

If the application client specifies an unsupported value for the ACTIVE LEVEL field, the device server shall terminate the MODE SELECT command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

If the ACTIVE LEVEL field is set to a non-zero value, the POWER CONSUMPTION IDENTIFIER field is ignored.

If the ACTIVE LEVEL field is set to zero, the POWER CONSUMPTION IDENTIFIER field specifies the power consumption identifier from one of the power consumption descriptors in the Power Consumption VPD page (see 7.7.11) that the device server is to use as described in 5.13.2.3.

If the application client specifies an ACTIVE LEVEL field set to zero and a value for the POWER CONSUMPTION IDENTIFIER field that is not contained in a power consumption descriptor in the Power Consumption VPD page, then the device server shall terminate the MODE SELECT command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

7.5.20 Protocol Specific Logical Unit mode page

The Protocol Specific Logical Unit mode page (see table 480) provides protocol specific controls that are associated with a logical unit.

During an I_T_L nexus, the Protocol Specific Logical Unit mode page controls parameters that affect both:

a) one or more target ports; and
b) the logical unit.

The mode parameters that may be implemented are defined in the SCSI transport protocol standard for the target port. The mode page policy (see 7.5.3) for this mode page shall be shared or per target port and should be per target port.

The mode parameters for a target port and logical unit affect their behavior regardless of which SCSI initiator port is forming an I_T_L nexus with the target port and logical unit. If a mode parameter value is changed, the device server shall establish a unit attention condition for the SCSI initiator port associated with every I_T nexus except the I_T nexus on which the MODE SELECT command (see 6.12) was received, with the additional sense code set to MODE PARAMETERS CHANGED.

Table 480 – Protocol Specific Logical Unit mode page

Bit Byte	7	6	5	4	3	2	1	0
0	PS	SPF (0b)	PAGE CODE (18h)					
1	PAGE LENGTH (n-1)							
2	Protocol specific mode parameters				PROTOCOL IDENTIFIER			
3 ••• n	Protocol specific mode parameters							

The PS bit, SPF bit, PAGE CODE field, and PAGE LENGTH field are described in 7.5.8.

The SPF bit and PAGE CODE field shall be set as shown in table 480 for the Protocol Specific Logical Unit mode page.

The value in the PROTOCOL IDENTIFIER field (see 7.6.1) defines the SCSI transport protocol to which the mode page applies. For a MODE SENSE command (see 6.13), the device server shall set the PROTOCOL IDENTIFIER field to one of the values shown in table 483 (see 7.6.1) to indicate the SCSI transport protocol used by the target port through which the MODE SENSE command is being processed. For a MODE SELECT command, the application client should set the PROTOCOL IDENTIFIER field to the same value that is returned in a MODE

SENSE command for that SCSI target port. If a device server receives a mode page containing a transport protocol identifier value other than the one used by the target port on which the MODE SELECT command was received, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

7.5.21 Protocol Specific Port mode page

The Protocol Specific Port mode page provides protocol specific controls that are associated with a SCSI port. The page_0 mode page format (see table 481) is used if a MODE SENSE command (see 6.13) contains zero in the SUBPAGE CODE field, and sub_page mode page format (see table 482) is used for subpages 01h to FEh. See the SCSI transport protocol standard for definition of the protocol specific mode parameters.

The Protocol Specific Port mode page controls mode parameters that affect one or more target ports. The mode parameters that may be implemented are defined in the SCSI transport protocol standard for the target port. The mode page policy (see 7.5.3) for this mode page shall be shared or per target port. If the SCSI target device contains more than one target port, the mode page policy should be per target port.

The mode parameters for a target port affect its behavior regardless of which SCSI initiator port is forming an I_T nexus with the target port. The MLUS bit (see 7.7.9) shall be set to one in the mode page policy descriptor for this mode page.

The mode parameters may be accessed by MODE SENSE commands and MODE SELECT commands (see 6.12) directed to any logical unit accessible through the target port. If a mode parameter value is changed, the device servers for all logical units accessible through the target port shall establish a unit attention condition for the SCSI initiator port associated with every I_T nexus except the I_T nexus on which the MODE SELECT command was received, with the additional sense code set to MODE PARAMETERS CHANGED.

Table 481 – Page_0 mode page Protocol Specific Port mode page

Bit Byte	7	6	5	4	3	2	1	0
0	PS	SPF (0b)	PAGE CODE (19h)					
1	PAGE LENGTH (n-1)							
2	Protocol specific mode parameters				PROTOCOL IDENTIFIER			
3 **...** **n**	Protocol specific mode parameters							

Table 482 – Sub_page mode page Protocol Specific Port mode page

Bit Byte	7	6	5	4	3	2	1	0
0	PS	SPF (1b)	PAGE CODE (19h)					
1	SUBPAGE CODE							
2	(MSB)		PAGE LENGTH (n-3)					
3								(LSB)
4	Reserved							
5	Protocol specific mode parameters				PROTOCOL IDENTIFIER			
6 ••• n	Protocol specific mode parameters							

The PS bit, SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field are described in 7.5.8.

The SPF bit and PAGE CODE field shall be set as shown in table 481 or table 482 for the Protocol Specific Port mode page.

The value in the PROTOCOL IDENTIFIER field (see 7.6.1) defines the SCSI transport protocol to which the mode page applies. For a MODE SENSE command, the device server shall set the PROTOCOL IDENTIFIER field to one of the values shown in table 483 (see 7.6.1) to indicate the SCSI transport protocol used by the target port through which the MODE SENSE command is being processed. For a MODE SELECT command, the application client should set the PROTOCOL IDENTIFIER field to the same value that is returned in a MODE SENSE command for that SCSI target port. If a device server receives a mode page containing a transport protocol identifier value other than the one used by the target port on which the MODE SELECT command was received, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

7.6 Protocol specific parameters

7.6.1 Protocol specific parameters introduction

Some commands include protocol specific information in their command definitions. This subclause describes those protocol specific parameters.

Protocol specific parameters may include a PROTOCOL IDENTIFIER field (see table 483) as a reference for the SCSI transport protocol to which the protocol specific parameter applies.

Table 483 – PROTOCOL IDENTIFIER field values

Protocol Identifier	Description	Protocol Standard
0h	Fibre Channel Protocol for SCSI	FCP-5
1h	Obsolete	
2h	Serial Storage Architecture SCSI-3 Protocol	SSA-S3P
3h	Serial Bus Protocol for IEEE 1394	SBP-3
4h	SCSI RDMA Protocol	SRP
5h	Internet SCSI (iSCSI)	iSCSI
6h	SAS Serial SCSI Protocol	SPL-5
7h	Automation/Drive Interface Transport Protocol	ADT-2
8h	AT Attachment Interface	ACS-2
9h	USB Attached SCSI	UAS
Ah	SCSI over PCI Express	SOP
Bh	PCI Express Protocols	PCIe
Ch to Eh	Reserved	
Fh	No specific protocol	

7.6.2 Alias entry protocol specific designations

7.6.2.1 Introduction to alias entry protocol specific designations

The alias entry formats (see 6.3.2) used by specific SCSI transport protocols in the CHANGE ALIASES command (see 6.3) and REPORT ALIASES command (see 6.27) are based on the SCSI transport protocol specified in the PROTOCOL IDENTIFIER field (see 7.6.1). These alias entry formats are defined in 7.6.2.

7.6.2.2 Fibre Channel specific alias entry formats

7.6.2.2.1 Summary of Fibre Channel specific alias entry formats

The alias entry formats for the Fibre Channel protocol are summarized in table 484.

Table 484 – Fibre Channel alias entry format codes

Format Code	Description	Designation Length (bytes)	Reference
00h	World Wide Port Name	8	7.6.2.2.2
01h	World Wide Port Name with N_Port checking	12	7.6.2.2.3
02h to FFh	Reserved		

7.6.2.2.2 Fibre Channel world wide port name alias entry format

The format of a Fibre Channel world wide port name alias entry is shown in table 485.

Table 485 – Fibre Channel world wide port name alias entry

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
•••				ALIAS VALUE				
7								(LSB)
8				PROTOCOL IDENTIFIER (00h)				
9								
10				Reserved				
11				FORMAT CODE (00h)				
12								
13				Reserved				
14	(MSB)							
15				DESIGNATION LENGTH (0008h)				(LSB)
16								
•••				FIBRE CHANNEL WORLD WIDE PORT NAME				
23								

The ALIAS VALUE field is defined in 6.3.2.

The PROTOCOL IDENTIFIER field is defined in 6.3.2 and shall be set as shown in table 485 for the Fibre Channel world wide port name alias entry format.

The FORMAT CODE field is defined in 6.3.2 and shall be set as shown in table 485 for the Fibre Channel world wide port name alias entry format.

The DESIGNATION LENGTH field is defined in 6.3.2 and shall be set as shown in table 485 for the Fibre Channel world wide port name alias entry format.

The FIBRE CHANNEL WORLD WIDE PORT NAME field shall contain the port world wide name defined by the port login (PLOGI) extended link service (see FC-FS-3).

A Fibre Channel world wide port name designation is valid (see 6.3.3) if the device server has access to a SCSI domain formed by a Fibre Channel fabric and the fabric contains a port with the specified port world wide name.

7.6.2.2.3 Fibre Channel world wide port name with N_Port checking alias entry format

The format of a Fibre Channel world wide port name with N_Port checking alias entry IS shown in table 486.

Table 486 – Fibre Channel world wide port name with N_Port checking alias entry

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
•••				ALIAS VALUE				
7								(LSB)
8				PROTOCOL IDENTIFIER (00h)				
9								
10				Reserved				
11				FORMAT CODE (01h)				
12								
13				Reserved				
14	(MSB)							
15				DESIGNATION LENGTH (000Ch)				(LSB)
16								
•••				FIBRE CHANNEL WORLD WIDE PORT NAME				
23								
24				Reserved				
25	(MSB)							
26				N_PORT				
27								(LSB)

The ALIAS VALUE field is defined in 6.3.2.

The PROTOCOL IDENTIFIER field is defined in 6.3.2 and shall be set as shown in table 486 for the Fibre Channel world wide port name with N_Port checking alias entry format.

The FORMAT CODE field is defined in 6.3.2 and shall be set as shown in table 486 for the Fibre Channel world wide port name with N_Port checking alias entry format.

The DESIGNATION LENGTH field is defined in 6.3.2 and shall be set as shown in table 486 for the Fibre Channel world wide port name with N_Port checking alias entry format.

The FIBRE CHANNEL WORLD WIDE PORT NAME field shall contain the port world wide name defined by the port login (PLOGI) extended link service (see FC-FS-3).

The N_PORT field shall contain the FC-FS-3 port D_ID to be used to transport frames including PLOGI and FCP-5 related frames.

A Fibre Channel world wide port name with N_Port checking designation is valid (see 6.3.3) if all of the following conditions are true:

a) the device server has access to a SCSI domain formed by a Fibre Channel fabric;
b) the fabric contains a port with the specified port World Wide Name; and
c) the value in the N_PORT field is the N_Port identifier of a Fibre Channel port whose port world wide name matches that in the FIBRE CHANNEL WORLD WIDE PORT NAME field.

7.6.2.3 RDMA specific alias entry formats

7.6.2.3.1 Summary of RDMA specific alias entry formats

The alias entry formats for the SCSI RDMA protocol are summarized in table 487.

Table 487 – RDMA alias entry format codes

Format Code	Description	Designation Length (bytes)	Reference
00h	Target Port Identifier	16	7.6.2.3.2
01h	InfiniBand™ Global Identifier with Target Port Identifier checking	32	7.6.2.3.3
02h to FFh	Reserved		

7.6.2.3.2 RDMA target port identifier alias entry format

The format of a SCSI RDMA target port identifier alias entry IS shown in table 488.

Table 488 – RDMA target port identifier alias entry

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
•••			ALIAS VALUE					
7								(LSB)
8			PROTOCOL IDENTIFIER (04h)					
9			Reserved					
10								
11			FORMAT CODE (00h)					
12			Reserved					
13								
14	(MSB)		DESIGNATION LENGTH (0010h)					
15								(LSB)
16								
•••			TARGET PORT IDENTIFIER					
31								

The ALIAS VALUE field is defined in 6.3.2.

The PROTOCOL IDENTIFIER field is defined in 6.3.2 and shall be set as shown in table 488 for the RDMA target port identifier alias entry format.

The FORMAT CODE field is defined in 6.3.2 and shall be set as shown in table 488 for the RDMA target port identifier alias entry format.

The DESIGNATION LENGTH field is defined in 6.3.2 and shall be set as shown in table 488 for the RDMA target port identifier alias entry format.

The TARGET PORT IDENTIFIER field shall contain an SRP target port identifier.

A SCSI RDMA target port identifier designation is valid (see 6.3.3) if the device server has access to an SRP SCSI domain containing the specified SRP target port identifier.

7.6.2.3.3 InfiniBand global identifier with target port identifier checking alias entry format

The format of an InfiniBand global identifier with target port identifier checking alias entry is shown in table 489.

Table 489 – InfiniBand global identifier with target port identifier checking alias entry

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
•••			ALIAS VALUE					
7								(LSB)
8			PROTOCOL IDENTIFIER (04h)					
9								
10			Reserved					
11			FORMAT CODE (01h)					
12								
13			Reserved					
14	(MSB)							
15			DESIGNATION LENGTH (0020h)					(LSB)
16								
•••			INFINIBAND GLOBAL IDENTIFIER					
31								
32								
•••			TARGET PORT IDENTIFIER					
47								

The ALIAS VALUE field is defined in 6.3.2.

The PROTOCOL IDENTIFIER field is defined in 6.3.2 and shall be set as shown in table 489 for the InfiniBand global identifier with target port identifier checking alias entry format.

The FORMAT CODE field is defined in 6.3.2 and shall be set as shown in table 489 for the InfiniBand global identifier with target port identifier checking alias entry format.

The DESIGNATION LENGTH field is defined in 6.3.2 and shall be set as shown in table 489 for the InfiniBand global identifier with target port identifier checking alias entry format.

The INFINIBAND GLOBAL IDENTIFIER field specifies an InfiniBand global identifier (GID) of an InfiniBand port connected to an SRP target port.

The TARGET PORT IDENTIFIER field specify an SRP target port identifier.

An InfiniBand global identifier with target port identifier checking designation is valid (see 6.3.3) if all of the following conditions are true:

    a)   the device server has access to an SRP SCSI domain layered on InfiniBand;

b) the device server has access to an SRP target port based on the InfiniBand global identifier specified in the INFINIBAND GLOBAL IDENTIFIER field; and

c) the value in the TARGET PORT IDENTIFIER field is the SRP target port identifier for the SRP target port that is accessible via the InfiniBand global identifier contained in the INFINIBAND GLOBAL IDENTIFIER field.

7.6.2.4 Internet SCSI specific alias entry formats

7.6.2.4.1 Summary of Internet SCSI specific alias entry formats

The alias entry formats for the iSCSI protocol are summarized in table 490.

Table 490 – iSCSI alias entry format codes

Format Code	Description	Designation Length (bytes, maximum)	Reference
00h	iSCSI Name	224	7.6.2.4.2
01h	iSCSI Name with binary IPv4 address	236	7.6.2.4.3
02h	iSCSI Name with IPName	488	7.6.2.4.4
03h	iSCSI Name with binary IPv6 address	248	7.6.2.4.5
04h to FFh	Reserved		

NOTE 27 - A designation that contains no IP addressing information or contains IP addressing information that does not address the named SCSI target device may require a device server to have access to a name server or to other discovery protocols to resolve the given iSCSI Name to an IP address through which the device server may establish iSCSI Login. Access to such a service is protocol specific and vendor specific.

7.6.2.4.2 iSCSI name alias entry format

The format of an iSCSI name alias entry IS shown in table 491.

Table 491 – iSCSI name alias entry

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
•••				ALIAS VALUE				
7								(LSB)
8				PROTOCOL IDENTIFIER (05h)				
9								
10				Reserved				
11				FORMAT CODE (00h)				
12								
13				Reserved				
14	(MSB)							
15				DESIGNATION LENGTH (4m-16)				(LSB)
16	(MSB)							
•••				ISCSI NAME				
4m-1								(LSB)

The ALIAS VALUE field is defined in 6.3.2.

The PROTOCOL IDENTIFIER field is defined in 6.3.2 and shall be set as shown in table 491 for the iSCSI name alias entry format.

The FORMAT CODE field is defined in 6.3.2 and shall be set as shown in table 491 for the iSCSI name alias entry format.

The DESIGNATION LENGTH field is defined in 6.3.2.

The null-terminated, null-padded (see 4.3.2) ISCSI NAME field shall contain the iSCSI name of an iSCSI node (see RFC 7143). The number of bytes in the ISCSI NAME field shall be a multiple of four.

An iSCSI name designation is valid if the device server has access to a SCSI domain containing an Internet protocol network and that network contains an iSCSI node with the specified iSCSI name.

7.6.2.4.3 iSCSI name with binary IPv4 address alias entry format

The format of an iSCSI name with binary IPv4 address alias entry is shown in table 492.

Table 492 – iSCSI name with binary IPv4 address alias entry

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
•••				ALIAS VALUE				
7								(LSB)
8				PROTOCOL IDENTIFIER (05h)				
9								
10				Reserved				
11				FORMAT CODE (01h)				
12								
13				Reserved				
14	(MSB)							
15				DESIGNATION LENGTH (4m+12)				(LSB)
16	(MSB)							
•••				ISCSI NAME				
4m-1								(LSB)
4m	(MSB)							
•••				IPV4 ADDRESS				
4m+3								(LSB)
4m+4								
4m+5				Reserved				
4m+6	(MSB)							
4m+7				PORT NUMBER				(LSB)
4m+8								
4m+9				Reserved				
4m+10	(MSB)							
4m+11				INTERNET PROTOCOL NUMBER				(LSB)

The ALIAS VALUE field is defined in 6.3.2.

The PROTOCOL IDENTIFIER field is defined in 6.3.2 and shall be set as shown in table 492 for the iSCSI name with binary IPv4 address alias entry format.

The FORMAT CODE field is defined in 6.3.2 and shall be set as shown in table 492 for the iSCSI name with binary IPv4 address alias entry format.

The DESIGNATION LENGTH field is defined in 6.3.2.

The null-terminated, null-padded (see 4.3.2) ISCSI NAME field shall contain the iSCSI name of an iSCSI node (see RFC 7143). The number of bytes in the ISCSI NAME field shall be a multiple of four.

The IPV4 ADDRESS field shall contain an IPv4 address (see RFC 791).

The PORT NUMBER field shall contain a TCP port number. The TCP port number shall conform to the requirements defined by iSCSI (see RFC 7143).

The INTERNET PROTOCOL NUMBER field shall contain an Internet protocol number. The Internet protocol number shall conform to the requirements defined by iSCSI (see RFC 7143).

An iSCSI name designation is valid if the device server has access to a SCSI domain containing an Internet protocol network and that network contains an iSCSI node with the specified iSCSI name.

The IPv4 address, port number, and Internet protocol number provided in the designation may be used by a device server for addressing to discover and establish communication with the named iSCSI node. Alternatively, the device server may use other protocol specific or vendor specific methods to discover and establish communication with the named iSCSI node.

7.6.2.4.4 iSCSI name with IPname alias entry format

The format of an iSCSI name with IPname alias entry IS shown in table 493.

Table 493 – iSCSI name with IPname alias entry

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
•••			ALIAS VALUE					
7								(LSB)
8			PROTOCOL IDENTIFIER (05h)					
9			Reserved					
10								
11			FORMAT CODE (03h)					
12			Reserved					
13								
14	(MSB)							
15			DESIGNATION LENGTH (4m+8)					(LSB)
16	(MSB)							
•••			ISCSI NAME					
k								(LSB)
k+1	(MSB)							
•••			IPNAME					
n								(LSB)
n+1			PAD (if any)					
4m-1								
4m			Reserved					
4m+1								
4m+2	(MSB)							
4m+3			PORT NUMBER					(LSB)
4m+4			Reserved					
4m+5								
4m+6	(MSB)							
4m+7			INTERNET PROTOCOL NUMBER					(LSB)

The ALIAS VALUE field is defined in 6.3.2.

The PROTOCOL IDENTIFIER field is defined in 6.3.2 and shall be set as shown in table 493 for the iSCSI name with IPname alias entry format.

The FORMAT CODE field is defined in 6.3.2 and shall be set as shown in table 493 for the iSCSI name with IPname alias entry format.

The DESIGNATION LENGTH field is defined in 6.3.2.

The null-terminated (see 4.3.2) ISCSI NAME field shall contain the iSCSI name of an iSCSI node (see RFC 7143).

The null-terminated (see 4.3.2) IPNAME field shall contain a hostname from the Internet domain name system defined by the IETF (see RFC 1034 and RFC 1035).

The PAD field shall contain zero to three bytes set to zero such that the total length of the ISCSI NAME field, IPNAME field, and PAD field is a multiple of four. Device servers shall ignore the PAD field.

The PORT NUMBER field shall contain a TCP port number. The TCP port number shall conform to the requirements defined by iSCSI (see RFC 7143).

The INTERNET PROTOCOL NUMBER field shall contain an Internet protocol number. The Internet protocol number shall conform to the requirements defined by iSCSI (see RFC 7143).

An iSCSI name designation is valid if the device server has access to a SCSI domain containing an Internet protocol network and that network contains an iSCSI node with the specified iSCSI name.

The contents of the IPNAME field, PORT NUMBER field, and the INTERNET PROTOCOL NUMBER field may be used by a device server for addressing to discover and establish communication with the named iSCSI node. Alternatively, the device server may use other protocol specific or vendor specific methods to discover and establish communication with the named iSCSI node.

7.6.2.4.5 iSCSI name with binary IPv6 address alias entry format

The format of an iSCSI name with binary IPv6 address alias entry is shown in table 494.

Table 494 – iSCSI name with binary IPv6 address alias entry

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
•••			ALIAS VALUE					
7								(LSB)
8			PROTOCOL IDENTIFIER (05h)					
9								
10			Reserved					
11			FORMAT CODE (03h)					
12								
13			Reserved					
14	(MSB)							
15			DESIGNATION LENGTH (4m+24)					(LSB)
16	(MSB)							
•••			ISCSI NAME					
n								(LSB)
4m	(MSB)							
•••			IPV6 ADDRESS					
4m+15								(LSB)
4m+16								
4m+17			Reserved					
4m+18	(MSB)							
4m+19			PORT NUMBER					(LSB)
4m+20								
4m+21			Reserved					
4m+22	(MSB)							
4m+23			INTERNET PROTOCOL NUMBER					(LSB)

The ALIAS VALUE field is defined in 6.3.2.

The PROTOCOL IDENTIFIER field is defined in 6.3.2 and shall be set as shown in table 494 for the iSCSI name with binary IPv6 address alias entry format.

The FORMAT CODE field is defined in 6.3.2 and shall be set as shown in table 494 for the iSCSI name with binary IPv6 address alias entry format.

The DESIGNATION LENGTH field is defined in 6.3.2.

The null-terminated, null-padded (see 4.3.2) ISCSI NAME field shall contain the iSCSI name of an iSCSI node (see RFC 7143).

The IPV6 ADDRESS field shall contain an IPv6 address (see RFC 4291).

The PORT NUMBER field shall contain a TCP port number. The TCP port number shall conform to the requirements defined by iSCSI (see RFC 7143).

The INTERNET PROTOCOL NUMBER field shall contain an Internet protocol number. The Internet protocol number shall conform to the requirements defined by iSCSI (see RFC 7143).

An iSCSI name designation is valid if the device server has access to a SCSI domain containing an Internet protocol network and that network contains an iSCSI node with the specified iSCSI name.

The IPv6 address, port number and Internet protocol number provided in the designation may be used by a device server for addressing to discover and establish communication with the named iSCSI node. Alternatively, the device server may use other protocol specific or vendor specific methods to discover and establish communication with the named iSCSI node.

7.6.3 EXTENDED COPY protocol specific CSCD descriptors

7.6.3.1 Introduction to EXTENDED COPY protocol specific CSCD descriptors

The protocol specific CSCD descriptors (see 6.6.5.1) in the parameter list (see 5.19.8.1) of the EXTENDED COPY command (see 6.6) are described in 7.6.3.

7.6.3.2 Fibre Channel N_Port_Name CSCD descriptor format

The CSCD descriptor format shown in table 495 is used by an EXTENDED COPY command to specify an FCP CSCD using its Fibre Channel N_Port_Name.

Table 495 – Fibre Channel N_Port_Name CSCD descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE CODE (E0h)							
1	LU ID TYPE		Obsolete	PERIPHERAL DEVICE TYPE				
2	(MSB)			RELATIVE INITIATOR PORT IDENTIFIER				
3								(LSB)
4 ••• 11				LU IDENTIFIER				
12 ••• 19				N_PORT_NAME				
20 ••• 27				Reserved				
28 ••• 31				Device type specific parameters				

The DESCRIPTOR TYPE CODE field, LU ID TYPE field, PERIPHERAL DEVICE TYPE field, RELATIVE INITIATOR PORT IDENTIFIER field, LU IDENTIFIER field, and the device type specific parameters are described in 6.6.5.1. The DESCRIPTOR TYPE CODE field shall be set as shown in table 495 for the Fibre Channel N_Port_Name CSCD descriptor.

The N_PORT_NAME field shall contain the N_Port_Name defined by the port login (PLOGI) extended link service (see FC-LS-2).

> NOTE 28 - The Fibre Channel N_Port_Name CSCD descriptor format requests that the copy manager translate the N_Port_Name to an N_Port_ID (see FC-FS-3, FC-LS-2, and 7.6.3.3).

7.6.3.3 Fibre Channel N_Port_ID CSCD descriptor format

The CSCD descriptor format shown in table 496 is used by an EXTENDED COPY command to specify an FCP CSCD using its Fibre Channel N_Port_ID.

Table 496 – Fibre Channel N_Port_ID CSCD descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE CODE (E1h)							
1	LU ID TYPE		Obsolete	PERIPHERAL DEVICE TYPE				
2	(MSB)			RELATIVE INITIATOR PORT IDENTIFIER				
3								(LSB)
4 ••• 11				LU IDENTIFIER				
12 ••• 20				Reserved				
21 ••• 23	(MSB)			N_PORT_ID				(LSB)
24 ••• 27				Reserved				
28 ••• 31				Device type specific parameters				

The DESCRIPTOR TYPE CODE field, LU ID TYPE field, PERIPHERAL DEVICE TYPE field, RELATIVE INITIATOR PORT IDENTIFIER field, LU IDENTIFIER field, and the device type specific parameters are described in 6.6.5.1. The DESCRIPTOR TYPE CODE field shall be set as shown in table 496 for the Fibre Channel N_Port_ID CSCD descriptor.

The N_PORT_ID field shall contain the port D_ID (see FC-FS-3) to be used to transport frames including PLOGI (see FC-LS-2) and FCP-5 related frames.

> NOTE 29 - Use of N_Port_ID addressing restricts this CSCD descriptor format to a single Fibre Channel fabric.

7.6.3.4 Fibre Channel N_Port_ID With N_Port_Name Checking CSCD descriptor format

The CSCD descriptor format shown in table 497 is used by an EXTENDED COPY command to specify an FCP CSCD using its Fibre Channel N_Port_ID and to require the copy manager to verify that the N_Port_Name of the specified N_Port matches the value in the CSCD descriptor.

Table 497 – Fibre Channel N_Port_ID With N_Port_Name Checking CSCD descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE CODE (E2h)							
1	LU ID TYPE		Obsolete	PERIPHERAL DEVICE TYPE				
2	(MSB)			RELATIVE INITIATOR PORT IDENTIFIER				
3								(LSB)
4								
•••				LU IDENTIFIER				
11								
12								
•••				N_PORT_NAME				
19								
20	Reserved							
21	(MSB)							
•••				N_PORT_ID				
23								(LSB)
24								
•••				Reserved				
27								
28								
•••				Device type specific parameters				
31								

The DESCRIPTOR TYPE CODE field, LU ID TYPE field, PERIPHERAL DEVICE TYPE field, RELATIVE INITIATOR PORT IDENTIFIER field, LU IDENTIFIER field, and the device type specific parameters are described in 6.6.5.1. The DESCRIPTOR TYPE CODE field shall be set as shown in table 497 for the Fibre Channel N_Port_ID With N_Port_Name Checking CSCD descriptor.

The N_PORT_NAME field shall contain the N_Port_Name defined by the port login (PLOGI) extended link service (see FC-FS-3 and FC-LS-2).

The N_PORT_ID field shall contain the port D_ID (see FC-FS-3) to be used to transport frames including PLOGI (see FC-LS-2) and FCP-5 related frames.

> NOTE 30 - Use of N_Port addressing restricts this CSCD descriptor format to a single fabric.

If the copy manager first processes a segment descriptor that references this type of CSCD descriptor, the copy manager shall confirm that the D_ID in the N_PORT_ID field is associated with the N_Port_Name in the N_PORT_NAME field. If the confirmation fails, the copy manager shall terminate the copy operation (see 5.19.4.3) because the CSCD is unreachable (see 5.19.8.4). The copy manager processing this CSCD

descriptor shall track configuration changes that affect the D_ID value for the duration of the copy operation (see 5.19.4.3). An application client is responsible for tracking configuration changes between commands.

7.6.3.5 IEEE 1394 EUI-64 CSCD descriptor format

The CSCD descriptor format shown in table 498 is used by an EXTENDED COPY command to specify an SBP-3 CSCD using its IEEE 1394 Extended Unique Identifier, 64-bits (EUI-64) and configuration ROM directory identifier.

Table 498 – IEEE 1394 EUI-64 CSCD descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE CODE (E8h)							
1	LU ID TYPE		Obsolete	PERIPHERAL DEVICE TYPE				
2	(MSB)							
3	RELATIVE INITIATOR PORT IDENTIFIER							(LSB)
4 ••• 11	LU IDENTIFIER							
12 ••• 19	EUI-64							
20 ••• 22	DIRECTORY ID							
23 ••• 27	Reserved							
28 ••• 31	Device type specific parameters							

The DESCRIPTOR TYPE CODE field, LU ID TYPE field, PERIPHERAL DEVICE TYPE field, RELATIVE INITIATOR PORT IDENTIFIER field, LU IDENTIFIER field, and the device type specific parameters are described in 6.6.5.1. The DESCRIPTOR TYPE CODE field shall be set as shown in table 498 for the IEEE 1394 EUI-64 CSCD descriptor.

The EUI-64 field shall contain the SBP-3 node's unique identifier (EUI-64) obtained from the configuration ROM bus information block, as specified by ANSI IEEE 1394a:2000.

> NOTE 31 - ANSI IEEE 1394a-2000 separately labels the components of the EUI-64 as NODE_VENDOR_ID, CHIP_ID_HI and CHIP_ID_LO. Collectively these form the node's EUI-64.

The DIRECTORY ID field shall contain the CSCD's directory identifier, as specified by ISO/IEC 13213:1994.

7.6.3.6 RDMA CSCD descriptor format

The CSCD descriptor format shown in table 499 is used by an EXTENDED COPY command to specify an SRP CSCD using its RDMA SRP target port identifier.

Table 499 – RDMA CSCD descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE CODE (E7h)							
1	LU ID TYPE		Obsolete	PERIPHERAL DEVICE TYPE				
2	(MSB)							
3	RELATIVE INITIATOR PORT IDENTIFIER							(LSB)
4								
•••	LU IDENTIFIER							
11								
12								
•••	TARGET PORT IDENTIFIER							
27								
28								
•••	Device type specific parameters							
31								

The DESCRIPTOR TYPE CODE field, LU ID TYPE field, PERIPHERAL DEVICE TYPE field, RELATIVE INITIATOR PORT IDENTIFIER field, LU IDENTIFIER field, and the device type specific parameters are described in 6.6.5.1. The DESCRIPTOR TYPE CODE field shall be set as shown in table 499 for the RDMA CSCD descriptor.

The TARGET PORT IDENTIFIER field specifies the SRP target port identifier (see SRP).

7.6.3.7 iSCSI IPv4 CSCD descriptor format

The CSCD descriptor format shown in table 500 is used by an EXTENDED COPY command to specify an iSCSI CSCD using its binary IPv4 address.

Table 500 – iSCSI IPv4 CSCD descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE CODE (E5h)							
1	LU ID TYPE		Obsolete	PERIPHERAL DEVICE TYPE				
2	(MSB)			RELATIVE INITIATOR PORT IDENTIFIER				
3								(LSB)
4 ••• 11				LU IDENTIFIER				
12 ••• 15	(MSB)			IPV4 ADDRESS				(LSB)
16 ••• 21				Reserved				
22 23	(MSB)			PORT NUMBER				(LSB)
24 25				Reserved				
26 27	(MSB)			INTERNET PROTOCOL NUMBER				(LSB)
28 ••• 31				Device type specific parameters				

The DESCRIPTOR TYPE CODE field, LU ID TYPE field, PERIPHERAL DEVICE TYPE field, RELATIVE INITIATOR PORT IDENTIFIER field, LU IDENTIFIER field, and the device type specific parameters are described in 6.6.5.1. The DESCRIPTOR TYPE CODE field shall be set as shown in table 500 for the iSCSI IPv4 CSCD descriptor.

The IPV4 ADDRESS field shall contain an IPv4 address (see RFC 791).

The PORT NUMBER field shall contain the TCP port number. The TCP port number shall conform to the requirements defined by iSCSI (see RFC 7143).

The INTERNET PROTOCOL NUMBER field shall contain an Internet protocol number. The Internet protocol number shall conform to the requirements defined by iSCSI (see RFC 7143).

> NOTE 32 - The internet protocol number for TCP is 0006h.

7.6.3.8 iSCSI IPv6 CSCD descriptor format

The CSCD descriptor format shown in table 501 is used by an EXTENDED COPY command to specify an iSCSI CSCD using its binary IPv6 address.

Table 501 – iSCSI IPv6 CSCD descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE CODE (EAh)							
1	LU ID TYPE		Obsolete	PERIPHERAL DEVICE TYPE				
2	(MSB)			RELATIVE INITIATOR PORT IDENTIFIER				
3								(LSB)
4 ••• 11				LU IDENTIFIER				
12 ••• 27	(MSB)			IPV6 ADDRESS				(LSB)
28 ••• 31				Device type specific parameters				
32	EXTENSION DESCRIPTOR TYPE CODE (FFh)							
33 34 35				Reserved				
36 37	(MSB)			PORT NUMBER				(LSB)
38 39	(MSB)			INTERNET PROTOCOL NUMBER				(LSB)
40 ••• 63				Reserved				

The DESCRIPTOR TYPE CODE field, LU ID TYPE field, PERIPHERAL DEVICE TYPE field, RELATIVE INITIATOR PORT IDENTIFIER field, LU IDENTIFIER field, and the device type specific parameters are described in 6.6.5.1. The DESCRIPTOR TYPE CODE field shall be set as shown in table 501 for the iSCSI IPv6 CSCD descriptor.

The IPV6 ADDRESS field shall contain a unicast IPv6 address (see RFC 4291).

The EXTENSION DESCRIPTOR TYPE CODE field is described in 6.6.5.2. If the EXTENSION DESCRIPTOR TYPE CODE field does not contain the value shown in table 501, then the copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to COPY ABORTED, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

The PORT NUMBER field shall contain the TCP port number. The TCP port number shall conform to the requirements defined by iSCSI (see RFC 7143).

The INTERNET PROTOCOL NUMBER field shall contain an Internet protocol number. The Internet protocol number shall conform to the requirements defined by iSCSI (see RFC 7143).

> NOTE 33 - The internet protocol number for TCP is 0006h.

7.6.3.9 SAS Serial SCSI Protocol CSCD descriptor format

The CSCD descriptor format shown in table 502 is used by an EXTENDED COPY command to specify a SAS CSCD using its SAS address.

Table 502 – SAS Serial SCSI Protocol CSCD descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR TYPE CODE (E9h)							
1	LU ID TYPE		Obsolete	PERIPHERAL DEVICE TYPE				
2	(MSB)			RELATIVE INITIATOR PORT IDENTIFIER				
3								(LSB)
4 ••• 11				LU IDENTIFIER				
12 ••• 19				SAS ADDRESS				
20 ••• 27				Reserved				
28 ••• 31				Device type specific parameters				

The DESCRIPTOR TYPE CODE field, LU ID TYPE field, PERIPHERAL DEVICE TYPE field, RELATIVE INITIATOR PORT IDENTIFIER field, LU IDENTIFIER field, and the device type specific parameters are described in 6.6.5.1. The DESCRIPTOR TYPE CODE field shall be set as shown in table 502 for the SAS Serial SCSI Protocol CSCD descriptor.

The SAS ADDRESS field specifies the SAS address (see SPL-5).

7.6.4 TransportID identifiers

7.6.4.1 Overview of TransportID identifiers

An application client may use a TransportID to specify a SCSI initiator port other than the SCSI initiator port that is transporting the command and parameter data (e.g., as the SCSI initiator port in the I_T nexus to which PERSISTENT RESERVE OUT command with REGISTER AND MOVE service action (see 5.14.8) is moving a persistent reservation).

TransportIDs (see table 503) shall be at least 24 bytes long and shall be a multiple of four bytes in length.

Table 503 – TransportID

Bit Byte	7	6	5	4	3	2	1	0
0	TPID FORMAT		Reserved		PROTOCOL IDENTIFIER			
1 ••• n	SCSI transport protocol specific data							

The TransportID format (TPID FORMAT) field specifies the format of the TransportID. All TransportID format codes not defined in this standard (i.e., in 7.6.4) are reserved.

The PROTOCOL IDENTIFIER field (see table 483 in 7.6.1) specifies the SCSI transport protocol to which the TransportID applies.

The format of the SCSI transport protocol specific data depends on the value in the PROTOCOL IDENTIFIER field. The SCSI transport protocol specific data in a TransportID shall only include initiator port identifiers, initiator port names, or SCSI device names (see SAM-6) that persist across hard resets and I_T nexus losses. TransportID formats specific to SCSI transport protocols are listed in table 504.

Table 504 – TransportID formats for specific SCSI transport protocols

SCSI transport protocol	Protocol standard	Reference
Fibre Channel Protocol (FCP)	FCP-5	7.6.4.2
Serial Bus Protocol (SBP) (i.e., IEEE 1394)	SBP-3	7.6.4.3
Remote Direct Memory Access (RDMA) (e.g., InfiniBand™)	SRP	7.6.4.4
Internet SCSI (iSCSI)	iSCSI	7.6.4.5
Serial Attached SCSI (SAS) Serial SCSI Protocol (SSP)	SPL-5	7.6.4.6
SCSI over PCI Express (SOP)	SOP	7.6.4.7

7.6.4.2 TransportID for initiator ports using SCSI over Fibre Channel

A Fibre Channel TransportID (see table 505) specifies an FCP-5 initiator port based on the N_Port_Name belonging to that SCSI initiator port.

Table 505 – Fibre Channel TransportID

Bit Byte	7	6	5	4	3	2	1	0
0	TPID FORMAT (00b)		Reserved		PROTOCOL IDENTIFIER (0h)			
1 ••• 7	Reserved							
8 ••• 15	N_PORT_NAME							
16 ••• 23	Reserved							

The TPID FORMAT field and PROTOCOL IDENTIFIER field are defined in 7.6.4.1, and shall be set as shown in table 505 for the Fibre Channel TransportID format.

The N_PORT_NAME field shall contain the N_Port_Name defined by the N_Port login (PLOGI) extended link service (see FC-FS-3).

7.6.4.3 TransportID for initiator ports using SCSI over IEEE 1394

An IEEE 1394 TransportID (see table 506) specifies an SBP-3 initiator port based on the EUI-64 initiator port name belonging to that SCSI initiator port.

Table 506 – IEEE 1394 TransportID

Bit Byte	7	6	5	4	3	2	1	0
0	TPID FORMAT (00b)		Reserved		PROTOCOL IDENTIFIER (3h)			
1 ••• 7	Reserved							
8 ••• 15	EUI-64 NAME							
16 ••• 23	Reserved							

The TPID FORMAT field and PROTOCOL IDENTIFIER field are defined in 7.6.4.1, and shall be set as shown in table 506 for the IEEE 1394 TransportID format.

The EUI-64 NAME field shall contain the EUI-64 IEEE 1394 node unique identifier (see SBP-3) for a SCSI initiator port.

7.6.4.4 TransportID for initiator ports using SCSI over an RDMA interface

A RDMA TransportID (see table 507) specifies an SRP initiator port based on the world wide unique initiator port name belonging to that SCSI initiator port.

Table 507 – RDMA TransportID

Bit Byte	7	6	5	4	3	2	1	0
0	TPID FORMAT (00b)		Reserved		PROTOCOL IDENTIFIER (4h)			
1 ••• 7	Reserved							
8 ••• 23	INITIATOR PORT IDENTIFIER							

The TPID FORMAT field and PROTOCOL IDENTIFIER field are defined in 7.6.4.1, and shall be set as shown in table 507 for the RDMA TransportID format.

The INITIATOR PORT IDENTIFIER field shall contain an SRP initiator port identifier (see SRP).

7.6.4.5 TransportID for initiator ports using SCSI over iSCSI

An iSCSI TransportID specifies an iSCSI initiator port using one of the TransportID formats listed in table 508.

Table 508 – iSCSI TPID FORMAT field codes

Code	Description	Reference
00b	SCSI initiator port is identified using the world wide unique SCSI device name of the iSCSI initiator device containing the SCSI initiator port.	table 509
01b	SCSI initiator port is identified using the world wide unique initiator port identifier.	table 510
10b to 11b	Reserved	

iSCSI TransportIDs with the TPID FORMAT field set to 01b should be processed. iSCSI TransportIDs with the TPID FORMAT field set to 00b may result in the command being terminated.

A iSCSI TransportID with the TPID FORMAT field set to 00b (see table 509) specifies an iSCSI initiator port based on the world wide unique SCSI device name of the iSCSI initiator device containing the SCSI initiator port.

Table 509 – iSCSI initiator device TransportID

Bit Byte	7	6	5	4	3	2	1	0
0	TPID FORMAT (00b)		Reserved		PROTOCOL IDENTIFIER (5h)			
1	Reserved							
2	(MSB)							
3	ADDITIONAL LENGTH (m-3)							(LSB)
4	(MSB)							
•••	ISCSI NAME							
m								(LSB)

The TPID FORMAT field and PROTOCOL IDENTIFIER field are defined in 7.6.4.1, and shall be set as shown in table 509 for the iSCSI initiator device TransportID format.

The ADDITIONAL LENGTH field specifies the number of bytes that follow in the TransportID. The additional length shall be at least 20 and shall be a multiple of four.

The null-terminated, null-padded (see 4.3.2) ISCSI NAME field shall contain the iSCSI name of an iSCSI initiator node (see RFC 7143). The first ISCSI NAME field byte containing an ASCII null character terminates the ISCSI NAME field without regard for the specified length of the iSCSI TransportID or the contents of the ADDITIONAL LENGTH field.

The iSCSI name length does not exceed 223 bytes. The maximum length of the iSCSI TransportID is 228 bytes.

If a iSCSI TransportID with the TPID FORMAT field set to 00b appears in a PERSISTENT RESERVE OUT parameter list (see 6.15.3), then all SCSI initiator ports known to the device server with an iSCSI node name matching the one in the TransportID shall be registered.

A iSCSI TransportID with the TPID FORMAT field set to 01b (see table 510) specifies an iSCSI initiator port based on its world wide unique initiator port identifier.

Table 510 – iSCSI initiator port TransportID

Bit Byte	7	6	5	4	3	2	1	0
0	TPID FORMAT (01b)		Reserved		PROTOCOL IDENTIFIER (5h)			
1	Reserved							
2	(MSB)							
3		ADDITIONAL LENGTH (m-3)						(LSB)
4	(MSB)							
•••		ISCSI NAME						
n-1								(LSB)
n	(MSB)							
•••		SEPARATOR (2C 692C 3078h)						
n+4								(LSB)
n+5	(MSB)							
•••		ISCSI INITIATOR SESSION ID						
m								(LSB)

The TPID FORMAT field and PROTOCOL IDENTIFIER field are defined in 7.6.4.1, and shall be set as shown in table 510 for the iSCSI initiator port TransportID format.

The ADDITIONAL LENGTH field specifies the number of bytes that follow in the TransportID encompassing the ISCSI NAME, SEPARATOR, and ISCSI INITIATOR SESSION ID fields. The additional length shall be at least 20 and shall be a multiple of four.

The ISCSI NAME field shall contain the iSCSI name of an iSCSI initiator node (see RFC 7143). The ISCSI NAME field shall not be null-terminated (see 4.3.2) and shall not be padded.

The SEPARATOR field shall be set as shown in table 510 (i.e., the five ASCII characters ',i,0x').

The null-terminated, null-padded ISCSI INITIATOR SESSION ID field shall contain the iSCSI initiator session identifier (see RFC 7143) in the form of ASCII characters that are the hexadecimal digits converted from the binary iSCSI initiator session identifier value. The first ISCSI INITIATOR SESSION ID field byte containing an ASCII null character terminates the ISCSI INITIATOR SESSION ID field without regard for the specified length of the iSCSI TransportID or the contents of the ADDITIONAL LENGTH field.

7.6.4.6 TransportID for initiator ports using SCSI over SAS Serial SCSI Protocol

A SAS Serial SCSI Protocol (SSP) TransportID (see table 511) specifies a SAS initiator port that is communicating via SSP using the SAS address belonging to that SCSI initiator port.

Table 511 – SAS Serial SCSI Protocol TransportID

Bit Byte	7	6	5	4	3	2	1	0
0	TPID FORMAT (00b)		Reserved		PROTOCOL IDENTIFIER (6h)			
1 ••• 3	Reserved							
4 ••• 11	SAS ADDRESS							
12 ••• 23	Reserved							

The TPID FORMAT field and PROTOCOL IDENTIFIER field are defined in 7.6.4.1, and shall be set as shown in table 511 for the SAS Serial SCSI Protocol TransportID format.

The SAS ADDRESS field specifies the SAS address of the SCSI initiator port (see SPL-5).

7.6.4.7 TransportID for initiator ports using SCSI over PCI Express

A SCSI over PCI Express (SOP) TransportID (see table 512) specifies a SOP initiator port.

Table 512 – SOP TransportID

Bit Byte	7	6	5	4	3	2	1	0
0	TPID FORMAT (00b)		Reserved		PROTOCOL IDENTIFIER (Ah)			
1	Reserved							
2 3	ROUTING ID							
4 ••• 23	Reserved							

The TPID FORMAT field and PROTOCOL IDENTIFIER field are defined in 7.6.4.1, and shall be set as shown in table 512 for the SOP TransportID format.

The ROUTING ID field shall contain a PCI Express routing ID (see SOP).

7.7 Vital product data parameters

7.7.1 Vital product data parameters overview

This subclause describes the vital product data (VPD) page structure and the VPD pages (see table 513) that are applicable to all SCSI devices. These VPD pages are returned by an INQUIRY command with the EVPD bit set to one (see 6.7) and contain product information about a logical unit and SCSI target device.

Table 513 – Vital product data page codes

VPD Page Name	Page code	Reference	Support
ASCII Information	01h to 7Fh	7.7.3	Optional
ATA Information	89h	SAT-5	See SAT-5
CFA Profile Information	8Ch	7.7.4	Optional
Device Constituents	8Bh	7.7.5	Optional
Device Identification	83h	7.7.6	Mandatory
Extended INQUIRY Data	86h	7.7.7	Optional
Management Network Addresses	85h	7.7.8	Optional
Mode Page Policy	87h	7.7.9	Optional
Power Condition	8Ah	7.7.10	Optional
Power Consumption	8Dh	7.7.11	Optional
Protocol Specific Logical Unit Information	90h	7.7.12	Protocol specific [a]
Protocol Specific Port Information	91h	7.7.13	Protocol specific [a]
SCSI Feature Sets	92h	7.7.14	Optional
SCSI Ports	88h	7.7.15	Optional
Software Interface Identification	84h	7.7.16	Optional
Supported VPD Pages	00h	7.7.17	Mandatory
Third-party Copy	8Fh	7.7.18	Optional
Unit Serial Number	80h	7.7.19	Optional
Restricted (see applicable command standard)	B0h to BFh		
Obsolete [b]			
Vendor specific [c]			
Reserved	All other codes		
A numeric ordered listing of VPD page codes is provided in clause E.7.			
[a] See applicable SCSI transport protocol standard for support requirements. [b] The following page codes are obsolete: 81h and 82h. [c] The following page codes are vendor specific: C0h to FFh.			

This standard does not define the location or method of storing the vital product data. The return of the vital product data may require completion of initialization operations within the logical unit that may result in delays before the vital product data is available to the application client. Time critical requirements for the return of vital product data are outside the scope of this standard.

7.7.2 VPD page format for all device types

This subclause describes the VPD page structure that is applicable to all SCSI devices. VPD pages specific to each device type are described in the command standard that applies to that device type.

An INQUIRY command with the EVPD bit set to one (see 6.7) specifies that the device server return a VPD page using the format defined in table 514.

Table 514 – VPD page

Bit Byte	7	6	5	4	3	2	1	0
0	PERIPHERAL QUALIFIER			PERIPHERAL DEVICE TYPE				
1	PAGE CODE							
2	(MSB)							
3	PAGE LENGTH (n-3)							(LSB)
4								
...	VPD parameters							
n								

The PERIPHERAL QUALIFIER field and the PERIPHERAL DEVICE TYPE field are the same as defined for standard INQUIRY data (see 6.7.2).

The PAGE CODE field (see 7.7.1) identifies the VPD page and contains the same value as in the PAGE CODE field in the INQUIRY CDB (see 6.7).

The PAGE LENGTH field indicates the length in bytes of the VPD parameters that follow this field. The contents of the PAGE LENGTH field are not altered based on the allocation length (see 4.2.5.6).

The VPD parameters are defined for each VPD page code. If the PERIPHERAL QUALIFIER field is not set to 000b, the contents of the PAGE LENGTH field and the VPD parameters are outside the scope of this standard.

7.7.3 ASCII Information VPD page

The ASCII Information VPD page (see table 515) contains information for the field replaceable unit code returned in the sense data (see 4.4).

Table 515 – ASCII Information VPD page

Bit Byte	7	6	5	4	3	2	1	0
0	PERIPHERAL QUALIFIER			PERIPHERAL DEVICE TYPE				
1	PAGE CODE (01h to 7Fh)							
2	(MSB)			PAGE LENGTH (n-3)				
3								(LSB)
4	ASCII LENGTH (m-4)							
5	(MSB)			ASCII INFORMATION				
•••								
m								(LSB)
m+1				Vendor specific information				
•••								
n								

The PERIPHERAL QUALIFIER field, PERIPHERAL DEVICE TYPE field, PAGE CODE field, and PAGE LENGTH field are defined in 7.7.2.

The value in the PAGE CODE field is associated with the FIELD REPLACEABLE UNIT CODE field returned in the sense data.

> NOTE 34 - The FIELD REPLACEABLE UNIT CODE field in the sense data provides for 255 possible codes, while the PAGE CODE field provides for only 127 possible codes. For that reason it is not possible to return ASCII Information VPD pages for the upper code values.

The ASCII LENGTH field indicates the length in bytes of the ASCII INFORMATION field. A value of zero in this field indicates that no ASCII information is available for the indicated page code. The contents of the ASCII LENGTH field are not altered based on the allocation length (see 4.2.5.6).

The ASCII INFORMATION field contains ASCII information concerning the field replaceable unit identified by the page code. The data in this field shall be formatted in one or more character string lines. Each line shall contain only ASCII printable characters (i.e., code values 20h to 7Eh) and shall be terminated with an ASCII null (i.e., code value 00h) character.

The contents of the vendor specific information are not defined in this standard.

7.7.4 CFA Profile Information VPD page

The CFA Profile Information VPD page (see table 516) provides information on the CFA profiles, if any, that are supported by the device server.

Table 516 – CFA Profile Information VPD page

Bit Byte	7	6	5	4	3	2	1	0
0	PERIPHERAL QUALIFIER			PERIPHERAL DEVICE TYPE			
1	PAGE CODE (8Ch)							
2	(MSB)	PAGE LENGTH (n-3)						
3								(LSB)
	CFA profile descriptor list							
4 ••• 7	CFA profile descriptor (see table 517) [first]							
	⋮							
n-3 ••• n	CFA profile descriptor (see table 517) [last]							

The PERIPHERAL QUALIFIER field, PERIPHERAL DEVICE TYPE field, and PAGE LENGTH field are defined in 7.7.2.

The PAGE CODE field is defined in 7.7.2 and shall be set as shown in table 516 for the CFA Profile Information VPD page.

Each CFA profile descriptor (see table 517) contains identifying information for one CFA profile supported by the device server described in the standard INQUIRY data (see 6.7.2).

Table 517 – CFA profile descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	CFA PROFILE SUPPORTED							
1	Reserved							
2	(MSB)	SEQUENTIAL WRITE DATA SIZE						
3								(LSB)

The CFA PROFILE SUPPORTED field indicates a CFA profile number (see VPG1) that the device server supports.

The SEQUENTIAL WRITE DATA SIZE field indicates the preferred number of logical blocks in a stream field write operation (see VPG1) for the CFA profile indicated by the CFA PROFILE SUPPORTED field. If the SEQUENTIAL WRITE DATA SIZE field is set to zero, then no preferred number of logical blocks is indicated for stream field write operations by this CFA profile descriptor.

7.7.5 Device Constituents VPD page

The Device Constituents VPD page (see table 518) provides identifying information for the constituents (e.g., logical units in other SCSI devices, microcode, storage medium, or vendor specific information technology components) of the logical unit described in the standard INQUIRY data (see 6.7.2).

Table 518 – Device Constituents VPD page

Bit Byte	7	6	5	4	3	2	1	0
0	PERIPHERAL QUALIFIER			PERIPHERAL DEVICE TYPE				
1	PAGE CODE (8Bh)							
2	(MSB)			PAGE LENGTH (n-3)				
3								(LSB)
	Constituent descriptor list							
4 •••				Constituent descriptor (see table 519) [first]				
				• • •				
••• n				Constituent descriptor (see table 519) [last]				

The PERIPHERAL QUALIFIER field, PERIPHERAL DEVICE TYPE field, and PAGE LENGTH field are defined in 7.7.2.

The PAGE CODE field is defined in 7.7.2 and shall be set as shown in table 518 for the Device Constituents VPD page.

Each constituent descriptor (see table 519) contains identifying information for one constituent of the logical unit described in the standard INQUIRY data (see 6.7.2).

Table 519 – Constituent descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			CONSTITUENT TYPE				
1								(LSB)
2				CONSTITUENT DEVICE TYPE				
3				Reserved				
4	(MSB)			T10 VENDOR IDENTIFICATION				
•••								
11								(LSB)
12	(MSB)			PRODUCT IDENTIFICATION				
•••								
27								(LSB)
28	(MSB)			PRODUCT REVISION LEVEL				
•••								
31								(LSB)
32				Reserved				
33								
34	(MSB)			CONSTITUENT DESCRIPTOR LENGTH (n-35)				
35								(LSB)
				Constituent specific descriptor list				
36				Constituent specific descriptor [first]				
•••								
				⋮				
•••				Constituent specific descriptor [last]				
n								

The CONSTITUENT TYPE field (see table 520) indicates the constituent descriptor type.

Table 520 – CONSTITUENT TYPE field

Code	Description
0000h	Reserved
0001h	Virtual tape library
0002h	Virtual tape drive
0003h	Direct access block device
0004h to FFFFh	Reserved

The CONSTITUENT DEVICE TYPE field (see table 521) indicates the constituent descriptor type.

Table 521 – CONSTITUENT DEVICE TYPE field

Code	Description	Reference
00h to 1Fh	One of the values defined for the PERIPHERAL DEVICE TYPE field in the standard INQUIRY data	6.7.2
20h to FEh	Reserved	
FFh	Unknown	

The T10 VENDOR IDENTIFICATION field, PRODUCT IDENTIFICATION field, and the PRODUCT REVISION LEVEL field are identifying information for one constituent of the logical unit described in the standard INQUIRY data, and are as defined in 6.7.2.

The CONSTITUENT DESCRIPTOR LENGTH field indicates the length of the constituent specific descriptor list.

Each constituent specific descriptor (see table 522) contains information that is specific to the constituent.

Table 522 – Constituent specific descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	CONSTITUENT SPECIFIC TYPE							
1	Reserved							
2	(MSB)							
3	ADDITIONAL LENGTH (n-3)							(LSB)
4 ... n	Constituent specific data							

The CONSTITUENT SPECIFIC TYPE field (see table 523) indicates the type of constituent specific data in this descriptor.

Table 523 – CONSTITUENT SPECIFIC TYPE field

Code	Description
01h	VPD page
FFh	Vendor specific
all others	Reserved

The ADDITIONAL LENGTH field indicates the number of bytes that follow in this descriptor.

The contents of the constituent specific data depend on the value in the CONSTITUENT SPECIFIC TYPE field.

If the CONSTITUENT SPECIFIC TYPE field is set to 01h, then:

    a) the constituent specific data contains a VPD page (see 7.7.1); and
    b) the device server shall not set the PAGE CODE field in that VPD page to 8Bh (i.e., the VPD page in the constituent specific data shall not be a Device Constituents VPD page).

If SCSI port specific information or protocol specific information is reported in the Device Constituents VPD page, then that information shall be associated with the device constituent, not the addressed logical unit.

7.7.6 Device Identification VPD page

7.7.6.1 Device Identification VPD page overview

The Device Identification VPD page (see table 524) provides the means to retrieve designation descriptors applying to the logical unit. Logical units may have more than one designation descriptor (e.g., if several types or associations of designator are supported). Designators consist of one or more of the following:

    a) logical unit names;
    b) SCSI target port identifiers;
    c) SCSI target port names;
    d) SCSI device names;
    e) relative target port identifiers;
    f) primary target port group number; or
    g) logical unit group number.

Designation descriptors shall be assigned to the logical unit and not to the currently mounted media, in the case of removable media devices. Application clients should use the designation descriptors during system configuration activities to determine whether alternate paths exist for the same logical unit.

Table 524 – Device Identification VPD page

Bit / Byte	7	6	5	4	3	2	1	0
0	PERIPHERAL QUALIFIER			PERIPHERAL DEVICE TYPE				
1	PAGE CODE (83h)							
2	(MSB)			PAGE LENGTH (n-3)				
3								(LSB)
	Designation descriptor list							
4 •••	Designation descriptor [first]							
	⋮							
••• n	Designation descriptor [last]							

The PERIPHERAL QUALIFIER field, PERIPHERAL DEVICE TYPE field, and PAGE LENGTH field are defined in 7.7.2.

The PAGE CODE field is defined in 7.7.2 and shall be set as shown in table 524 for the Device Identification VPD page.

Each designation descriptor (see table 525) contains information identifying the logical unit, SCSI target device containing the logical unit, or access path (i.e., target port) used by the command and returned parameter data. The Device Identification VPD page shall contain the designation descriptors enumerated in 7.7.6.2.

Table 525 – Designation descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	PROTOCOL IDENTIFIER				CODE SET			
1	PIV	Reserved	ASSOCIATION		DESIGNATOR TYPE			
2	Reserved							
3	DESIGNATOR LENGTH (n-3)							
4	DESIGNATOR							
•••								
n								

The PROTOCOL IDENTIFIER field may indicate the SCSI transport protocol to which the designation descriptor applies. If the ASSOCIATION field is set to a value other than 01b (i.e., target port) or 10b (i.e., SCSI target device) or the PIV bit is set to zero, then the PROTOCOL IDENTIFIER field contents are reserved. If the ASSOCIATION field is set to a value of 01b or 10b and the PIV bit is set to one, then the PROTOCOL IDENTIFIER field shall contain one of the values shown in table 483 (see 7.6.1) to indicate the SCSI transport protocol to which the designation descriptor applies.

The CODE SET field contains a code set enumeration (see table 25) that indicates the format of the DESIGNATOR field.

A protocol identifier valid (PIV) bit set to zero indicates the PROTOCOL IDENTIFIER field contents are reserved. If the ASSOCIATION field is set to a value of 01b or 10b, then a PIV bit set to one indicates the PROTOCOL IDENTIFIER field contains a valid protocol identifier selected from the values shown in table 483 (see 7.6.1). If the ASSOCIATION field is set to a value other than 01b or 10b, then the PIV bit contents are reserved.

The ASSOCIATION field indicates the entity with which the DESIGNATOR field is associated, as described in table 526. If a logical unit returns a designation descriptor with the ASSOCIATION field set to 00b or 10b, the logical unit shall return the same descriptor when it is accessed through any other I_T nexus.

Table 526 – ASSOCIATION field

Code	Description
00b	The DESIGNATOR field is associated with the addressed logical unit.
01b	The DESIGNATOR field is associated with the target port that received the command.
10b	The DESIGNATOR field is associated with the SCSI target device that contains the addressed logical unit.
11b	Reserved

The DESIGNATOR TYPE field (see table 527) indicates the format and assignment authority for the designator.

Table 527 – DESIGNATOR TYPE field

Code	Description	Reference
0h	Vendor specific	7.7.6.3
1h	T10 vendor ID based	7.7.6.4
2h	EUI-64 based	7.7.6.5
3h	NAA	7.7.6.6
4h	Relative target port identifier	7.7.6.7
5h	Target port group	7.7.6.8
6h	Logical unit group	7.7.6.9
7h	MD5 logical unit identifier	7.7.6.10
8h	SCSI name string	7.7.6.11
9h	Protocol specific port identifier	7.7.6.12
Ah	UUID	7.7.6.13
Bh to Fh	Reserved	

The DESIGNATOR LENGTH field indicates the length in bytes of the DESIGNATOR field. The contents of the DESIGNATOR LENGTH field are not altered based on the allocation length (see 4.2.5.6).

The DESIGNATOR field contains the designator as described by the ASSOCIATION field, DESIGNATOR TYPE field, CODE SET field, and DESIGNATOR LENGTH field.

7.7.6.2 Device designation descriptor requirements

7.7.6.2.1 Designation descriptors for logical units other than well known logical units

For each logical unit that is not a well known logical unit, the Device Identification VPD page shall include at least one designation descriptor in which a logical unit name (see SAM-6) is indicated. The designation descriptor shall have the ASSOCIATION field set to 00b (i.e., logical unit) and the DESIGNATOR TYPE field set to:

    a) 1h (i.e., T10 vendor ID based);
    b) 2h (i.e., EUI-64-based);
    c) 3h (i.e., NAA);
    d) 8h (i.e., SCSI name string); or
    e) Ah (i.e., UUID).

At least one designation descriptor should have the DESIGNATOR TYPE field set to:

    a) 2h (i.e., EUI-64-based);
    b) 3h (i.e., NAA);
    c) 8h (i.e., SCSI name string); or
    d) Ah (i.e., UUID).

In the case of virtual logical units (e.g., volume sets as defined by SCC-2), designation descriptors should contain a DESIGNATOR TYPE field set to:

    a) 2h (i.e., EUI-64-based);
    b) 3h (i.e., NAA);
    c) 8h (i.e., SCSI name string); or

    d) Ah (i.e., UUID).

In the case of virtual logical units that have an EUI-64 based designation descriptor (see 7.7.6.5) the DESIG-NATOR LENGTH field should be set to:

    a) 0Ch (i.e., EUI-64-based 12-byte); or
    b) 10h (i.e., EUI-64-based 16-byte).

In the case of virtual logical units that have an NAA designation descriptor (see 7.7.6.6) the NAA field should be set to 6h (i.e., IEEE Registered Extended).

The Device Identification VPD page shall contain the same set of designation descriptors with the ASSOCIATION field set to 00b (i.e., logical unit) regardless of the I_T nexus being used to retrieve the designation descriptors.

For logical units that are not well known logical units, the requirements for SCSI target device designation descriptors are defined in 7.7.6.2.4 and the requirements for SCSI target port designation descriptors are defined in 7.7.6.2.3.

7.7.6.2.2 Designation descriptors for well known logical units

Well known logical units shall not return any designation descriptors with the ASSOCIATION field set to 00b (i.e., logical unit).

The Device Identification VPD page shall contain the same set of designation descriptors with the ASSOCIATION field set to 10b (i.e., SCSI target device) regardless of the I_T nexus being used to retrieve the designation descriptors.

7.7.6.2.3 Designation descriptors for SCSI target ports

7.7.6.2.3.1 Relative target port identifiers

For the target port through which the Device Identification VPD page is accessed, the Device Identification VPD page should include one designation descriptor with the ASSOCIATION field set to 01b (i.e., target port) and the DESIGNATOR TYPE field set to 4h (i.e., relative target port identifier) identifying the target port being used to retrieve the designation descriptors.

7.7.6.2.3.2 Target port names or identifiers

For the SCSI target port through which the Device Identification VPD page is accessed, the Device Identification VPD page should include one designation descriptor in which the target port name or identifier (see SAM-6) is indicated. The designation descriptor, if any, shall have the ASSOCIATION field set to 01b (i.e., target port) and the DESIGNATOR TYPE field set to:

    a) 2h (i.e., EUI-64-based);
    b) 3h (i.e., NAA);
    c) 8h (i.e., SCSI name string); or
    d) Ah (i.e., UUID).

If the SCSI transport protocol standard for the target port defines target port names, the designation descriptor, if any, shall contain the target port name. If the SCSI transport protocol for the target port does not define target port names, the designation descriptor, if any, shall contain the target port identifier.

7.7.6.2.4 Designation descriptors for SCSI target devices

If the SCSI target device contains a well known logical unit, the Device Identification VPD page shall have one or more designation descriptors for the SCSI target device. If the SCSI target device does not contain a well known logical unit, the Device Identification VPD page should have one or more designation descriptors for the SCSI target device.

Each SCSI target device designation descriptor, if any, shall have the ASSOCIATION field set to 10b (i.e., SCSI target device) and the DESIGNATOR TYPE field set to:

    a) 2h (i.e., EUI-64-based);
    b) 3h (i.e., NAA);
    c) 8h (i.e., SCSI name string); or
    d) Ah (i.e., UUID).

The Device Identification VPD page shall contain designation descriptors, if any, for all the SCSI device names for all the SCSI transport protocols supported by the SCSI target device.

7.7.6.3 Vendor specific designator format

If the designator type is 0h (i.e., vendor specific), no assignment authority was used and there is no guarantee that the designator is globally unique (i.e., the identifier is vendor specific). Table 528 defines the DESIGNATOR field format.

Table 528 – Vendor specific DESIGNATOR field

Bit Byte	7	6	5	4	3	2	1	0
0								
•••				VENDOR SPECIFIC IDENTIFIER				
n								

7.7.6.4 T10 vendor ID based designator format

If the designator type is 1h (i.e., T10 vendor ID based), the DESIGNATOR field has the format shown in table 529.

Table 529 – T10 vendor ID based DESIGNATOR field

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
•••				T10 VENDOR IDENTIFICATION				
7								(LSB)
8								
•••				VENDOR SPECIFIC IDENTIFIER				
n								

The T10 VENDOR IDENTIFICATION field contains eight bytes of left-aligned ASCII data (see 4.3.1) identifying the manufacturer of the product. The data shall be left aligned within this field. The T10 vendor identification shall be one assigned by INCITS. A list of assigned T10 vendor identifications is in Annex F and on the T10 web site (http://www.t10.org).

> NOTE 35 - The T10 web site (http://www.t10.org) provides a convenient means to request an identification code.

The organization associated with the T10 vendor identification is responsible for ensuring that the VENDOR SPECIFIC DESIGNATOR field is unique in a way that makes the T10 vendor ID based designator unique. A recommended method of constructing a unique DESIGNATOR field is to concatenate the PRODUCT IDENTIFICATION field from the standard INQUIRY data (see 6.7.2) and the PRODUCT SERIAL NUMBER field from the Unit Serial Number VPD page (see 7.7.19).

7.7.6.5 EUI-64 based designator format

7.7.6.5.1 EUI-64 based designator format overview

If the designator type is 2h (i.e., EUI-64 based), the DESIGNATOR LENGTH field (see table 530) indicates the format of the designation descriptor.

Table 530 – EUI-64 based designator lengths

Designator Length	Description	Reference
08h	EUI-64 identifier	7.7.6.5.2
0Ch	EUI-64 based 12-byte identifier	7.7.6.5.3
10h	EUI-64 based 16-byte identifier	7.7.6.5.4
all other values	Reserved	

7.7.6.5.2 EUI-64 designator format

If the designator type is 2h (i.e., EUI-64 based identifier) and the DESIGNATOR LENGTH field is set to 08h, the DESIGNATOR field has the format shown in table 531. The CODE SET field shall be set to 1h (i.e., binary).

Table 531 – EUI-64 identifier DESIGNATOR field

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
•••				IEEE IDENTIFIER				
7								(LSB)

The IEEE IDENTIFIER field contains an EUI-64 or an ELI-64.

7.7.6.5.3 EUI-64 based 12-byte designator format

If the designator type is 2h (i.e., EUI-64 based identifier) and the DESIGNATOR LENGTH field is set to 0Ch, the DESIGNATOR field has the format shown in table 532. The CODE SET field shall be set to 1h (i.e., binary).

Table 532 – EUI-64 based 12-byte DESIGNATOR field

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
•••				IEEE IDENTIFIER				
7								(LSB)
8	(MSB)							
•••				DIRECTORY ID				
11								(LSB)

The IEEE IDENTIFIER field contains an EUI-64 or an ELI-64.

The DIRECTORY ID field contains a directory identifier, as specified by ISO/IEC 13213:1994.

> NOTE 36 - The EUI-64 based 12-byte format is used to return IEEE 1394 target port identifiers (see SBP-3).

7.7.6.5.4 EUI-64 based 16-byte designator format

If the designator type is 2h (i.e., EUI-64 based identifier) and the DESIGNATOR LENGTH field is set to 10h, the DESIGNATOR field has the format shown in table 533. The CODE SET field shall be set to 1h (i.e., binary).

Table 533 – EUI-64 based 16-byte DESIGNATOR field

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
•••				IDENTIFIER EXTENSION				
7								(LSB)
8	(MSB)							
•••				IEEE IDENTIFIER				
15								(LSB)

The IDENTIFIER EXTENSION field contains a 64-bit numeric value.

The IEEE IDENTIFIER field contains an EUI-64 or an ELI-64.

> NOTE 37 - The EUI-64 based 16-byte format is used to return SCSI over RDMA target port identifiers (see SRP).

7.7.6.6 NAA designator format

7.7.6.6.1 NAA identifier basic format

If the designator type is 3h (i.e., NAA identifier), the DESIGNATOR field has the format shown in table 534. This format is compatible with the Name_Identifier format defined in FC-FS-6.

Table 534 – NAA DESIGNATOR field

Bit Byte	7	6	5	4	3	2	1	0
0			NAA					
1 ••• n				NAA specific data				

The Network Address Authority (NAA) field (see table 535) defines the format of the NAA specific data in the designator.

Table 535 – Network Address Authority (NAA) field

Code	Description	Reference
2h	IEEE Extended	7.7.6.6.2
3h	Locally Assigned	7.7.6.6.3
5h	IEEE Registered	7.7.6.6.4
6h	IEEE Registered Extended	7.7.6.6.5
All others	Reserved	

7.7.6.6.2 NAA IEEE Extended designator format

If NAA is 2h (i.e., IEEE Extended), the eight-byte fixed length DESIGNATOR field shall have the format shown in table 536. The CODE SET field shall be set to 1h (i.e., binary) and the DESIGNATOR LENGTH field shall be set to 08h.

Table 536 – NAA IEEE Extended DESIGNATOR field

Bit Byte	7	6	5	4	3	2	1	0
0			NAA (2h)		(MSB)			
1				VENDOR SPECIFIC IDENTIFIER A				(LSB)
2	(MSB)							
3				AOI				
4								(LSB)
5	(MSB)							
6				VENDOR SPECIFIC IDENTIFIER B				
7								(LSB)

The NAA field is described in 7.7.6.6.1 and shall be set as shown in table 536 for the NAA IEEE Extended designator format.

The VENDOR SPECIFIC IDENTIFIER A field contains a 12-bit numeric value that is assigned by the organization associated with the AOI in a way that combines with the VENDOR SPECIFIC IDENTIFIER B field to make the NAA IEEE Extended designator unique.

The AOI field contains an AOI assigned by the IEEE.

The VENDOR SPECIFIC IDENTIFIER B field contains a 24-bit numeric value that is assigned by the organization associated with the AOI in a way that combines with the VENDOR SPECIFIC IDENTIFIER A field to make the NAA IEEE Extended designator unique.

7.7.6.6.3 NAA Locally Assigned designator format

If NAA is 3h (i.e., Locally Assigned), the eight-byte fixed length DESIGNATOR field shall have the format shown in table 537. The CODE SET field shall be set to 1h (i.e., binary) and the DESIGNATOR LENGTH field shall be set to 08h.

Table 537 – NAA Locally Assigned DESIGNATOR field

Bit Byte	7	6	5	4	3	2	1	0
0	NAA (3h)							
1 ••• 7	LOCALLY ADMINISTERED VALUE							

The LOCALLY ADMINISTERED VALUE field contains a 60-bit value that is assigned by an administrator to be unique within the set of SCSI domains that are accessible by a common instance of an administrative tool or tools.

7.7.6.6.4 NAA IEEE Registered designator format

If NAA is 5h (i.e., IEEE Registered), the eight-byte fixed length DESIGNATOR field shall have the format shown in table 538. The CODE SET field shall be set to 1h (i.e., binary) and the DESIGNATOR LENGTH field shall be set to 08h.

Table 538 – NAA IEEE Registered DESIGNATOR field

Bit Byte	7	6	5	4	3	2	1	0
0	NAA (5h)			(MSB)				
1 2	AOI							
3			(LSB)	(MSB)				
4 ••• 7	VENDOR SPECIFIC IDENTIFIER							(LSB)

The NAA field is described in 7.7.6.6.1 and shall be set as shown in table 538 for the NAA IEEE Registered designator format.

The AOI field contains an AOI assigned by the IEEE.

The VENDOR SPECIFIC IDENTIFIER field contains a 36-bit numeric value that is assigned by the organization associated with the AOI in a way that makes the NAA IEEE Registered designator unique.

7.7.6.6.5 NAA IEEE Registered Extended designator format

If NAA is 6h (i.e., IEEE Registered Extended), the 16-byte fixed length DESIGNATOR field shall have the format shown in table 539. The CODE SET field shall be set to 1h (i.e., binary) and the DESIGNATOR LENGTH field shall be set to 10h.

Table 539 – NAA IEEE Registered Extended DESIGNATOR field

Bit Byte	7	6	5	4	3	2	1	0
0			NAA (6h)		(MSB)			
1								
2				AOI				
3				(LSB)	(MSB)			
4								
•••			VENDOR SPECIFIC IDENTIFIER					
7								(LSB)
8	(MSB)							
•••			VENDOR SPECIFIC IDENTIFIER EXTENSION					
15								(LSB)

The NAA field is described in 7.7.6.6.1 and shall be set as shown in table 539 for the NAA IEEE Registered Extended designator format.

The AOI field contains an AOI assigned by the IEEE.

The VENDOR SPECIFIC IDENTIFIER field contains a 36-bit numeric value that is assigned by the organization associated with the AOI in a way that combines with the VENDOR SPECIFIC IDENTIFIER EXTENSION field to make the NAA IEEE Registered Extended designator unique.

The VENDOR SPECIFIC IDENTIFIER EXTENSION field contains a 64-bit numeric value that is assigned by the organization associated with the AOI in a way that combines with the VENDOR SPECIFIC IDENTIFIER field to make the NAA IEEE Registered Extended designator unique.

7.7.6.7 Relative target port identifier designator format

If the designator type is 4h (i.e., relative target port identifier) and the ASSOCIATION field is set to 01b (i.e., target port), then the DESIGNATOR field shall have the format shown in table 540. The CODE SET field shall be set to 1h (i.e., binary) and the DESIGNATOR LENGTH field shall be set to 04h. If the ASSOCIATION field does not contain 01b, use of this designator type is reserved.

Table 540 – Relative target port identifier DESIGNATOR field

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved							
1								
2	(MSB)	RELATIVE TARGET PORT IDENTIFIER						
3								(LSB)

The RELATIVE TARGET PORT IDENTIFIER field (see 4.3.4) contains the relative port identifier of the target port on which the INQUIRY command was received.

7.7.6.8 Target port group designator format

If the designator type is 5h (i.e., target port group) and the ASSOCIATION value is 01b (i.e., target port), the four-byte fixed length DESIGNATOR field shall have the format shown in table 541. The CODE SET field shall be set to 1h (i.e., binary) and the DESIGNATOR LENGTH field shall be set to 04h. If the ASSOCIATION field does not contain 01b, use of this designator type is reserved.

Table 541 – Target port group DESIGNATOR field

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved							
1								
2	(MSB)	TARGET PORT GROUP						
3								(LSB)

The TARGET PORT GROUP field indicates the primary target port group to which the target port is a member (see 5.18).

7.7.6.9 Logical unit group designator format

If the designator type is 6h (i.e., logical unit group) and the ASSOCIATION value is 00b (i.e., logical unit), the four-byte fixed length DESIGNATOR field shall have the format shown in table 542. The CODE SET field shall be set to 1h (i.e., binary) and the DESIGNATOR LENGTH field shall be set to 04h. If the ASSOCIATION field does not contain 00b, use of this designator type is reserved.

Table 542 – Logical unit group DESIGNATOR field

Bit Byte	7	6	5	4	3	2	1	0
0				Reserved				
1								
2	(MSB)			LOGICAL UNIT GROUP				
3								(LSB)

The LOGICAL UNIT GROUP field indicates the logical unit group to which the logical unit is a member.

7.7.6.10 MD5 logical unit identifier designator format

If the designator type is 7h (i.e., MD5 logical unit identifier) and the ASSOCIATION value is 00b (i.e., logical unit), the DESIGNATOR field has the format shown in table 543. The CODE SET field shall be set to 1h (i.e., binary). The MD5 logical unit designator shall not be used if a logical unit provides unique identification using designator types 2h (i.e., EUI-64 based identifier), 3h (i.e., NAA identifier), 8h (i.e., SCSI name string), or Ah (i.e., UUID).

If the ASSOCIATION field does not contain 00b, use of this designator type is reserved.

Table 543 – MD5 logical unit identifier DESIGNATOR field

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
•••				MD5 LOGICAL UNIT IDENTIFIER				
15								(LSB)

The MD5 LOGICAL UNIT IDENTIFIER field contains the message digest of the supplied message input. The message digest shall be generated using the MD5 message-digest algorithm as defined in RFC 1321 with the following information as message input:

1) the contents of the T10 VENDOR IDENTIFICATION field in the standard INQUIRY data (see 6.7.2);
2) the contents of the PRODUCT IDENTIFICATION field in the standard INQUIRY data;
3) the contents of the PRODUCT SERIAL NUMBER field in the Unit Serial Number VPD page (see 7.7.19);
4) the contents of a vendor specific DESIGNATOR field (designator type 0h) from the Device Identification VPD page; and
5) the contents of a T10 vendor ID based DESIGNATOR field (designator type 1h) from the Device Identification VPD page.

If a field or page is not available, the message input for that field or page shall be 8 bytes of ASCII space characters (i.e., 20h).

The uniqueness of the MD5 logical unit identifier is dependent upon the relative degree of randomness (i.e., the entropy) of the message input. If two or more logical units have the same MD5 logical unit identifier, the application client should determine in a vendor specific manner whether the logical units are the same entities.

EXAMPLE – In this practical MD5 example, the data available for input to the MD5 algorithm is shown in table 544.

Table 544 – MD5 logical unit identifier example available data

MD5 message input	Available	Contents
T10 VENDOR IDENTIFICATION field	Yes	'T10'
PRODUCT IDENTIFICATION field	Yes	'MD5 Logical Unit'
PRODUCT SERIAL NUMBER field	Yes	'01234567'
vendor specific DESIGNATOR field	No	
T10 vendor ID based DESIGNATOR field	No	

In this example, the concatenation of the fields in table 544 to form input to the MD5 algorithm is shown in table 545.

Table 545 – Example MD5 input for computation of a logical unit identifier

Bytes	Hexadecimal values				ASCII values
00 to 15	54 31 30 20	20 20 20 20	4D 44 35 20	4C 6F 67 69	T10 MD5 Logi
16 to 31	63 61 6C 20	55 6E 69 74	30 31 32 33	34 35 36 37	cal Unit01234567
32 to 47	20 20 20 20	20 20 20 20	20 20 20 20	20 20 20 20	

Based on the example inputs shown in table 544 and the concatenation of the inputs shown in table 545, the MD5 base 16 algorithm described in RFC 1321 produces the value 8FAC A22A 0AC0 3839 1255 25F2 0EFE 2E7Eh.

7.7.6.11 SCSI name string designator format

If the designator type is 8h (i.e., SCSI name string), the DESIGNATOR field has the format shown in table 546. The CODE SET field shall be set to 3h (i.e., UTF-8).

Table 546 – SCSI name string DESIGNATOR field

Bit Byte	7	6	5	4	3	2	1	0
0								
•••				SCSI NAME STRING				
n								

The null-terminated, null-padded (see 4.3.2) SCSI NAME STRING field contains a UTF-8 format string. The number of bytes in the SCSI NAME STRING field (i.e., the value in the DESIGNATOR LENGTH field) shall be:

   a)   less than 256; and
   b)   a multiple of four.

The SCSI NAME STRING field starts with either:

   a)   the four UTF-8 characters 'eui.' concatenated with 16, 24, or 32 hexadecimal digits (i.e., the UTF-8 characters 0 to 9 and A to F) for an EUI-64 based identifier (see 7.7.6.5). The first hexadecimal digit

shall be the most significant four bits of the first byte (i.e., most significant byte) of the EUI-64 based identifier;

   b) the four UTF-8 characters 'naa.' concatenated with 16 or 32 hexadecimal digits for an NAA identifier (see 7.7.6.6). The first hexadecimal digit shall be the most significant four bits of the first byte (i.e., most significant byte) of the NAA identifier; or

   c) the four UTF-8 characters 'iqn.' concatenated with an iSCSI Name for an iSCSI-name based identifier (see iSCSI).

If the ASSOCIATION field is set to 00b (i.e., logical unit) and the SCSI NAME STRING field starts with the four UTF-8 characters 'iqn.', then the SCSI NAME STRING field ends with the five UTF-8 characters ',L,0x' concatenated with 16 hexadecimal digits for the logical unit name extension. The logical unit name extension is a UTF-8 string containing no more than 16 hexadecimal digits. The logical unit name extension is assigned by the SCSI target device vendor and shall be assigned so the logical unit name is world wide unique.

If the ASSOCIATION field is set to 01b (i.e., target port), the SCSI NAME STRING field ends with the five UTF-8 characters ',t,0x' concatenated with two or more hexadecimal digits as defined in the applicable SCSI transport protocol standard.

If the ASSOCIATION field is set to 10b (i.e., SCSI target device), the SCSI NAME STRING field has no additional characters.

7.7.6.12 Protocol specific port identifier designator format

7.7.6.12.1 Protocol specific port identifier designator format overview

If the designator type is 9h (i.e., protocol specific port identifier), then:

   a) the ASSOCIATION field shall be set to 01b (i.e., target port);
   b) the PIV bit shall set to one; and
   c) the contents of the PROTOCOL IDENTIFIER field (see table 547) indicate the format of the DESIGNATOR field.

Table 547 – Protocol specific port identifier DESIGNATOR formats

PROTOCOL IDENTIFIER field	Description	Reference
9h	USB target port identifier	7.7.6.12.2
Ah	PCI Express routing ID	7.7.6.12.3
all others	Reserved	

7.7.6.12.2 USB target port identifier designator format

If the DESIGNATOR TYPE field is set to 9h (i.e., protocol specific port identifier) and the PROTOCOL IDENTIFIER field is set to 9h (i.e., USB Attached SCSI), then:

    a) the DESCRIPTOR LENGTH field shall be set to four; and
    b) the DESIGNATOR field has the format is shown in table 548.

Table 548 – USB target port identifier DESIGNATOR field

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved	DEVICE ADDRESS						
1	Reserved							
2	INTERFACE NUMBER							
3	Reserved							

The DEVICE ADDRESS field contains a USB device address (see USB-3).

The INTERFACE NUMBER field contains a USB interface number within a USB configuration (see USB-3).

7.7.6.12.3 PCI Express routing ID designator format

If the DESIGNATOR TYPE field is set to 9h (i.e., protocol specific port identifier) and the PROTOCOL IDENTIFIER field is set to Ah (i.e., SCSI over PCI Express architecture), then:

    a) the DESCRIPTOR LENGTH field shall be set to eight; and
    b) the DESIGNATOR field has the format shown in table 549.

Table 549 – PCI Express routing ID DESIGNATOR field

Bit Byte	7	6	5	4	3	2	1	0
0	ROUTING ID							
1								
2	Reserved							
•••								
7								

The ROUTING ID field contains a PCI Express routing ID (see SOP).

7.7.6.13 UUID designator format

7.7.6.13.1 UUID designator basic format

If the designator type is Ah (i.e., UUID), the DESIGNATOR field has the format shown in table 550.

Table 550 – UUID DESIGNATOR field

Bit Byte	7	6	5	4	3	2	1	0
0	UUID TYPE							
1 ••• n	UUID specific data							

The UUID TYPE field (see table 551) defines the format of the content of the UUID specific data in the designator.

Table 551 – UUID TYPE field

Code	Description	Length	Reference
1h	Locally assigned RFC 4122 UUID	18 bytes	7.7.6.13.2
All others	Reserved		

7.7.6.13.2 Locally assigned RFC 4122 UUID format

If the UUID type is 1h (i.e., Locally assigned RFC 4122 UUID), the 18-byte fixed length DESIGNATOR field shall have the format shown in table 552. The CODE SET field shall be set to 1h (i.e., binary) and the DESIGNATOR LENGTH field shall be set to 12h.

Table 552 – UUID specific data for UUID type 1h

Bit Byte	7	6	5	4	3	2	1	0
0	UUID TYPE (1h)				Reserved			
1	Reserved							

2
•••
17
	(MSB)
	               LOCALLY ASSIGNED UUID
	     (LSB)							

The UUID TYPE field indicates the UUID type for this identifier and shall be set as shown in table 552.

The LOCALLY ASSIGNED UUID field contains an RFC 4122 structured UUID.

7.7.7 Extended INQUIRY Data VPD page

The Extended INQUIRY Data VPD page (see table 553) provides the application client with a means to obtain information about the logical unit.

Table 553 – Extended INQUIRY Data VPD page (part 1 of 2)

Bit Byte	7	6	5	4	3	2	1	0
0	PERIPHERAL QUALIFIER			PERIPHERAL DEVICE TYPE				
1	PAGE CODE (86h)							
2	(MSB)			PAGE LENGTH (003Ch)				
3								(LSB)
4	ACTIVATE MICROCODE		SPT			GRD_CHK	APP_CHK	REF_CHK
5	Reserved		UASK_SUP	GROUP_SUP	PRIOR_SUP	HEADSUP	ORDSUP	SIMPSUP
6	Reserved				WU_SUP	Obsolete	NV_SUP	V_SUP
7	Reserved		NO_PI_CHK	P_I_I_SUP	Reserved			LUICLR
8	LU COLLECTION TYPE			R_SUP	RTD_SUP	Reserved	HSSRELEF	Obsolete
9	Reserved				MULTI I_T NEXUS MICROCODE DOWNLOAD			
10	(MSB)			EXTENDED SELF-TEST COMPLETION MINUTES				
11								(LSB)
12	POA_SUP	HRA_SUP	VSA_SUP	DMS_VALID	Reserved			
13	MAXIMUM SUPPORTED SENSE DATA LENGTH							
14	Bind support byte							
	IBS	IAS	Reserved			SAC	NRD1	NRD0
15	(MSB)			MAXIMUM INQUIRY CHANGE LOGS				
16								(LSB)
17	(MSB)			MAXIMUM MODE PAGE CHANGE LOGS				
18								(LSB)
19	Download microcode support byte							
	DM_MD_4 [a]	DM_MD_5 [b]	DM_MD_6 [c]	DM_MD_7 [d]	DM_MD_D [e]	DM_MD_E [f]	DM_MD_F [g]	Reserved
20 ••• 63	Reserved							

[a] The DM_MD_4 bit indicates support for the download microcode and activate (i.e., 04h) mode.
[b] The DM_MD_5 bit indicates support for the download microcode, save, and activate (i.e., 05h) mode.
[c] The DM_MD_6 bit indicates support for the download microcode with offsets and activate (i.e., 06h) mode.
[d] The DM_MD_7 bit indicates support for the download microcode with offsets, save, and activate (i.e., 07h) mode.

Table 553 – Extended INQUIRY Data VPD page (part 2 of 2)

Bit Byte	7	6	5	4	3	2	1	0
^e The DM_MD_D bit indicates support for the download microcode with offsets, select activation events, save, and defer activate (i.e., 0Dh) mode. ^f The DM_MD_E bit indicates support for the download microcode with offsets, save, and defer activate (i.e., 0Eh) mode. ^g The DM_MD_F bit indicates support for the activate deferred microcode (i.e., 0Fh) mode.								

The PERIPHERAL QUALIFIER field and PERIPHERAL DEVICE TYPE field are defined in 7.7.2.

The PAGE CODE field and PAGE LENGTH field are defined in 7.7.2, and shall be set to the value shown in table 553 for the Extended INQUIRY Data VPD page.

The ACTIVATE MICROCODE field (see table 554) indicates how a device server activates microcode and establishes a unit attention condition during the processing of a WRITE BUFFER command (see 6.49) with the download microcode mode set to 05h or 07h (see 5.5).

Table 554 – ACTIVATE MICROCODE field

Code	Meaning
00b	The actions of the device server are not indicated.
01b	The device server: 1) activates the microcode before completion of the final command in the WRITE BUFFER sequence; and 2) establishes zero or more unit attention conditions as described in 5.5.2.

10b	The device server:
	1) activates the microcode after:
	  A) a vendor specific event;
	  B) a power on event; or
	  C) a hard reset event;
	  and
	2) establishes a unit attention condition for the SCSI initiator port associated with every I_T nexus with the additional sense code set to MICROCODE HAS BEEN CHANGED.

11b	Reserved

The supported protection type (SPT) field indicates the type of protection the logical unit supports based on the contents of the PERIPHERAL DEVICE TYPE field. If the PROTECT bit (see 6.7.2) is set to zero, the SPT field is reserved. If the device server supports the Supported Block Lengths and Protection Types VPD page (see SBC-5) and the SBLP bit is set to one in the Control mode page (see 7.5.13), then the SPT field shall be set to 110b (i.e., specified in the Supported Block Lengths and Protection Types VPD page).

If the PERIPHERAL DEVICE TYPE field is set to 00h (i.e., direct access block device) and the PROTECT bit is set to one, then table 555 defines the contents of the SPT field.

Table 555 – SPT field for device type value 00h

Code	Protection type supported		
	Type 1	Type 2	Type 3
000b	yes	no	no
001b	yes	yes	no
010b	no	yes	no
011b	yes	no	yes
100b	no	no	yes
101b	no	yes	yes
110b	See the Supported Block Lengths and Protection Types VPD page in SBC-5.		
111b	yes	yes	yes

If the PERIPHERAL DEVICE TYPE field is set to 01h (i.e., sequential access device) and the PROTECT bit is set to one, then table 556 defines the contents of the SPT field.

Table 556 – SPT field for device type value 01h

Code	Protection type supported
001b	Logical block protection
all others	Reserved

If the PROTECT bit is set to one and the PERIPHERAL DEVICE TYPE field is set to a value other than 00h or 01h, the SPT field is reserved.

If the SPT field is not set to 110b, a guard check (GRD_CHK) bit set to zero indicates that the device server does not check the LOGICAL BLOCK GUARD field in the protection information (see SBC-5), if any. A GRD_CHK bit set to one indicates that the device server checks the LOGICAL BLOCK GUARD field in the protection information, if any. If the SPT field is set to 110b, the GRD_CHK bit shall be set to zero.

If the SPT field is not set to 110b, an application tag check (APP_CHK) bit set to zero indicates that the device server does not check the LOGICAL BLOCK APPLICATION TAG field in the protection information (see SBC-5), if any. An APP_CHK bit set to one indicates that the device server checks the LOGICAL BLOCK APPLICATION TAG field in the protection information, if any. If the SPT field is set to 110b, the APP_CHK bit shall be set to zero.

If the SPT field is not set to 110b, a reference tag check (REF_CHK) bit set to zero indicates that the device server does not check the LOGICAL BLOCK REFERENCE TAG field in the protection information (see SBC-5), if any. A REF_CHK bit set to one indicates that the device server checks the LOGICAL BLOCK REFERENCE TAG field in the protection information, if any. If the SPT field is set to 110b, the REF_CHK bit shall be set to zero.

A unit attention condition sense key specific data supported (UASK_SUP) bit set to one indicates that the device server returns sense-key specific data for the UNIT ATTENTION sense key (see 4.4.2.4.6). A UASK_SUP bit set to zero indicates that the device server does not return sense-key specific data for the UNIT ATTENTION sense key.

A grouping function supported (GROUP_SUP) bit set to one indicates that the grouping function (see SBC-5) is supported by the device server. A GROUP_SUP bit set to zero indicates that the grouping function is not supported.

A priority supported (PRIOR_SUP) bit set to one indicates that command priority (see SAM-6) is supported by the logical unit. A PRIOR_SUP bit set to zero indicates that command priority is not supported.

A head of queue supported (HEADSUP) bit set to one indicates that the HEAD OF QUEUE task attribute (see SAM-6) is supported by the logical unit. A HEADSUP bit set to zero indicates that the HEAD OF QUEUE task attribute is not supported. If the HEADSUP bit is set to zero, application clients should not specify the HEAD OF QUEUE task attribute as an Execute Command (see SAM-6) procedure call argument.

An ordered supported (ORDSUP) bit set to one indicates that the ORDERED task attribute (see SAM-6) is supported by the logical unit. An ORDSUP bit set to zero indicates that the ORDERED task attribute is not supported. If the ORDSUP bit is set to zero, application clients should not specify the ORDERED task attribute as an Execute Command procedure call argument.

The simple supported (SIMPSUP) bit shall be set to one indicating that the SIMPLE task attribute (see SAM-6) is supported by the logical unit.

SAM-6 defines how unsupported task attributes are processed.

A write uncorrectable supported (WU_SUP) bit set to zero indicates that the device server does not support application clients setting the WR_UNCOR bit to one in the WRITE LONG command (see SBC-5). A WU_SUP bit set to one indicates that the device server supports application clients setting the WR_UNCOR bit to one in the WRITE LONG command.

A nonvolatile cache supported (NV_SUP) bit set to one indicates that the device server supports a non-volatile cache and that the applicable command standard defines features using this cache (e.g., the FUA_NV bit in SBC-2). An NV_SUP bit set to zero indicates that the device server may or may not support a nonvolatile cache.

A volatile cache supported (V_SUP) bit set to one indicates that the device server supports a volatile cache and that the applicable command standard defines features using this cache (e.g., the FUA bit in SBC-5). An V_SUP bit set to zero indicates that the device server may or may not support a volatile cache.

If the SPT field is not set to 110b, a no protection information checking (NO_PI_CHK) bit set to one indicates that the device server disables checking of all protection information for the associated protection information interval when performing a write operation if:

a) the LOGICAL BLOCK APPLICATION TAG field is set to FFFFh and type 1 protection (see SBC-5) is enabled;
b) the LOGICAL BLOCK APPLICATION TAG field is set to FFFFh and type 2 protection (see SBC-5) is enabled; or
c) the LOGICAL BLOCK APPLICATION TAG field is set to FFFFh, the LOGICAL BLOCK REFERENCE TAG field is set to FFFF FFFFh, and type 3 protection (see SBC-5) is enabled.

A NO_PI_CHK bit set to zero indicates that the device server checks protection information as specified by the WRPROTECT field (see SBC-5) when performing a write operation. If the SPT field is set to 110b, the NO_PI_CHK bit shall be set to zero.

If the SPT field is not set to 110b, a protection information interval supported (P_I_I_SUP) bit set to one indicates that the logical unit supports protection information intervals (see SBC-5). A P_I_I_SUP bit set to zero indicates

that the logical unit does not support protection information intervals. If the SPT field is set to 110b, the P_I_I_SUP bit shall be set to zero.

A logical unit I_T nexus clear (LUICLR) bit set to one indicates the SCSI target device clears any unit attention condition with an additional sense code of REPORTED LUNS DATA HAS CHANGED in each logical unit accessible to an I_T nexus after reporting the unit attention condition for any logical unit over that I_T nexus (see SAM-6). An LUICLR bit set to zero indicates the SCSI target device clears unit attention conditions as defined in SPC-3. The LUICLR bit shall be set to one.

The logical unit collection type (LU COLLECTION TYPE) field (see table 557) indicates the type of logical unit collection (see 5.18.2.2) used by a logical unit conglomerate to report primary target port asymmetric access state.

Table 557 – LU COLLECTION TYPE field

Code	Description
000b	Collection type not reported
001b	Conglomerate collection type
010b	Logical unit group collection type
all others	Reserved

A referrals supported (R_SUP) bit set to zero indicates that the device server does not support referrals (see SBC-5). An R_SUP bit set to one indicates that the device server supports referrals.

A revert to defaults supported (RTD_SUP) bit set to zero indicates that the device does not support the RTD bit being set to one in a MODE SELECT command (see 6.12 and 6.12). A RTD_SUP bit set to one indicates that the device supports the RTD bit being set to one in a MODE SELECT command.

The history snapshots release effects (HSSRELEF) bit indicates how the device server handles device internal status data in response to specified causes (see 5.6.4). A HSSRELEF bit set to zero indicates the device server implements normal reset handling (see 5.6.4). A HSSRELEF bit set to one indicates the device server implements alternate reset handling (see 5.6.4).

The MULTI I_T NEXUS MICROCODE DOWNLOAD field (see table 55 in 5.5) indicates how the device server handles concurrent attempts to download microcode using the WRITE BUFFER command (see 5.5) from multiple I_T nexuses.

The EXTENDED SELF-TEST COMPLETION MINUTES field contains advisory data that is the time in minutes that the device server requires to complete an extended self-test provided the device server is not interrupted by subsequent commands and no errors occur during processing of the self-test. The application client should expect the self-test completion time to exceed the value in this field if other commands are sent to the logical unit while a self-test is in progress or if errors occur during the processing of the self-test. If a device server supports SELF-TEST CODE field values other than 000b for the SEND DIAGNOSTIC command (see 6.39) and the self-test completion time is greater than 18 hours, then the device server shall support the EXTENDED SELF-TEST COMPLETION MINUTES field. A value of 0000h indicates that the EXTENDED SELF-TEST COMPLETION MINUTES field is not supported. A value of FFFFh indicates that the extended self-test takes 65 535 minutes (i.e., 45 days, 12 hours, and 15 minutes) or longer.

A power on activation supported (POA_SUP) bit set to one indicates that the device server supports a WRITE BUFFER command with the MODE field set to 0Dh (see 6.49.9) and the PO_ACT bit set to one. A POA_SUP bit set to zero indicates that the device server does not support a WRITE BUFFER command with the MODE field set to 0Dh and the PO_ACT bit set to one.

A hard reset activation supported (HRA_SUP) bit set to one indicates that the device server supports a WRITE BUFFER command with the MODE field set to 0Dh (see 6.49.9) and the HR_ACT bit set to one. A HRA_SUP bit set to zero indicates that the device server does not support a WRITE BUFFER command with the MODE field set to 0Dh and the HR_ACT bit set to one.

A vendor specific activation supported (VSA_SUP) bit set to one indicates that the device server supports a WRITE BUFFER command with the MODE field set to 0Dh (see 6.49.9) and the VSE_ACT bit set to one. A VSA_SUP bit set to zero indicates that the device server does not support a WRITE BUFFER command with the MODE field set to 0Dh and the VSE_ACT bit set to one.

A DMS_VALID bit set to one indicates that the download microcode support byte is valid. A DMS_VALID bit set to zero indicates that the download microcode support byte is not valid.

The MAXIMUM SUPPORTED SENSE DATA LENGTH field indicates the maximum length in bytes of sense data (see 4.4) that the device server is capable of including in the same I_T nexus transaction as the status. A MAXIMUM SUPPORTED SENSE DATA LENGTH field set to zero indicates that the device server does not report a maximum length. This value shall be less than or equal to 252.

The bind support byte indicates support for logical unit binding and unbinding (see 5.8). A bind support byte set to zero indicates that logical unit binding and unbinding are not supported. In a logical unit conglomerate, the bind support byte value for a subsidiary logical unit shall be the same as the bind support byte value for the administrative logical unit associated with that subsidiary logical unit.

An implicit bind supported (IBS) bit set to one indicates that implicit bind operations (see 5.8.11) are supported by the device server. An IBS bit set to zero indicates that implicit bind operations are not supported by the device server.

An implicit affiliation supported (IAS) bit set to one indicates that the implicit management of affiliations (see 5.8.6) is supported by the device server. An IAS bit set to zero indicates that the implicit management of affiliations is not supported by the device server.

A SET AFFILIATION command supported (SAC) bit set to one indicates that the SET AFFILIATION command (see 6.40) is supported by the device server. A SAC bit set to zero indicates that the SET AFFILIATION command is not supported by the device server.

A no redirect one supported (NRD1) bit set to one indicates that BIND commands (see 6.2) with the NRD bit set to one are supported by the device server. A NRD1 bit set to zero indicates that BIND commands with the NRD bit set to one are not supported by the device server.

A no redirect zero supported (NRD0) bit set to one indicates that BIND commands with the NRD bit set to zero are supported by the device server. A NRD0 bit set to zero indicates that BIND commands with the NRD bit set to zero are not supported by the device server.

The MAXIMUM INQUIRY CHANGE LOGS field indicates the maximum number of log parameters supported in the Last *n* Inquiry Data Changed log page (see 7.3.15). A value of 0000h indicates that the Last *n* Inquiry Data Changed log page is not supported. For example, a value of 0005h indicates that the Last *n* Inquiry Data Changed log supports four Inquiry Data Changed Indicator log parameters.

The MAXIMUM MODE PAGE CHANGE LOGS field indicates the maximum number of log parameters supported in the Last *n* Mode Page Data Changed log page (see 7.3.16). A value of 0000h indicates that the Last *n* Mode Page Data Changed log page is not supported. For example, a value of 0005h indicates that the Last *n* Mode Page Data Changed log supports four Mode Page Data Changed Indicator log parameters.

The download microcode support byte (see table 553) indicates the WRITE BUFFER microcode download modes (see 5.5.1) that the device server supports. If the DMS_VALID bit is set to one, then each of the DM_MD_4 bit, the DM_MD_5 bit, the DM_MD_6 bit, the DM_MD_7 bit, the DM_MD_D bit, the DM_MD_E bit, and the DM_MD_F bit being set to:

a) one indicates that the corresponding microcode download mode is supported; and
b) zero indicates that the corresponding microcode download mode is not supported.

7.7.8 Management Network Addresses VPD page

The Management Network Addresses VPD page (see table 558) provides a list of network addresses of management services associated with a SCSI target device, target port, or logical unit.

Table 558 – Management Network Addresses VPD page

Bit Byte	7	6	5	4	3	2	1	0
0	PERIPHERAL QUALIFIER			PERIPHERAL DEVICE TYPE				
1	PAGE CODE (85h)							
2	(MSB)		PAGE LENGTH (n-3)					
3								(LSB)
	Network services descriptor list							
4 •••	Network services descriptor [first]							
	⋮							
••• n	Network services descriptor [last]							

The PERIPHERAL QUALIFIER field, PERIPHERAL DEVICE TYPE field, and PAGE LENGTH field are defined in 7.7.2.

The PAGE CODE field is defined in 7.7.2 and shall be set as shown in table 558 for the Management Network Address VPD page.

Each network service descriptor (see table 559) contains information about one management service.

Table 559 – Network service descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved	ASSOCIATION		SERVICE TYPE				
1	Reserved							
2	(MSB)	NETWORK ADDRESS LENGTH (n-3)						
3								(LSB)
4		NETWORK ADDRESS						
•••								
n								

The ASSOCIATION field (see table 526 in 7.7.6.1) indicates the entity (i.e., SCSI target device, target port, or logical unit) with which the service is associated.

The SERVICE TYPE field (see table 560) allows differentiation of multiple services with the same protocol running at different port numbers or paths.

> NOTE 38 - A SCSI target device is allowed to provide separate HTTP services for configuration and diagnostics. One of these services uses the standard HTTP port 80 and the other service uses a different port (e.g., 8080).

Table 560 – SERVICE TYPE field

Code	Description
00h	Unspecified
01h	Storage Configuration Service
02h	Diagnostics
03h	Status
04h	Logging
05h	Code Download
06h	Copy Service
07h	Administrative Configuration Service
08h to 1Fh	Reserved

The NETWORK ADDRESS LENGTH field indicates the length in bytes of the NETWORK ADDRESS field. The network address length shall be a multiple of four.

The null-terminated, null-padded NETWORK ADDRESS field contains the URL form of a URI as defined in RFC 3986.

7.7.9 Mode Page Policy VPD page

The Mode Page Policy VPD page (see table 561) indicates which mode page policy (see 7.5.3) is in effect for each mode page supported by the logical unit.

Table 561 – Mode Page Policy VPD page

Bit Byte	7	6	5	4	3	2	1	0
0	PERIPHERAL QUALIFIER			PERIPHERAL DEVICE TYPE				
1	PAGE CODE (87h)							
2	(MSB)			PAGE LENGTH (n-3)				
3								(LSB)
	Mode page policy descriptor list							
4 ••• 7				Mode page policy descriptor [first]				
				⋮				
n-3 ••• n				Mode page policy descriptor [last]				

The PERIPHERAL QUALIFIER field, PERIPHERAL DEVICE TYPE field, and PAGE LENGTH field are defined in 7.7.2.

The PAGE CODE field is defined in 7.7.2 and shall be set as shown in table 561 for the Mode Page Policy VPD page.

Each mode page policy descriptor (see table 562) contains information describing the mode page policy for one or more mode pages or subpages (see 7.5.8). The information in the mode page policy descriptors in this VPD page shall describe the mode page policy for every mode page and subpage supported by the logical unit.

Table 562 – Mode page policy descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved			POLICY PAGE CODE				
1	POLICY SUBPAGE CODE							
2	MLUS		Reserved				MODE PAGE POLICY	
3	Reserved							

The POLICY PAGE CODE field and POLICY SUBPAGE CODE field indicate the mode page and subpage to which the descriptor applies. The POLICY PAGE CODE field contains the value that is used in a MODE SENSE command (see table 170 in 6.13.1) to retrieve the mode page being described.

If the first mode page policy descriptor in the list contains a POLICY PAGE CODE field set to 3Fh and a POLICY SUBPAGE CODE field set to FFh, then the descriptor applies to all mode pages and subpages not described by other mode page policy descriptors. The POLICY PAGE CODE field shall be set to 3Fh and the POLICY SUBPAGE CODE field shall be set to FFh only in the first mode page policy descriptor in the list.

If the POLICY PAGE CODE field is set to a value other than 3Fh and a POLICY SUBPAGE CODE field is set to a value other than FFh, then the POLICY PAGE CODE field and the POLICY SUBPAGE CODE field indicate a single mode page and subpage to which the descriptor applies.

If the POLICY PAGE CODE field is set to a value other than 3Fh, the POLICY SUBPAGE CODE field shall contain a value other than FFh. If the POLICY SUBPAGE CODE field is set to a value other than FFh, then POLICY PAGE CODE field shall contain a value other than 3Fh.

If the SCSI target device has more than one logical unit, a multiple logical units share (MLUS) bit set to one indicates the mode page and subpage identified by the POLICY PAGE CODE field and POLICY SUBPAGE CODE field is shared by more than one logical unit. A MLUS bit set to zero indicates the logical unit maintains its own copy of the mode page and subpage identified by the POLICY PAGE CODE field and POLICY SUBPAGE CODE field.

The MLUS bit is set to one in the mode page policy descriptors or descriptor that indicates the mode page policy for:

    a)   the Disconnect-Reconnect mode page (see 7.5.15); and
    b)   the Protocol Specific Port mode page (see 7.5.21).

The MODE PAGE POLICY field (see table 563) indicates the mode page policy for the mode page and subpage identified by the POLICY PAGE CODE field and POLICY SUBPAGE CODE field. The mode page policies are described in table 443 (see 7.5.3).

Table 563 – MODE PAGE POLICY field

Code	Description
00b	Shared
01b	Per target port
10b	Obsolete
11b	Per I_T nexus

7.7.10 Power Condition VPD page

The Power Condition VPD page (see table 564) indicates which power conditions (see 5.13) are supported by the logical unit and provides information about how those power conditions operate.

Table 564 – Power Condition VPD page

Bit Byte	7	6	5	4	3	2	1	0
0	PERIPHERAL QUALIFIER			PERIPHERAL DEVICE TYPE				
1	PAGE CODE (8Ah)							
2	(MSB)	PAGE LENGTH (000Eh)							
3									(LSB)
4	Reserved						STANDBY_Y	STANDBY_Z
5	Reserved					IDLE_C	IDLE_B	IDLE_A
6	(MSB)	STOPPED CONDITION RECOVERY TIME							
7								(LSB)
8	(MSB)	STANDBY_Z CONDITION RECOVERY TIME							
9								(LSB)
10	(MSB)	STANDBY_Y CONDITION RECOVERY TIME							
11								(LSB)
12	(MSB)	IDLE_A CONDITION RECOVERY TIME							
13								(LSB)
14	(MSB)	IDLE_B CONDITION RECOVERY TIME							
15								(LSB)
16	(MSB)	IDLE_C CONDITION RECOVERY TIME							
17								(LSB)

The PERIPHERAL QUALIFIER field and PERIPHERAL DEVICE TYPE field are defined in 7.7.2.

The PAGE CODE field and PAGE LENGTH field are defined in 7.7.2, and shall be set to the value shown in table 564 for the Power Condition VPD page.

If set to one, a power condition support bit (i.e., the STANDBY_Y bit, the STANDBY_Z bit, the IDLE_C bit, the IDLE_B bit, and the IDLE_A bit) indicates that:

    a) the associated power condition may be entered with the START STOP UNIT command (see SBC-5) if that command is implemented; and

    b) the associated power condition may be entered with a power condition timer if the associated timer is supported and enabled (see 7.5.18).

A STANDBY_Y power conditions support bit set to one indicates that the logical unit supports the standby_y power condition as described in 5.13. A STANDBY_Y bit set to zero indicates that the logical unit does not support the standby_y power condition.

A STANDBY_Z power conditions support bit set to one indicates that the logical unit supports the standby_z power condition as described in 5.13. A STANDBY_Z bit set to zero indicates that the logical unit does not support the standby_z power condition.

A IDLE_C power conditions support bit set to one indicates that the logical unit supports the idle_c power condition as described in 5.13. A IDLE_C bit set to zero indicates that the logical unit does not support the idle_c power condition.

A IDLE_B power conditions support bit set to one indicates that the logical unit supports the idle_b power condition as described in 5.13. A IDLE_B bit set to zero indicates that the logical unit does not support the idle_b power condition.

A IDLE_A power conditions support bit set to one indicates that the logical unit supports the idle_a power condition as described in 5.13. A IDLE_A bit set to zero indicates that the logical unit does not support the idle_a power condition.

The STOPPED CONDITION RECOVERY TIME field indicates the time, in one millisecond increments, that the logical unit takes to transition from the stopped power condition to the active power condition. This field is only applicable to logical units that implement the START STOP UNIT command (see SBC-5). This time does not include the processing time for the command that caused this transition to occur or any SCSI transport protocol specific waiting time (e.g., the NOTIFY (ENABLE SPINUP) requirement described in SPL-5). A value of zero indicates that the recovery time is not specified. A value of FFFFh indicates that the recovery time is more than 65.534 seconds.

The STANDBY_Z CONDITION RECOVERY TIME field indicates the time, in one millisecond increments, that the logical unit takes to transition from the standby_z power condition to the active power condition. This time does not include the processing time for the command that caused this transition to occur or any SCSI transport protocol specific waiting time (e.g., the NOTIFY (ENABLE SPINUP) requirement described in SPL-5). A value of zero indicates that the recovery time is not specified. A value of FFFFh indicates that the recovery time is more than 65.534 seconds.

The STANDBY_Y CONDITION RECOVERY TIME field indicates the time, in one millisecond increments, that the logical unit takes to transition from the standby_y power condition to the active power condition. This time does not include the processing time for the command that caused this transition to occur or any SCSI transport protocol specific waiting time (e.g., the NOTIFY (ENABLE SPINUP) requirement described in SPL-5). A value of zero indicates that the recovery time is not specified. A value of FFFFh indicates that the recovery time is more than 65.534 seconds.

The IDLE_A CONDITION RECOVERY TIME field indicates the time, in one millisecond increments, that the logical unit takes to transition from the idle_a power condition to the active power condition. This time does not include the processing time for the command that caused this transition to occur. A value of zero indicates that the recovery time is not specified. A value of FFFFh indicates that the recovery time is more than 65.534 seconds.

The IDLE_B CONDITION RECOVERY TIME field indicates the time, in one millisecond increments, that the logical unit takes to transition from the idle_b power condition to the active power condition. This time does not include the processing time for the command that caused this transition to occur. A value of zero indicates that the recovery time is not specified. A value of FFFFh indicates that the recovery time is more than 65.534 seconds.

The IDLE_C CONDITION RECOVERY TIME field indicates the time, in one millisecond increments, that the logical unit takes to transition from the idle_c power condition to the active power condition. This time does not include the processing time for the command that caused this transition to occur. A value of zero indicates that

the recovery time is not specified. A value of FFFFh indicates that the recovery time is more than 65.534 seconds.

7.7.11 Power Consumption VPD page

The Power Consumption VPD page (see table 565) provides an application client with a list of the available settings to limit the maximum power consumption (e.g., see USB-3) of the logical unit while in the active power condition (see 5.13.5) as described in 5.13.2.

Table 565 – Power Consumption VPD page

Bit Byte	7	6	5	4	3	2	1	0
0	PERIPHERAL QUALIFIER			PERIPHERAL DEVICE TYPE				
1	PAGE CODE (8Dh)							
2	(MSB)			PAGE LENGTH (n-3)				
3								(LSB)
	Power consumption descriptor list							
4 ••• 7	Power consumption descriptor [first]							
	⋮							
n-3 ••• n	Power consumption descriptor [last]							

The PERIPHERAL QUALIFIER field and PERIPHERAL DEVICE TYPE field are defined in 7.7.2.

The PAGE CODE field and PAGE LENGTH field are defined in 7.7.2, and shall be set to the value shown in table 565 for the Power Consumption VPD page.

Each power consumption descriptor (see table 566) describes one maximum power consumption level that the application client may establish for use by the active power condition (see 5.13.5) using the Power Consumption mode page (see 7.5.19) as described in 5.13.2.

Table 566 – Power consumption descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	POWER CONSUMPTION IDENTIFIER							
1	Reserved					POWER CONSUMPTION UNITS		
2	(MSB)			POWER CONSUMPTION VALUE				
3								(LSB)

The POWER CONSUMPTION IDENTIFIER field contains a value that the application client or device server may use in the Power Consumption mode page (see 7.5.19) to specify which descriptor is being used to effect the maximum power consumption level.

The POWER CONSUMPTION UNITS field (see table 567) indicates the units used for the POWER CONSUMPTION VALUE field.

Table 567 – POWER CONSUMPTION UNITS field

Code	Units
000b	Gigawatts
001b	Megawatts
010b	Kilowatts
011b	Watts
100b	Milliwatts
101b	Microwatts
all others	Reserved

The POWER CONSUMPTION VALUE field indicates the maximum power consumption associated with the identifier in the POWER CONSUMPTION IDENTIFIER field using the units specified by the POWER CONSUMPTION UNITS field.

7.7.12 Protocol Specific Logical Unit Information VPD page

The Protocol Specific Logical Unit Information VPD page (see table 568) contains protocol specific data associated with a SCSI port that may be different for each logical unit in the SCSI target device.

Table 568 – Protocol Specific Logical Unit Information VPD page

Bit Byte	7	6	5	4	3	2	1	0
0	PERIPHERAL QUALIFIER			PERIPHERAL DEVICE TYPE				
1	PAGE CODE (90h)							
2	(MSB)			PAGE LENGTH (n-3)				
3								(LSB)
	Logical unit information descriptor list							
4 ...				Logical unit information descriptor (see table 569) [first]				
				• • •				
... n				Logical unit information descriptor (see table 569) [last]				

The PERIPHERAL QUALIFIER field, PERIPHERAL DEVICE TYPE field, and PAGE LENGTH field are defined in 7.7.2.

The PAGE CODE field is defined in 7.7.2 and shall be set as shown in table 568 for the Protocol Specific Logical Unit Information VPD page.

The logical unit information descriptor list contains descriptors for SCSI ports known to the device server that is processing the INQUIRY command. The logical unit information descriptors (see table 569) may be returned in any order.

Table 569 – Logical unit information descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			RELATIVE PORT IDENTIFIER				
1								(LSB)
2			Reserved			PROTOCOL IDENTIFIER		
3								
4				Reserved				
5								
6	(MSB)			PROTOCOL SPECIFIC DATA LENGTH (n-7)				
7								(LSB)
8				Per logical unit SCSI transport protocol specific				
n				data				

The RELATIVE PORT IDENTIFIER field (see 4.3.4) indicates the relative port identifier of the SCSI port to which the logical unit information descriptor applies.

The PROTOCOL IDENTIFIER field indicates the SCSI transport protocol to which the logical unit information descriptor applies as described in 7.6.1.

The PROTOCOL SPECIFIC DATA LENGTH field indicates the length in bytes of the per logical unit SCSI transport protocol specific data.

The per logical unit SCSI transport protocol specific data is defined by the SCSI transport protocol standard that corresponds to the SCSI port.

7.7.13 Protocol Specific Port Information VPD page

The Protocol Specific Port Information VPD page (see table 570) contains protocol specific data associated with a SCSI port that are the same for all logical units in the SCSI target device.

Table 570 – Protocol Specific Port Information VPD page

Bit Byte	7	6	5	4	3	2	1	0
0	PERIPHERAL QUALIFIER			PERIPHERAL DEVICE TYPE				
1	PAGE CODE (91h)							
2	(MSB)			PAGE LENGTH (n-3)				
3								(LSB)
	Port information descriptor list							
4 •••		Port information descriptor (see table 569) [first]						
				⋮				
••• n		Port information descriptor (see table 569) [last]						

The PERIPHERAL QUALIFIER field, PERIPHERAL DEVICE TYPE field, and PAGE LENGTH field are defined in 7.7.2.

The PAGE CODE field is defined in 7.7.2 and shall be set as shown in table 570 for the Protocol Specific Port Information VPD page.

The port information descriptor list contains descriptors for SCSI ports known to the device server that is processing the INQUIRY command. The port information descriptors (see table 571) may be returned in any order.

Table 571 – Port information descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
1				RELATIVE PORT IDENTIFIER				(LSB)
2			Reserved			PROTOCOL IDENTIFIER		
3								
4				Reserved				
5								
6	(MSB)							
7			PROTOCOL SPECIFIC DATA LENGTH (n-7)					(LSB)
8								
•••			Shared SCSI transport protocol specific data					
n								

The RELATIVE PORT IDENTIFIER field (see 4.3.4) indicates the relative port identifier of the SCSI port to which the port information descriptor applies.

The PROTOCOL IDENTIFIER field indicates the SCSI transport protocol to which the port information descriptor applies as described in 7.6.1.

The PROTOCOL SPECIFIC DATA LENGTH field indicates the length in bytes of the shared SCSI transport protocol specific data.

The shared SCSI transport protocol specific data is defined by the SCSI transport protocol standard that corresponds to the SCSI target port.

7.7.14 SCSI Feature Sets VPD page

The SCSI Feature Sets VPD page (see table 572) indicates the SCSI feature sets supported by the device server.

Table 572 – SCSI Feature Sets VPD page

Bit Byte	7	6	5	4	3	2	1	0
0	PERIPHERAL QUALIFIER			PERIPHERAL DEVICE TYPE				
1	PAGE CODE (92h)							
2	(MSB)			PAGE LENGTH (n-3)				
3								(LSB)
4				Reserved				
•••								
7								
	Feature set code list							
8	(MSB)			FEATURE SET CODE (see table 573) [first]				
9								(LSB)
	⋮							
n-1	(MSB)			FEATURE SET CODE (see table 573) [last]				
n								(LSB)

The PERIPHERAL QUALIFIER field, PERIPHERAL DEVICE TYPE field, and PAGE LENGTH field are defined in 7.7.2.

The PAGE CODE field is defined in 7.7.2 and shall be set as shown in table 572 for the SCSI Feature Sets VPD page.

The feature set code list shall contain a list of feature set codes that indicate the SCSI feature sets implemented by the device server in ascending order. Each FEATURE SET CODE field (see table 573) indicates one SCSI feature set implemented by the device server.

Table 573 – Feature set codes

Code	Description	Reference [a]
0000h to 00FFh	SPC feature sets	Annex A
0100h to 01FFh	SBC feature sets	SBC-5
0200h to 02FFh	SSC feature sets	SSC-5
0300h to 03FFh	ZBC feature sets	ZBC-3
all others	Reserved	
[a] A referenced standard may not define all the feature set codes assigned to it in this table. Unless otherwise specified, an undefined feature set code is reserved.		

7.7.15 SCSI Ports VPD page

The SCSI Ports VPD page (see table 574) contains designation descriptors for all the SCSI ports in a SCSI target device.

The SCSI Ports VPD page only reports information on SCSI ports known to the device server processing the INQUIRY command. The REPORT LUNS well known logical unit (see 8.2) may be used to return information on all SCSI ports in the SCSI device (i.e., all target ports and all SCSI initiator ports).

If the device server detects that a SCSI port is added or removed from the SCSI device and the SCSI port designation descriptor list changes, then the device server shall establish a unit attention condition (see SAM-6) for the SCSI initiator port associated with every I_T nexus, with the additional sense code set to INQUIRY DATA HAS CHANGED.

Table 574 – SCSI Ports VPD page

Bit Byte	7	6	5	4	3	2	1	0
0	PERIPHERAL QUALIFIER			PERIPHERAL DEVICE TYPE				
1	PAGE CODE (88h)							
2	(MSB)			PAGE LENGTH (n-3)				
3								(LSB)
	SCSI port designation descriptor list							
4 •••		SCSI port designation descriptor (see table 575) [first]						
	⋮							
••• n		SCSI port designation descriptor (see table 575) [last]						

The PERIPHERAL QUALIFIER field, PERIPHERAL DEVICE TYPE field, and PAGE LENGTH field are defined in 7.7.2.

The PAGE CODE field is defined in 7.7.2 and shall be set as shown in table 574 for the SCSI Ports VPD page.

Each SCSI port designation descriptor (see table 575) identifies a SCSI port. The SCSI port designation descriptors may be returned in any order.

Table 575 – SCSI port designation descriptor

Bit Byte	7	6	5	4	3	2	1	0
0				Reserved				
1								
2	(MSB)							
3				RELATIVE PORT IDENTIFIER				(LSB)
4				Reserved				
5								
6	(MSB)							
7				INITIATOR PORT TRANSPORTID LENGTH (k-7)				(LSB)
8								
•••				INITIATOR PORT TRANSPORTID, if any				
k								
k+1				Reserved				
k+2								
k+3	(MSB)							
k+4				TARGET PORT DESCRIPTORS LENGTH (n-(k+4))				(LSB)
				Target port descriptor list				
k+5								
•••				Target port descriptor (see table 576) [first]				
				⋮				
•••				Target port descriptor (see table 576) [last]				
n								

The RELATIVE PORT IDENTIFIER field (see 4.3.4) contains the relative port identifier of the SCSI port to which the SCSI port designation descriptor applies.

The INITIATOR PORT TRANSPORTID LENGTH field indicates the length of the INITIATOR PORT TRANSPORTID field. An INITIATOR PORT TRANSPORTID LENGTH field set to zero indicates no INITIATOR PORT TRANSPORTID field is present (i.e., the SCSI port is not an SCSI initiator port).

If the INITIATOR PORT TRANSPORTID LENGTH field is set to a non-zero value, the INITIATOR PORT TRANSPORTID field indicates a TransportID identifying the SCSI initiator port as defined in 7.6.4.

The TARGET PORT DESCRIPTORS LENGTH field indicates the length of the target port descriptors, if any. A TARGET PORT DESCRIPTORS LENGTH field set to zero indicates no target port descriptors are present (i.e., the SCSI port is not a target port).

Each target port descriptor (see table 576) contains an identifier for the target port. The target port descriptors may be returned in any order.

Table 576 – Target port descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	PROTOCOL IDENTIFIER				CODE SET			
1	PIV (1b)	Reserved	ASSOCIATION (01b)		DESIGNATOR TYPE			
2	Reserved							
3	DESIGNATOR LENGTH (n-3)							
4 ••• n	DESIGNATOR							

The PROTOCOL IDENTIFIER field indicates the SCSI transport protocol to which the designation descriptor applies as described in 7.6.1.

The CODE SET field, PIV field, ASSOCIATION field, DESIGNATOR TYPE field, DESIGNATOR LENGTH field, and DESIGNATOR field are as defined in the Device Identification VPD page designation descriptor (see 7.7.6.1), with the following additional requirements:

   a)   the PIV bit shall be set to one (i.e., the PROTOCOL IDENTIFIER field always contains a SCSI transport protocol identifier); and
   b)   the ASSOCIATION field shall be set to 01b (i.e., the descriptor always identifies a target port).

7.7.16 Software Interface Identification VPD page

The Software Interface Identification VPD page (see table 577) provides identification of software interfaces applicable to the logical unit. Logical units may have more than one associated software interface identifier.

> NOTE 39 - Application clients are allowed to use the software IDs to differentiate device type functions in cases where the command set (e.g., processor devices) is too generic to distinguish different software interfaces implemented.

Table 577 – Software Interface Identification VPD page

Bit Byte	7	6	5	4	3	2	1	0
0	PERIPHERAL QUALIFIER			PERIPHERAL DEVICE TYPE				
1	PAGE CODE (84h)							
2	(MSB)			PAGE LENGTH (n-3)				
3								(LSB)
	Software interface identifier list							
4								
•••				Software interface identifier [first]				
10								
	⋮							
n-9								
•••				Software interface identifier [last]				
n								

The PERIPHERAL QUALIFIER field, PERIPHERAL DEVICE TYPE field, and PAGE LENGTH field are defined in 7.7.2.

The PAGE CODE field is defined in 7.7.2 and shall be set as shown in table 577 for the Software Interface Identification VPD page.

Each software interface identifier (see table 578) information that identifies a software interface implemented by the logical unit. The contents of software interface identifier are in EUI-48 format or ELI-48 format.

Table 578 – Software interface identifier

Bit Byte	7	6	5	4	3	2	1	0
0								
•••				IEEE IDENTIFIER				
5								(LSB)

The IEEE IDENTIFIER field contains an EUI-48 or an ELI-48. The EUI-48 or ELI-48 shall uniquely identify the software interface.

7.7.17 Supported VPD Pages VPD page

The Supported VDP Pages VPD page (see table 579) contains a list of the VPD page codes that the device server reports as supported. The Supported VPD Pages VPD page list may or may not include all the VPD pages that are able to be returned by the device server.

Table 579 – Supported VPD Pages VPD page

Bit Byte	7	6	5	4	3	2	1	0
0	PERIPHERAL QUALIFIER			PERIPHERAL DEVICE TYPE				
1	PAGE CODE (00h)							
2	(MSB)			PAGE LENGTH (n-3)				
3								(LSB)
4				Supported VPD page list				
•••								
n								

The PERIPHERAL QUALIFIER field, PERIPHERAL DEVICE TYPE field, and PAGE LENGTH field are defined in 7.7.2.

The PAGE CODE field is defined in 7.7.2 and shall be set as shown in table 579 for the Supported VDP Pages VPD page.

The supported VPD page list shall contain a list of all VPD page codes (see 7.7) implemented by the logical unit in ascending order beginning with page code 00h.

7.7.18 Third-party Copy VPD page

7.7.18.1 Third-party Copy VPD page overview

The Third-party Copy VPD page (see table 580) provides a means to retrieve descriptors that indicate the capabilities supported by the copy manager (see 5.19.2).

Table 580 – Third-party Copy VPD page

Bit Byte	7	6	5	4	3	2	1	0
0	PERIPHERAL QUALIFIER			PERIPHERAL DEVICE TYPE				
1	PAGE CODE (8Fh)							
2	(MSB)			PAGE LENGTH (n-3)				
3								(LSB)
	Third-party copy descriptors							
4 ••• 	Third-party copy descriptor [first] (see 7.7.18.2)							
	⋮							
••• n	Third-party copy descriptor [last] (see 7.7.18.2)							

The PERIPHERAL QUALIFIER field, PERIPHERAL DEVICE TYPE field, and PAGE LENGTH field are defined in 7.7.2.

The PAGE CODE field is defined in 7.7.2 and shall be set as shown in table 580 for the Third-party Copy VPD page.

The third-party copy descriptors shall be returned in ascending order based on third-party copy descriptor type values (see 7.7.18.3).

7.7.18.2 Third-party copy descriptor format

Each third-party copy descriptor shall have the format shown in table 581.

Table 581 – Third-party copy descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			THIRD-PARTY COPY DESCRIPTOR TYPE				
1								(LSB)
2	(MSB)			THIRD-PARTY COPY DESCRIPTOR LENGTH (n-3)				
3								(LSB)
4 ••• n	Third-party copy parameters							

The THIRD-PARTY COPY DESCRIPTOR TYPE field is described in 7.7.18.3.

The THIRD-PARTY COPY DESCRIPTOR LENGTH field indicates the number of bytes of third-party copy parameters that follow. All third-party copy descriptor lengths are a multiple of four.

The contents of the third-party copy parameters are indicated by the contents of the THIRD-PARTY COPY DESCRIPTOR TYPE field (see 7.7.18.3).

7.7.18.3 Third-party copy descriptor type codes

Third-party copy descriptor type codes (see table 582) indicate which third-party copy descriptor is being returned.

Table 582 – Third-party copy descriptor type codes

Third-party copy descriptor name	Code	Reference	Support [a]
Block Device ROD Limits	0000h	SBC-5	See [b]
Supported Commands	0001h	7.7.18.4	Mandatory
Parameter Data	0004h	7.7.18.5	See [c]
Supported Descriptors	0008h	7.7.18.6	See [c]
Supported CSCD Descriptor IDs	000Ch	7.7.18.7	See [c]
Copy Group Identifier	000Dh	7.7.18.13	Optional
ROD Token Features	0106h	7.7.18.8	See [d]
Supported ROD Token and ROD Types	0108h	7.7.18.9	See [d]
General Copy Operations	8001h	7.7.18.10	Mandatory
Stream Copy Operations	9101h	7.7.18.11	See [e]
Held Data	C001h	7.7.18.12	See [f]
Restricted (see applicable command standard)	E000h to EFFFh		
Reserved	All other codes		

[a] Applicable only if the Third-party Copy VPD page is supported.
[b] Mandatory as defined by the applicable command standard.
[c] Mandatory if the EXTENDED COPY command (see 6.6) is supported.
[d] Mandatory if the EXTENDED COPY command ROD CSCD descriptor (see 6.6.5.10) is supported or as defined by the applicable command standard.
[e] Mandatory if any EXTENDED COPY command stream segment descriptor (see 6.6.6.1) is supported.
[f] Mandatory if the RECEIVE COPY DATA command (see 6.22) is supported.

7.7.18.4 Supported Commands third-party copy descriptor

7.7.18.4.1 Supported Commands third-party copy descriptor overview

The Supported Commands third-party copy descriptor (see table 583) indicates which commands (i.e., combinations of operation code and service action) (see 5.19.3) the copy manager supports.

Table 583 – Supported Commands third-party copy descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			THIRD-PARTY COPY DESCRIPTOR TYPE (0001h)				
1								(LSB)
2	(MSB)			THIRD-PARTY COPY DESCRIPTOR LENGTH (n-3)				
3								(LSB)
4	COMMANDS SUPPORTED LIST LENGTH (m-4)							
	Command support descriptor list							
5 •••	Command support descriptor (see table 584) [first]							
	⋮							
••• m	Command support descriptor (see table 584) [last]							
m+1 ••• n	DESCRIPTOR PAD (if any)							

The THIRD-PARTY COPY DESCRIPTOR TYPE field is described in 7.7.18.3 and shall be set as shown in table 583 for the Supported Commands third-party copy descriptor.

The THIRD-PARTY COPY DESCRIPTOR LENGTH field is described in 7.7.18.2.

The COMMANDS SUPPORTED LIST LENGTH field indicates the length, in bytes, of the commands supported list.

Each command support descriptor (see 7.7.18.4.2) lists the service actions that the copy manager supports for a specific operation code. The Supported Commands third-party copy descriptor shall contain command support descriptors for at least the following operation codes in ascending order by operation code value:

1) 83h (e.g., the EXTENDED COPY command (see 6.6)); and
2) 84h (e.g., the RECEIVE COPY STATUS command (see 6.23)).

The DESCRIPTOR PAD field shall contain zero to three bytes set to zero such that the total length of the Supported Commands third-party copy descriptor is a multiple of four.

7.7.18.4.2 Command support descriptor format

Each command support descriptor (see table 584) indicates one or more third-party copy commands (see 5.19.3) that the copy manager supports using one operation code and all supported service actions for that operation code.

Table 584 – Command support descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	SUPPORTED OPERATION CODE							
1	SUPPORTED SERVICE ACTIONS LIST LENGTH (m-1)							
2 ••• m	List of supported service actions							

The SUPPORTED OPERATION CODE field indicates the operation code for which a list of supported service actions is being returned.

The SUPPORTED SERVICE ACTIONS LIST LENGTH field indicates the length, in bytes, of the list of supported services actions.

The list of supported service actions contains one byte for each service action of the operation code indicated by the SUPPORTED OPERATION CODE field that the copy manager supports, with a unique supported service action in each byte. The service actions shall appear in the list in ascending numerical order.

7.7.18.5 Parameter Data third-party copy descriptor

The Parameter Data third-party copy descriptor (see table 585) indicates the limits that the copy manager places on the contents of the EXTENDED COPY command parameter data.

Table 585 – Parameter Data third-party copy descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
1			THIRD-PARTY COPY DESCRIPTOR TYPE (0004h)					(LSB)
2	(MSB)							
3			THIRD-PARTY COPY DESCRIPTOR LENGTH (001Ch)					(LSB)
4								
•••				Reserved				
7								
8	(MSB)							
9			MAXIMUM CSCD DESCRIPTOR COUNT					(LSB)
10	(MSB)							
11			MAXIMUM SEGMENT DESCRIPTOR COUNT					(LSB)
12	(MSB)							
•••			MAXIMUM DESCRIPTOR LIST LENGTH					
15								(LSB)
16	(MSB)							
•••			MAXIMUM INLINE DATA LENGTH					
19								(LSB)
20								
•••				Reserved				
31								

The THIRD-PARTY COPY DESCRIPTOR TYPE field is described in 7.7.18.3 and shall be set as shown in table 585 for the Parameter Data third-party copy descriptor.

The THIRD-PARTY COPY DESCRIPTOR LENGTH field is described in 7.7.18.2 and shall be set as shown in table 585 for the Parameter Data third-party copy descriptor.

The MAXIMUM CSCD DESCRIPTOR COUNT field indicates the maximum number of CSCD descriptors that the copy manager allows in an EXTENDED COPY parameter list (see 5.19.8.1).

The MAXIMUM SEGMENT COUNT field indicates the maximum number of segment descriptors that the copy manager allows in an EXTENDED COPY parameter list (see 5.19.8.1).

The MAXIMUM DESCRIPTOR LIST LENGTH field indicates the maximum length, in bytes, of the CSCD descriptor list and segment descriptor list that the copy manager allows in an EXTENDED COPY command parameter list (see 5.19.8.1).

The MAXIMUM INLINE DATA LENGTH field indicates the length, in bytes, of the largest amount of inline data (see 6.6.3.6) that the copy manager supports in an EXTENDED COPY parameter list (see 5.19.8.1). The MAXIMUM INLINE DATA LENGTH field shall be set to zero if the copy manager does not support segment descriptor type code 04h (see 6.6.6.6).

7.7.18.6 Supported Descriptors third-party copy descriptor

The Supported Descriptors third-party copy descriptor (see table 586) indicates which CSCD descriptors (see 6.6.5.1) and segment descriptors (see 6.6.6.1) the copy manager supports.

Table 586 – Supported Descriptors third-party copy descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
1				THIRD-PARTY COPY DESCRIPTOR TYPE (0008h)				(LSB)
2	(MSB)							
3				THIRD-PARTY COPY DESCRIPTOR LENGTH (n-3)				(LSB)
4				SUPPORTED DESCRIPTOR LIST LENGTH (m-4)				
5								
•••				List of supported descriptor type codes				
m								
m+1								
•••				DESCRIPTOR PAD (if any)				
n								

The THIRD-PARTY COPY DESCRIPTOR TYPE field is described in 7.7.18.3 and shall be set as shown in table 586 for the Supported Descriptors third-party copy descriptor.

The THIRD-PARTY COPY DESCRIPTOR LENGTH field is described in 7.7.18.2.

The SUPPORTED DESCRIPTOR LIST LENGTH field indicates the length, in bytes, of the list of supported descriptor type codes.

The list of supported descriptor type codes contains one byte for each CSCD descriptor and segment descriptor DESCRIPTOR TYPE CODE value (see 6.6.4) supported by the copy manager, with a unique supported DESCRIPTOR TYPE CODE value in each byte. The descriptor type code values shall appear in the list in ascending numerical order.

The DESCRIPTOR PAD field shall contain zero to three bytes set to zero such that the total length of the Supported Descriptors third-party copy descriptor is a multiple of four.

7.7.18.7 Supported CSCD Descriptor IDs third-party copy descriptor

The Supported CSCD Descriptor IDs third-party copy descriptor (see table 587) indicates which CSCD descriptor IDs (see table 103 in 6.6.5.1) other than 0000h to 07FFh the copy manager supports.

Table 587 – Supported CSCD Descriptor IDs third-party copy descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
1				THIRD-PARTY COPY DESCRIPTOR TYPE (000Ch)				(LSB)
2	(MSB)							
3				THIRD-PARTY COPY DESCRIPTOR LENGTH (n-3)				(LSB)
4	(MSB)			SUPPORTED CSCD DESCRIPTOR IDS LIST LENGTH				
5				(m-5)				(LSB)
	Supported CSCD descriptor ID list							
6	(MSB)							
7				SUPPORTED CSCD DESCRIPTOR ID [first]				(LSB)
	⋮							
m-1	(MSB)							
m				SUPPORTED CSCD DESCRIPTOR ID [last]				(LSB)
m+1								
•••				DESCRIPTOR PAD (if any)				
n								

The THIRD-PARTY COPY DESCRIPTOR TYPE field is described in 7.7.18.3 and shall be set as shown in table 587 for the Supported CSCD Descriptor IDs third-party copy descriptor.

The THIRD-PARTY COPY DESCRIPTOR LENGTH field is described in 7.7.18.2.

The SUPPORTED CSCD DESCRIPTOR IDS LIST LENGTH field indicates the length, in bytes, of the list of supported CSCD descriptor IDs.

Each SUPPORTED CSCD DESCRIPTOR ID field indicates one unique CSCD descriptor ID (see table 121 in 6.6.6.1) with a value greater than 07FFh that is supported by the copy manger. The CSCD descriptor IDs shall appear in the list in ascending numerical order.

In addition to the CSCD descriptor IDs listed in the Supported CSCD Descriptor IDs third-party copy descriptor, the copy manager shall support each CSCD descriptor ID between zero and one less than the value in the MAXIMUM CSCD DESCRIPTOR COUNT field in the Parameter Data third-party copy descriptor (see 7.7.18.5).

If the TOKEN_IN bit is set to one in any ROD token descriptor in the Supported ROD Types third-party copy descriptor (see 7.7.18.9), then F800h shall be included in the CSCD descriptor IDs list. F800h shall not be included in the CSCD descriptor IDs list if:

   a) the Supported ROD Types third-party copy descriptor is not included in the Third-party Copy VPD page; or
   b) the TOKEN_IN bit is set to zero in all the ROD token descriptors in the Supported ROD Types third-party copy descriptor.

The DESCRIPTOR PAD field shall contain zero to three bytes set to zero such that the total length of the Supported CSCD Descriptor IDs Descriptors third-party copy descriptor is a multiple of four.

7.7.18.8 ROD Token Features third-party copy descriptor

7.7.18.8.1 ROD Token Features third-party copy descriptor overview

The ROD Token Features third-party copy descriptor (see table 588) indicates the limits that the copy manager places on processing of ROD tokens by copy operations (see 5.19.4.3).

Table 588 – ROD Token Features third-party copy descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
1				THIRD-PARTY COPY DESCRIPTOR TYPE (0106h)				(LSB)
2	(MSB)							
3				THIRD-PARTY COPY DESCRIPTOR LENGTH (n-3)				(LSB)
4	Reserved				REMOTE TOKENS			
5 ••• 15	Reserved							
16 ••• 19	(MSB)			MINIMUM TOKEN LIFETIME				(LSB)
20 ••• 23	(MSB)			MAXIMUM TOKEN LIFETIME				(LSB)
24 ••• 27	(MSB)			MAXIMUM TOKEN INACTIVITY TIMEOUT				(LSB)
28 ••• 45	Reserved							
46 47	(MSB)		ROD DEVICE TYPE SPECIFIC FEATURES DESCRIPTORS LENGTH (m-47)					(LSB)
	ROD device type specific features descriptor list							
48 •••	ROD device type specific features descriptor [first]							
	⋮							
••• m	ROD device type specific features descriptor [last]							
m+1 ••• n	DESCRIPTOR PAD (if any)							

The THIRD-PARTY COPY DESCRIPTOR TYPE field is described in 7.7.18.3 and shall be set as shown in table 588 for the ROD Token Features third-party copy descriptor.

The THIRD-PARTY COPY DESCRIPTOR LENGTH field is described in 7.7.18.2.

The REMOTE TOKENS field (see table 589) indicates the level of support the copy manager provides for ROD tokens (see 5.19.6) that are not created by the copy manager that is processing the copy operation (see 5.19.4.3).

Table 589 – REMOTE TOKENS field

Code	Description
0h	The copy manager: a) supports the use of ROD tokens created by itself or any other copy manager in the same SCSI target device as copy sources and copy destinations; and b) does not support creation of ROD tokens that represent any bytes other than those accessible to its logical unit (e.g., a ROD CSCD descriptor (see 6.6.5.10) in which the ROD TYPE field is set to zero and the ROD PRODUCER CSCD DESCRIPTOR ID field specifies a copy manager producer of the ROD that is not the copy manager that is processing the EXTENDED COPY command).
4h	The copy manager: a) supports the use of ROD tokens created by itself or any other copy manager in any SCSI target device as copy sources and copy destinations; and b) does not support creation of ROD tokens that represent any bytes other than those accessible to its logical unit.
6h	The copy manager supports: a) the use of ROD tokens created by itself or any other copy manager in any SCSI target device as copy sources and copy destinations; and b) the creation of ROD tokens that represent bytes that are accessible or not accessible to its logical unit.
all others	Reserved

The MINIMUM TOKEN LIFETIME field indicates the smallest lifetime, in seconds, that the copy manager supports for a ROD token. If a ROD token lifetime is requested (e.g., if the REQUESTED ROD TOKEN LIFETIME field in a ROD CSCD descriptor (see 6.6.5.10) specifies a value) that is less than the value in the MINIMUM TOKEN LIFETIME field, then the ROD token lifetime may be set to the value in the MINIMUM TOKEN LIFETIME field.

The MAXIMUM TOKEN LIFETIME field indicates the largest lifetime, in seconds, that the copy manager supports for a ROD token. If a ROD token lifetime is requested (e.g., if the REQUESTED ROD TOKEN LIFETIME field in a ROD CSCD descriptor (see 6.6.5.10) specifies a value) that is greater than the value in the MAXIMUM TOKEN LIFETIME field, then the copy manager shall terminate (see 6.6.5.10) the copy operation (see 5.19.4.3).

The MAXIMUM TOKEN INACTIVITY TIMEOUT field indicates the largest inactivity timeout value, in seconds, that the copy manager supports for a ROD token. If a ROD token inactivity timeout is requested (e.g., if the REQUESTED ROD TOKEN INACTIVITY TIMEOUT field in a ROD CSCD descriptor (see 6.6.5.10) specifies a value) that is greater than the value in the MAXIMUM TOKEN INACTIVITY TIMEOUT field, then the copy manager shall terminate (see 6.6.5.10) the copy operation (see 5.19.4.3). The MAXIMUM TOKEN INACTIVITY TIMEOUT field is also used by the POPULATE TOKEN command (see SBC-3).

The ROD DEVICE TYPE SPECIFIC FEATURES DESCRIPTORS LENGTH field indicates the length, in bytes, of the ROD device type specific features descriptors.

Each ROD device type specific features descriptor provides support information for internal RODs and ROD tokens associated with a specific device type. The ROD device type specific features descriptors shall be included in the ROD Token Features third-party copy descriptor in the following order:

1) zero or one block ROD device type specific features descriptors (see 7.7.18.8.2);
2) zero or one stream ROD device type specific features descriptors (see 7.7.18.8.3); and
3) zero or one copy manager ROD device type specific features descriptors (see 7.7.18.8.4).

ROD device type specific features descriptors:

a) shall be included for each device type for which internal RODs or ROD tokens may be generated by the copy manager; and
b) shall not be included for any device type for which the copy manager does not generate internal RODs or ROD tokens.

7.7.18.8.2 Block ROD device type specific features descriptor

The block ROD device type specific features descriptor (see table 590) provides support information for ROD tokens associated with block type devices.

Table 590 – Block ROD device type specific features descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR FORMAT (000b)			PERIPHERAL DEVICE TYPE (00h)				
1	Reserved							
2	(MSB)			DESCRIPTOR LENGTH (002Ch)				
3								(LSB)
4				Reserved				
5								
6	(MSB)			OPTIMAL BLOCK ROD LENGTH GRANULARITY				
7								(LSB)
8	(MSB)			MAXIMUM BYTES IN BLOCK ROD				
•••								
15								(LSB)
16	(MSB)			OPTIMAL BYTES IN BLOCK ROD TRANSFER				
•••								
23								(LSB)
24	(MSB)			OPTIMAL BYTES TO TOKEN PER SEGMENT				
•••								
31								(LSB)
32	(MSB)			OPTIMAL BYTES FROM TOKEN PER SEGMENT				
•••								
39								(LSB)
40				Reserved				
•••								
47								

The DESCRIPTOR FORMAT field indicates the format of the descriptor and shall be set as shown in table 590 for the block ROD device type specific features descriptor.

The PERIPHERAL DEVICE TYPE field indicates the device type associated with the descriptor and shall be set as shown in table 590 for the block ROD device type specific features descriptor.

The DESCRIPTOR LENGTH field indicates the number of bytes that follow in the descriptor and shall be set as shown in table 590 for the block ROD device type specific features descriptor.

The OPTIMAL BLOCK ROD LENGTH GRANULARITY field indicates the optimal size granularity in logical blocks for a ROD or ROD token. RODs or ROD tokens with sizes not equal to a multiple of this value may incur processing delays with adverse effects. If the OPTIMAL BLOCK ROD LENGTH GRANULARITY field is set to zero, then the copy manager does not report the optimal ROD or ROD token length granularity for a block device.

The MAXIMUM BYTES IN BLOCK ROD field indicates the largest number of bytes the copy manager supports in an internal ROD or ROD token for a block device. If a third-party copy command (see 5.19.3) attempts to populate an internal ROD or ROD token with more than the indicated number of bytes, then the copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST. If the MAXIMUM BYTES IN BLOCK ROD field is set to zero, then the copy manager does not report the largest number of bytes the copy manager supports in an internal ROD or ROD token for a block device.

The OPTIMAL BYTES IN BLOCK ROD TRANSFER field indicates the optimal number of bytes the copy manager is able to transfer in a single third-party copy command (see 5.19.3) or EXTENDED COPY segment descriptor (see 6.6.6). Processing delays with adverse effects may be incurred if a third-party copy command attempts to transfer more bytes than indicated by the OPTIMAL BYTES IN BLOCK ROD TRANSFER field to or from a ROD associated with a block device. If the OPTIMAL BYTES IN BLOCK ROD TRANSFER field is set to zero, then the copy manager does not report the optimal number of bytes the copy manager is able to transfer in a single third-party copy command for a block device. If the OPTIMAL BYTES IN BLOCK ROD TRANSFER field is set to FFFF FFFF FFFF FFFFh, then there is no limit on the optimal number of bytes the copy manager is able to transfer in a single third-party copy command.

The OPTIMAL BYTES TO TOKEN PER SEGMENT field indicates the optimal number of bytes of user data the copy manager is able to transfer into a ROD associated with a block device in a single segment descriptor (see 6.6.6) or block device range descriptor (see SBC-5). Processing delays with adverse effects may be incurred if a third-party copy command attempts to transfer more bytes of user data in a single descriptor than indicated by the OPTIMAL BYTES TO TOKEN PER SEGMENT field to a ROD associated with a block device. If the OPTIMAL BYTES TO TOKEN PER SEGMENT field is set to zero, then the copy manager does not report the optimal number of bytes the copy manager is able to transfer in a single descriptor for a block device. If the OPTIMAL BYTES TO TOKEN PER SEGMENT field is set to FFFF FFFF FFFF FFFFh, then there is no limit on the optimal number of bytes the copy manager is able to transfer in a single descriptor.

The OPTIMAL BYTES FROM TOKEN PER SEGMENT field indicates the optimal number of bytes of user data the copy manager is able to transfer from a ROD associated with a block device in a single segment descriptor (see 6.6.6) or block device range descriptor (see SBC-5). Processing delays with adverse effects may be incurred if a third-party copy command attempts to transfer more bytes of user data in a single descriptor than indicated by the OPTIMAL BYTES FROM TOKEN PER SEGMENT field from a ROD associated with a block device. If the OPTIMAL BYTES FROM TOKEN PER SEGMENT field is set to zero, then the copy manager does not report the optimal number of bytes the copy manager is able to transfer in a single descriptor for a block device. If the OPTIMAL BYTES FROM TOKEN PER SEGMENT field is set to FFFF FFFF FFFF FFFFh, then there is no limit on the optimal number of bytes the copy manager is able to transfer in a single descriptor.

7.7.18.8.3 Stream ROD token device type features descriptor

The stream ROD device type specific features descriptor (see table 591) provides support information for ROD tokens associated with stream type devices.

Table 591 – Stream ROD device type specific features descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR FORMAT (000b)			PERIPHERAL DEVICE TYPE (01h)				
1	Reserved							
2	(MSB)			DESCRIPTOR LENGTH (002Ch)				
3								(LSB)
4 ••• 7	Reserved							
8 ••• 15	(MSB)			MAXIMUM BYTES IN STREAM ROD				 (LSB)
16 ••• 23	(MSB)			OPTIMAL BYTES IN STREAM ROD TRANSFER				 (LSB)
24 ••• 47	Reserved							

The DESCRIPTOR FORMAT field indicates the format of the descriptor and shall be set as shown in table 591 for the stream ROD device type specific features descriptor.

The PERIPHERAL DEVICE TYPE field indicates the device type associated with the descriptor and shall be set as shown in table 591 for the stream ROD device type specific features descriptor.

The DESCRIPTOR LENGTH field indicates the number of bytes that follow in the descriptor and shall be set as shown in table 591 for the stream ROD device type specific features descriptor.

The MAXIMUM BYTES IN STREAM ROD field indicates the largest number of bytes the copy manager supports in an internal ROD or ROD token for a stream device. If third-party copy command (see 5.19.3) attempts to populate an internal ROD or ROD token with more than the indicated number of bytes, then the copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST. If the MAXIMUM BYTES IN STREAM ROD field is set to zero, then the copy manager does not report a largest number of bytes the copy manager supports in an internal ROD or ROD token for a stream device.

The OPTIMAL BYTES IN STREAM ROD TRANSFER field indicates the optimal number of bytes the copy manager is able to transfer in a single third-party copy command (see 5.19.3) or EXTENDED COPY segment descriptor (see 6.6.6). Processing delays with adverse effects may be incurred if a third-party copy command attempts to transfer more bytes than indicated by the OPTIMAL BYTES IN STREAM TOKEN TRANSFER field to or from a stream device. If the OPTIMAL BYTES IN STREAM ROD TRANSFER field is set to zero, then the copy manager does not report the optimal number of bytes the copy manager is able to transfer in a single third-party copy command

for a stream device. If the OPTIMAL BYTES IN STREAM ROD TRANSFER field is set to FFFF FFFF FFFF FFFFh, then there is no limit on the optimal number of bytes the copy manager is able to transfer in a single third-party copy command.

7.7.18.8.4 Copy manager ROD token device type features descriptor

The copy manager ROD device type specific features descriptor (see table 592) provides support information for ROD tokens associated with copy manager only devices (e.g., devices for which the device server associated with the copy manager reports a device type value of 03h (i.e., processor) as described in 5.19.2).

Table 592 – Copy manager ROD device type specific features descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	DESCRIPTOR FORMAT (000b)			PERIPHERAL DEVICE TYPE (03h)				
1	Reserved							
2	(MSB)							
3	DESCRIPTOR LENGTH (002Ch)							(LSB)
4								
•••	Reserved							
7								
8	(MSB)							
•••	MAXIMUM BYTES IN PROCESSOR ROD							
15								(LSB)
16	(MSB)							
•••	OPTIMAL BYTES IN PROCESSOR ROD TRANSFER							
23								(LSB)
24								
•••	Reserved							
47								

The DESCRIPTOR FORMAT field indicates the format of the descriptor and shall be set as shown in table 592 for the copy manager ROD device type specific features descriptor.

The PERIPHERAL DEVICE TYPE field indicates the device type associated with the descriptor and shall be set as shown in table 592 for the copy manager ROD device type specific features descriptor.

The DESCRIPTOR LENGTH field indicates the number of bytes that follow in the descriptor and shall be set as shown in table 592 for the copy manager ROD device type specific features descriptor.

The MAXIMUM BYTES IN PROCESSOR ROD field indicates the largest number of bytes the copy manager supports in an internal ROD or ROD token for a copy manager only device. If a third-party copy command (see 5.19.3) attempts to populate an internal ROD or ROD token with more than the indicated number of bytes, then the copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST. If the MAXIMUM BYTES IN PROCESSOR ROD field is set to zero, then the copy manager does not report a largest number of bytes the copy manager supports in an internal ROD or ROD token for a copy manager only device.

The OPTIMAL BYTES IN PROCESSOR ROD TRANSFER field indicates the optimal number of bytes the copy manager is able to transfer in a single third-party copy command (see 5.19.3) or EXTENDED COPY segment descriptor (see 6.6.6). Processing delays with adverse effects may be incurred if a third-party copy command attempts to transfer more bytes than indicated by the OPTIMAL BYTES IN PROCESSOR ROD TRANSFER field to or from a copy manager only device. If the OPTIMAL BYTES IN PROCESSOR ROD TRANSFER field is set to zero, then the copy manager does not report the optimal number of bytes the copy manager is able to transfer in a single third-party copy command for a copy manager only device. If the OPTIMAL BYTES IN PROCESSOR ROD TRANSFER field is set to FFFF FFFF FFFF FFFFh, then there is no limit on the optimal number of bytes the copy manager is able to transfer in a single third-party copy command.

7.7.18.9 Supported ROD Types third-party copy descriptor

The Supported ROD Types third-party copy descriptor (see table 593) indicates which ROD types (see 5.19.6.2) the copy manager supports and the processing characteristics supported for those types.

Table 593 – Supported ROD Types third-party copy descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
1			THIRD-PARTY COPY DESCRIPTOR TYPE (0108h)					(LSB)
2	(MSB)							
3			THIRD-PARTY COPY DESCRIPTOR LENGTH (n-3)					(LSB)
4				Reserved				
5								
6	(MSB)							
7			ROD TYPE DESCRIPTORS LENGTH (m-7)					(LSB)
				ROD type descriptor list				
8								
•••			ROD type descriptor (see table 594) [first]					
				⋮				
•••								
m			ROD type descriptor (see table 594) [last]					
m+1								
•••			DESCRIPTOR PAD (if any)					
n								

The THIRD-PARTY COPY DESCRIPTOR TYPE field is described in 7.7.18.3 and shall be set as shown in table 593 for the Supported ROD Token and ROD Types third-party copy descriptor.

The THIRD-PARTY COPY DESCRIPTOR LENGTH field is described in 7.7.18.2.

The ROD TYPE DESCRIPTORS LENGTH field indicates the length, in bytes, of the ROD type descriptors.

Each ROD type descriptor (see table 594) indicates what support the copy manager provides for a specific ROD type (see 5.19.6.2).

The ROD type descriptors shall appear in ascending numerical order based on the contents of the ROD TYPE field (see table 594).

The DESCRIPTOR PAD field shall contain zero to three bytes set to zero such that the total length of the Supported ROD Types third-party copy descriptor is a multiple of four.

The copy manager's support for a ROD type (see 5.19.6.2) and the ROD token, if any, associated with that ROD type is indicated by the ROD type descriptor (see table 594).

Table 594 – ROD type descriptor

Bit Byte	7	6	5	4	3	2	1	0
0 ••• 3	(MSB)			ROD TYPE				(LSB)
4	ECPY_INT			Reserved			TOKEN_IN	TOKEN_OUT
5	Reserved							
6 7				PREFERENCE INDICATOR				
8 ••• 63				Reserved				

The ROD TYPE field indicates the ROD type (see table 79 in 5.19.6.2) for which this ROD type descriptor indicates copy manager support.

The copy manager shall support a ROD TYPE field set to zero in a ROD CSCD descriptor (see 6.6.5.10), shall include a ROD type descriptor with the ROD TYPE field set to zero in the Supported ROD Types third-party copy descriptor (see 7.7.18.9), and shall include CSCD descriptor ID F800h in the Supported CSCD Descriptor IDs third-party copy descriptor (see 7.7.18.7), if:

   a) the ROD CSCD descriptor is supported; and
   b) any ROD type descriptor contains:
      A) a non-zero value in the ROD TYPE field; and
      B) the TOKEN_IN bit set to one.

An ECPY_INT bit set to one indicates that the copy manager supports use of the ROD type indicated by the ROD TYPE field for internal RODs in the EXTENDED COPY command (see 5.19.8). An ECPY_INT bit set to zero indicates that the copy manager does not support use of the ROD type indicated by the ROD TYPE field for internal RODs in the EXTENDED COPY command.

A TOKEN_IN bit set to one indicates that the copy manager supports the receipt of ROD tokens (see 5.19.6) that have the ROD type indicated by the ROD TYPE field by one or more commands that the copy manager processes. A TOKEN_IN bit set to zero indicates that the copy manager does not support the receipt of ROD tokens that have the ROD type indicated by the ROD TYPE field.

A TOKEN_OUT bit set to one indicates that the copy manager supports the generation and returning of ROD tokens (see 5.19.6) that have the ROD type indicated by the ROD TYPE field by one or more commands that the copy manager processes. A TOKEN_OUT bit set to zero indicates that the copy manager does not support the generation and returning of ROD tokens that have the ROD type indicated by the ROD TYPE field.

If the ROD TYPE field is set to FFFF 0001h (i.e., if the ROD type is the one used by the block device zero ROD token (see SBC-5)), then the TOKEN_OUT bit shall be set to zero (i.e., the return of block device zero ROD tokens is prohibited).

The PREFERENCE INDICATOR field indicates the degree of preference the copy manager provides for the services (e.g., number of RODs supported as active at the one time, number of ROD tokens supported as active at the one time, maximum ROD lifetimes supported, performance associated with any aspect of ROD processing) that are associated with the ROD type indicated by the ROD TYPE field. Except for zero, values in the PREFERENCE INDICATOR field provide this indication as follows:

  a) larger values indicate a higher degree of preference for the ROD related services; and
  b) smaller value indicate a lower degree of preference for the same ROD related services.

A PREFERENCE INDICATOR field set to zero indicates that:

  a) no ROD preference information is provided, if all PREFERENCE INDICATOR fields in all ROD type descriptors are set to zero; or
  b) no valid comparison is possible between the preference for the ROD type indicated by the ROD TYPE field and other ROD types supported by the copy manager, if at least one PREFERENCE INDICATOR field is not set to zero in another ROD type descriptor.

The sum of the values in all PREFERENCE INDICATOR fields in all ROD type descriptors shall be equal to either zero or FFFFh.

EXAMPLE – An instance where some PREFERENCE INDICATOR field values are zero and other are non-zero concerns the block device zero ROD token (see SBC-5). Suppose several copy on reference ROD types are supported in addition to the block device zero ROD token. Each supported ROD type has a ROD type descriptor, including the ROD type used by the block device zero ROD token. Further suppose that support for the block device zero ROD token requires so few resources that its preference is infinite for all practical purposes. Setting the PREFERENCE INDICATOR field values to zero in the ROD type descriptor for the block device zero ROD token allows the copy manager to better reflect the preferences among the various copy on reference ROD types.

7.7.18.10 General Copy Operations third-party copy descriptor

The General Copy Operations third-party copy descriptor (see table 595) indicates the limits that the copy manager places on processing of copy operations (see 5.19.4.3).

Table 595 – General Copy Operations third-party copy descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
1			THIRD-PARTY COPY DESCRIPTOR TYPE (8001h)					(LSB)
2	(MSB)							
3			THIRD-PARTY COPY DESCRIPTOR LENGTH (0020h)					(LSB)
4	(MSB)							
•••			TOTAL CONCURRENT COPIES					
7								(LSB)
8	(MSB)							
•••			MAXIMUM IDENTIFIED CONCURRENT COPIES					
11								(LSB)
12	(MSB)							
			MAXIMUM SEGMENT LENGTH					
15								(LSB)
16			DATA SEGMENT GRANULARITY (log 2)					
17			INLINE DATA GRANULARITY (log 2)					
18								
•••			Reserved					
35								

The THIRD-PARTY COPY DESCRIPTOR TYPE field is described in 7.7.18.3 and shall be set as shown in table 595 for the General Copy Operations third-party copy descriptor.

The THIRD-PARTY COPY DESCRIPTOR LENGTH field is described in 7.7.18.2 and shall be set as shown in table 595 for the General Copy Operations third-party copy descriptor.

The TOTAL CONCURRENT COPIES field indicates the maximum number of third-party copy commands (see 5.19.3) that are supported for concurrent processing by the copy manager.

The MAXIMUM IDENTIFIED CONCURRENT COPIES field indicates the maximum number of third-party copy commands (see 5.19.3) that are not an EXTENDED COPY command with the LIST ID USAGE field (see 6.6.3.2) set to 11b that are supported for concurrent processing by the copy manager.

The contents of the TOTAL CONCURRENT COPIES field shall be greater than or equal to the contents of the MAXIMUM IDENTIFIED CONCURRENT COPIES field.

The MAXIMUM SEGMENT LENGTH field indicates the length, in bytes, of the largest amount of data that the copy manager supports writing via a single segment. Bytes introduced as a result of the PAD bit being set to one (see 5.19.8.2) are not counted towards this limit. A value of zero indicates that the copy manager places no limits on the amount of data written by a single segment.

The DATA SEGMENT GRANULARITY field indicates the length of the smallest data block that the copy manager permits in a non-inline segment descriptor (i.e., segment descriptors with type codes other than 04h). The amount of data transferred by a single segment descriptor shall be a multiple of the granularity. The DATA SEGMENT GRANULARITY value is expressed as a power of two. Bytes introduced as a result of the PAD bit being set to one (see 5.19.8.2) are not counted towards the data length granularity.

The INLINE DATA GRANULARITY field indicates the length of the smallest block of inline data that the copy manager permits being written by a segment descriptor containing the 04h descriptor type code (see 6.6.6.6). The amount of inline data written by a single segment descriptor shall be a multiple of the granularity. The INLINE DATA GRANULARITY value is expressed as a power of two. Bytes introduced as a result of the PAD bit being set to one (see 5.19.8.2) are not counted towards the length granularity.

If the copy manager encounters a data or inline segment descriptor that violates either the data segment granularity or the inline data granularity, then the copy manager shall terminate the copy operation (see 5.19.4.3) with CHECK CONDITION status, with the sense key set to COPY ABORTED, and the additional sense code set to COPY SEGMENT GRANULARITY VIOLATION.

7.7.18.11 Stream Copy Operations third-party copy descriptor

The Stream Copy Operations third-party copy descriptor (see table 596) indicates the limits that the copy manager places on processing of copy operations (see 5.19.4.3) that affect stream devices.

Table 596 – Stream Copy Operations third-party copy descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
1			THIRD-PARTY COPY DESCRIPTOR TYPE (9101h)					(LSB)
2	(MSB)							
3			THIRD-PARTY COPY DESCRIPTOR LENGTH (000Ch)					(LSB)
4	(MSB)							
•••			MAXIMUM STREAM DEVICE TRANSFER SIZE					
7								(LSB)
8								
•••			Reserved					
15								

The THIRD-PARTY COPY DESCRIPTOR TYPE field is described in 7.7.18.3 and shall be set as shown in table 596 for the Stream Copy Operations third-party copy descriptor.

The THIRD-PARTY COPY DESCRIPTOR LENGTH field is described in 7.7.18.2 and shall be set as shown in table 596 for the Stream Copy Operations third-party copy descriptor.

The MAXIMUM STREAM DEVICE TRANSFER SIZE field indicates the maximum transfer size, in bytes, supported for stream devices.

7.7.18.12 Held Data third-party copy descriptor

The Held Data third-party copy descriptor (see table 597) indicates the limits that the copy manager places on held data (see 5.19.4.5).

Table 597 – Held Data third-party copy descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
1			THIRD-PARTY COPY DESCRIPTOR TYPE (C001h)					(LSB)
2	(MSB)							
3			THIRD-PARTY COPY DESCRIPTOR LENGTH (001Ch)					(LSB)
4	(MSB)							
•••			HELD DATA LIMIT					
7								(LSB)
8			HELD DATA GRANULARITY (log 2)					
9								
•••			Reserved					
31								

The THIRD-PARTY COPY DESCRIPTOR TYPE field is described in 7.7.18.3 and shall be set as shown in table 597 for the Held Data third-party copy descriptor.

The THIRD-PARTY COPY DESCRIPTOR LENGTH field is described in 7.7.18.2 and shall be set as shown in table 597 for the Held Data third-party copy descriptor.

The HELD DATA LIMIT field indicates the length, in bytes, of the minimum amount of data the copy manager shall hold for return to the application client as described in 5.19.4.5.

The HELD DATA GRANULARITY field indicates the length of the smallest block of held data (see 5.19.4.5) that the copy manager shall transfer to the application client in response to a RECEIVE COPY DATA command (see 6.22). The amount of data held by the copy manager in response to any one function (e.g., one segment descriptor (see 6.6.6)) in a copy operation (see 5.19.4.3) shall be a multiple of this granularity. The HELD DATA GRANULARITY value is expressed as a power of two.

7.7.18.13 Copy Group Identifier third-party copy descriptor

The Copy Group Identifier third-party copy descriptor (see table 598) indicates the identifier for the Copy Group of which the logical unit is a member.

Table 598 – Copy Group Identifier third-party copy descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
1				THIRD-PARTY COPY DESCRIPTOR TYPE (000Dh)				(LSB)
2	(MSB)							
3				THIRD-PARTY COPY DESCRIPTOR LENGTH (n-3)				(LSB)
4	COPY GROUP IDENTIFIER LENGTH (m-4)							
5 ••• m	Copy Group Identifier							
m+1 ••• n	DESCRIPTOR PAD (if any)							

The THIRD-PARTY COPY DESCRIPTOR TYPE field is described in 7.7.18.3 and shall be set as shown in table 598 for the Copy Group Identifier third-party copy descriptor.

The THIRD-PARTY COPY DESCRIPTOR LENGTH field is described in 7.7.18.2.

The COPY GROUP IDENTIFIER LENGTH field indicates the length, in bytes, of the Copy Group Identifier.

The Copy Group Identifier contains a UUID designator (see 7.7.6.13.1) for the Copy Group with which the logical unit is associated.

The DESCRIPTOR PAD field shall contain zero to three bytes set to zero such that the total length of the Copy Group Identifier third-party copy descriptor is a multiple of four.

7.7.19 Unit Serial Number VPD page

The Unit Serial Number VPD page (see table 599) provides a product serial number for the SCSI target device or logical unit.

Table 599 – Unit Serial Number VPD page

Bit Byte	7	6	5	4	3	2	1	0
0	PERIPHERAL QUALIFIER			PERIPHERAL DEVICE TYPE				
1	PAGE CODE (80h)							
2	(MSB)			PAGE LENGTH (n-3)				
3								(LSB)
4	(MSB)			PRODUCT SERIAL NUMBER				
•••								
n								(LSB)

The PERIPHERAL QUALIFIER field, PERIPHERAL DEVICE TYPE field, and PAGE LENGTH field are defined in 7.7.2.

The PAGE CODE field is defined in 7.7.2 and shall be set as shown in table 599 for the Unit Serial Number VPD page.

The PRODUCT SERIAL NUMBER field contains right-aligned ASCII data (see 4.3.1) that is a vendor specific serial number. If the product serial number is not available, the device server shall return ASCII spaces (20h) in this field.

8 Well known logical units

8.1 Model for well known logical units

Well known logical units are addressed using the well known logical unit addressing method of extended logical unit addressing (see SAM-6). Each well known logical unit has a well known logical unit number as shown in table 600.

Table 600 – Well known logical unit numbers

W-LUN [a]	Description	Reference
00h	Reserved	
01h	REPORT LUNS well known logical unit	8.2
02h	Obsolete	
03h	TARGET LOG PAGES well known logical unit	8.3
04h	SECURITY PROTOCOL well known logical unit	8.4
05h	MANAGEMENT PROTOCOL well known logical unit	8.5
06h	TARGET COMMANDS well known logical unit	8.6
07h to FFh	Reserved	
[a] well known logical unit number		

If a well known logical unit is supported within a SCSI target device, then that logical unit shall support all the commands defined for it.

The SCSI device name of the SCSI target device that contains a well known logical unit may be determined by issuing an INQUIRY command (see 6.7) requesting the Device Identification VPD page (see 7.7.6).

All well known logical units shall support the INQUIRY command's Device Identification VPD page as defined in 7.7.6.2.2.

8.2 REPORT LUNS well known logical unit

The REPORT LUNS well known logical unit shall only process the commands listed in table 601. If a command is received by the REPORT LUNS well known logical unit that is not listed in table 601, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID COMMAND OPERATION CODE.

Table 601 – Commands for the REPORT LUNS well known logical unit

Command	Operation code	Support	Reference
INQUIRY	12h	M	6.7
REPORT LUNS	A0h	M	6.30
REQUEST SENSE	03h	M	6.36
TEST UNIT READY	00h	M	6.46
Key: M = Command implementation is mandatory.			

8.3 TARGET LOG PAGES well known logical unit

The TARGET LOG PAGES well known logical unit shall only process the commands listed in table 602. If a command is received by the TARGET LOG PAGES well know logical unit that is not listed in table 602, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID COMMAND OPERATION CODE.

Table 602 – Commands for the TARGET LOG PAGES well known logical unit

Command	Operation code	Support	Reference
INQUIRY	12h	M	6.7
LOG SELECT	4Ch	M	6.8
LOG SENSE	4Dh	M	6.9
REQUEST SENSE	03h	M	6.36
TEST UNIT READY	00h	M	6.41
Key: M = Command implementation is mandatory.			

The TARGET LOG PAGES well known logical unit shall support the Protocol Specific Port log page (see 7.3.19) and may support other log pages with log parameters that apply to the SCSI target device.

8.4 SECURITY PROTOCOL well known logical unit

The SECURITY PROTOCOL well known logical unit shall only process the commands listed in table 603. If a command is received by the SECURITY PROTOCOL well known logical unit that is not listed in table 603, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID COMMAND OPERATION CODE.

Table 603 – Commands for the SECURITY PROTOCOL well known logical unit

Command	Operation code	Support	Reference
INQUIRY	12h	M	6.7
REQUEST SENSE	03h	M	6.36
SECURITY PROTOCOL IN	A2h	M	6.37
SECURITY PROTOCOL OUT	B5h	M	6.38
TEST UNIT READY	00h	M	6.46
Key: M = Command implementation is mandatory.			

8.5 MANAGEMENT PROTOCOL well known logical unit

The MANAGEMENT PROTOCOL well known logical unit shall only process the commands listed in table 604. If a command is received by the MANAGEMENT PROTOCOL well known logical unit that is not listed in table 604, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID COMMAND OPERATION CODE.

Table 604 – Commands for the MANAGEMENT PROTOCOL well known logical unit

Command	Operation code	Support	Reference
INQUIRY	12h	M	6.7
MANAGEMENT PROTOCOL IN	A3h/10h [a]	M	6.10
MANAGEMENT PROTOCOL OUT	A4h/10h [a]	M	6.11
REQUEST SENSE	03h	M	6.36
TEST UNIT READY	00h	M	6.46
Key: M = Command implementation is mandatory.			
[a] This command is defined by a combination of operation code and service action. The operation code value is shown preceding the slash and the service action value is shown after the slash.			

8.6 TARGET COMMANDS well known logical unit

8.6.1 TARGET COMMANDS well known logical unit overview

The TARGET COMMANDS well known logical unit shall only process the commands listed by name in table 605 and described in 8.6.2. If a command is received by the TARGET COMMANDS well known logical unit that is not one of the commands listed by name in table 605 or described in 8.6.2, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID COMMAND OPERATION CODE.

Table 605 – Commands for the TARGET COMMANDS well known logical unit

Command	Operation code	Support	Reference
INQUIRY	12h	M	6.7
REPORT SUPPORTED OPERATION CODES	A3h/0Ch [a]	M	6.32
REQUEST SENSE	03h	M	6.36
TEST UNIT READY	00h	M	6.46
Other whole target commands	see 8.6.2	see 8.6.2	8.6.2
Key: M = Command implementation is mandatory.			
[a] This command is defined by a combination of operation code and service action. The operation code value is shown preceding the slash and the service action value is shown after the slash.			

8.6.2 Other commands that affect the entire SCSI target device

If a command is capable of affecting the operation of all the logical units contained in the SCSI target device (e.g., commands that download and activate microcode (i.e., WRITE BUFFER commands (see 6.49) with the MODE field set as described in 5.5.1)), then the TARGET COMMANDS well known logical unit may process that command.

The REPORT SUPPORTED OPERATION CODES command shall report all the commands described in table 605, including all the commands that are:

    a)   capable of affecting the operation of all the logical units contained in the SCSI target device; and
    b)   processed by the TARGET COMMANDS well known logical unit.

If the device server in one of the logical units contained in the SCSI target device that are not a well known logical unit receives a command that is reported by REPORT SUPPORTED OPERATION CODES command for the TARGET COMMANDS well known logical unit, then that device server may terminate that command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to WELL KNOWN LOGICAL UNIT ACCESS REQUIRED.

Annex A

(normative)

SPC feature sets

A.1 Overview

This annex defines SCSI feature sets (see 5.17) for all device types (see table A.1).

Table A.1 – SPC feature set codes

Code	Feature set	Reference
0000h	Reserved	
0001h	Discovery 2016	clause A.2
0002h to 00FFh	Reserved	

A.2 Discovery 2016 feature set

A.2.1 Overview

The Discovery 2016 feature set includes features intended for discovery and basic connectivity of SCSI devices.

Table A.2 lists the commands that are mandatory and may have additional mandatory requirements for support in the Discovery 2016 feature set.

Table A.2 – Commands that are mandatory in the Discovery 2016 feature set

Command	Additional requirements reference	SPC reference
INQUIRY	A.2.3.1	6.7
MODE SENSE(10)	n/a	6.13
REPORT LUNS	n/a	6.30
REPORT SUPPORTED OPERATION CODES	n/a	6.32
TEST UNIT READY	n/a	6.46

Table A.3 lists the mode pages that are mandatory and may have additional mandatory requirements for support in the Discovery 2016 feature set.

Table A.3 – Mode pages that are mandatory in the Discovery 2016 feature set

Mode page	Additional requirements reference	SPC reference
Control	n/a	7.5.13
Control Extension	n/a	7.5.14

Table A.4 lists the VPD pages that are mandatory and may have additional mandatory requirements for support in the Discovery 2016 feature set.

Table A.4 – VPD pages that are mandatory in the Discovery 2016 feature set

VPD page	Additional requirements reference	SPC reference
Device Identification	A.2.4.1	7.7.6
Extended INQUIRY Data	A.2.4.2	7.7.7
Mode Page Policy	n/a	7.7.9
SCSI Feature Sets	n/a	7.7.14
Supported VPD Pages	n/a	7.7.17

A.2.2 Discovery 2016 feature set additional requirements

The application client should ignore reserved bits and bytes in response data.

Optional SCSI features not specified in this SCSI feature set (e.g., bits and fields not specified by this feature set) may also be supported by device servers compliant with this feature set.

The device server shall support the following task management functions (see SAM-6 and the applicable SCSI transport standard):

a) ABORT TASK;
b) ABORT TASK SET;
c) CLEAR ACA, if the device server supports a NACA bit set to one in the CDB control byte and supports the ACA task attribute (see SAM-6);
d) CLEAR TASK SET; and
e) LOGICAL UNIT RESET.

A.2.3 Discovery 2016 feature set commands

A.2.3.1 INQUIRY command

A.2.3.1.1 Standard INQUIRY data

Standard INQUIRY data (see 6.7.2) shall be available without incurring any media access delays even if the device server is not ready for other commands.

The device server is not required to return:

    a)   the VERSION field set to any particular value; or
    b)   version descriptors.

The device server shall support:

    a)   the RESPONSE DATA FORMAT field set to 2h (i.e., the format defined in this standard).

A.2.3.1.2 Inquiry VPD pages

See A.2.1 for the list of VPD pages required to be supported by the Discovery 2016 feature set. See A.2.4 for Discovery 2016 feature set specific requirements for VPD pages.

A.2.4 Discovery 2016 feature set VPD pages

A.2.4.1 Device Identification VPD page

If a T10 Vendor ID Based designation descriptor (see 7.7.6.4) is returned, the VENDOR SPECIFIC DESIGNATOR field shall be constructed by concatenating:

    a)   the PRODUCT IDENTIFICATION field from the standard INQUIRY data (see 6.7.2); and
    b)   the PRODUCT SERIAL NUMBER field from the Unit Serial Number VPD page (see 7.7.19).

A.2.4.2 Extended INQUIRY Data VPD page

The device server shall return the following values:

    a)   the SIMPSUP bit set to one (i.e., SIMPLE task attribute is supported), as specified in 7.7.7; and
    b)   the LUICLR bit set to one (i.e., logical unit I_T nexus clear), as specified in 7.7.7.

Annex B
(informative)

REPORT LUNS command examples

This annex contains examples of logical unit inventory reporting. For the examples in this annex, a logical unit inventory of the 11 LUNs shown in table B.1 is assumed.

Table B.1 – Example logical unit inventory

Logical unit name	LUN	LU_CONG bit	Description
A	0000 0000 0000 0000h	0	LUN 0
B	0001 0000 0000 0000h	0	Single level peripheral device addressing LUN
C	D201 0020 0000 0000h	0	Single level extended flat space addressing LUN
D	0130 0000 0000 0000h	1	Administrative logical unit contained in a logical unit conglomerate
E	0180 0000 0000 0000h	1	Administrative logical unit contained in a logical unit conglomerate
F	0180 0001 0000 0000h	1	Subsidiary logical unit contained in the logical unit conglomerate for which logical unit E is the administrative logical unit.
G	0180 0180 0000 0000h	1	Subsidiary logical unit contained in the logical unit conglomerate for which logical unit E is the administrative logical unit.
J	0181 0000 0000 0000h	1	Administrative logical unit contained in a logical unit conglomerate
K	0181 017F 0000 0000h	1	Subsidiary logical unit contained in the logical unit conglomerate for which logical unit J is the administrative logical unit.
L	0181 0180 0000 0000h	1	Subsidiary logical unit contained in the logical unit conglomerate for which logical unit J is the administrative logical unit.
N	C105 0000 0000 0000h	0	MANAGEMENT PROTOCOL well known logical unit at level 1

a The LU_CONG bit is described in the standard INQUIRY data (see 6.7.2).

Figure B.1 shows a representation of these example logical units.
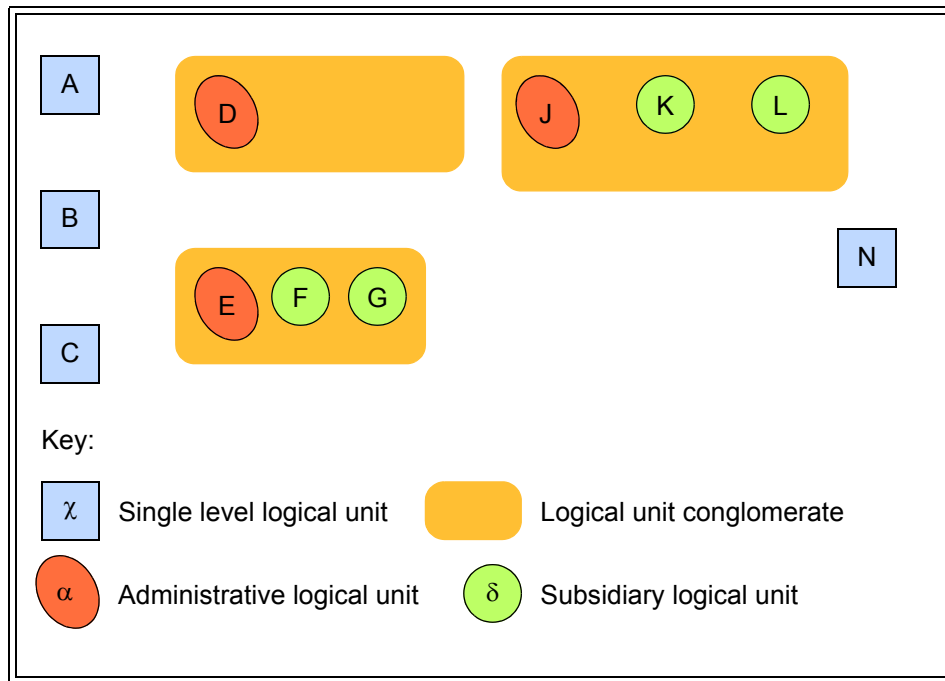
Figure B.1 – Example logical unit representation

Table B.2 shows the LUN list returned by a REPORT LUNS command (see 6.30) for various select report types when addressed to various logical unit numbers.

Table B.2 – REPORT LUNS command returned LUN list (part 1 of 3)

Logical unit to which command is addressed		SELECT REPORT field [a]	Logical unit list returned	
			Name	**Number**
A [b]	0000 0000 0000 0000h	00h	A	0000 0000 0000 0000h
			B	0001 0000 0000 0000h
			C	D201 0020 0000 0000h
			D	0130 0000 0000 0000h
			E	0180 0000 0000 0000h
			F	0180 0001 0000 0000h
			G	0180 0180 0000 0000h
			J	0181 0000 0000 0000h
			K	0181 017F 0000 0000h
			L	0181 0180 0000 0000h

[a] The SELECT REPORT field is described in the REPORT LUNS command (see 6.30).
[b] Commands addressed to the REPORT LUNS well known logical unit
(i.e., C101 0000 0000 0000h), if supported, return the same logical unit number
list returned by commands addressed to LUN 0 (i.e., logical unit A).

Table B.2 – REPORT LUNS command returned LUN list (part 2 of 3)

Logical unit to which command is addressed		SELECT REPORT field [a]	Logical unit list returned	
			Name	Number
A [b]	0000 0000 0000 0000h	01h	N	C105 0000 0000 0000h
A [b]	0000 0000 0000 0000h	02h	A	0000 0000 0000 0000h
			B	0001 0000 0000 0000h
			C	D201 0020 0000 0000h
			D	0130 0000 0000 0000h
			E	0180 0000 0000 0000h
			F	0180 0001 0000 0000h
			G	0180 0180 0000 0000h
			J	0181 0000 0000 0000h
			K	0181 017F 0000 0000h
			L	0181 0180 0000 0000h
			N	C105 0000 0000 0000h
A [b]	0000 0000 0000 0000h	10h	D	0130 0000 0000 0000h
			E	0180 0000 0000 0000h
			J	0181 0000 0000 0000h
A [b]	0000 0000 0000 0000h	11h	A	0000 0000 0000 0000h
			B	0001 0000 0000 0000h
			C	D201 0020 0000 0000h
			D	0130 0000 0000 0000h
			E	0180 0000 0000 0000h
			J	0181 0000 0000 0000h
A [b]	0000 0000 0000 0000h	12h		null
B	0001 0000 0000 0000h	00h to 02h		Vendor specific
B	0001 0000 0000 0000h	10h to 12h		null
E	0180 0000 0000 0000h	00h to 02h		Vendor specific
E	0180 0000 0000 0000h	10h to 11h		null
E	0180 0000 0000 0000h	12h	E	0180 0000 0000 0000h
			F	0180 0001 0000 0000h
			G	0180 0180 0000 0000h

[a] The SELECT REPORT field is described in the REPORT LUNS command (see 6.30).
[b] Commands addressed to the REPORT LUNS well known logical unit
  (i.e., C101 0000 0000 0000h), if supported, return the same logical unit number
  list returned by commands addressed to LUN 0 (i.e., logical unit A).

Table B.2 – REPORT LUNS command returned LUN list (part 3 of 3)

Logical unit to which command is addressed		SELECT REPORT field [a]	Logical unit list returned	
			Name	Number
F	0180 0001 0000 0000h	10h to 12h		null
G	0180 0180 0000 0000h	10h to 12h		null
J	0181 0000 0000 0000h	10h to 11h		null
J	0181 0000 0000 0000h	12h	J	0181 0000 0000 0000h
			K	0181 017F 0000 0000h
			L	0181 0180 0000 0000h
K	0181 017F 0000 0000h	10h to 12h		null
L	0181 0180 0000 0000h	10h to 12h		null
[a] The SELECT REPORT field is described in the REPORT LUNS command (see 6.30). [b] Commands addressed to the REPORT LUNS well known logical unit (i.e., C101 0000 0000 0000h), if supported, return the same logical unit number list returned by commands addressed to LUN 0 (i.e., logical unit A).				

Annex C
(informative)

Replacing RESERVE/RELEASE functionality with PERSISTENT RESERVE IN/OUT equivalents

C.1 Introduction

This annex specifies the PERSISTENT RESERVE OUT command features necessary to replace the reserve/release management method (see SPC-2) and provides guidance on how to perform a third party reservation using persistent reservations. The PERSISTENT RESERVE IN command is not used to replace any feature of the reserve/release management method.

C.2 Replacing the reserve/release method with the PERSISTENT RESERVE OUT COMMAND

The minimum PERSISTENT RESERVE OUT command (see 6.15) features necessary to replace the reserve/release management method (see SPC-2) are shown in table C.1.

Table C.1 – PERSISTENT RESERVE OUT command features

PERSISTENT RESERVE OUT command features		Replaces reserve/release
Service action	REGISTER	Yes [a]
	RESERVE	Yes
	RELEASE	Yes
	CLEAR	Yes [b]
	PREEMPT	No
	PREEMPT AND ABORT	No
	REGISTER AND IGNORE EXISTING KEY	Yes [a]
	REGISTER AND MOVE	Yes [c]
Scope	LU_SCOPE	Yes
Type	Write Exclusive	No
	Exclusive Access	Yes
	Write Exclusive – Registrants Only	No
	Exclusive Access – Registrants Only	No
	Write Exclusive – All Registrants	No
	Exclusive Access – All Registrants	No
[a] An application client uses either the REGISTER service action or REGISTER AND IGNORE EXISTING KEY service action.		
[b] Necessary to clear the registration and reservation (e.g., a failed initiator).		
[c] Necessary only for third party reservations.		

C.3 Third party reservations

For some uses of the EXTENDED COPY command (see 6.6), the application client performs a locking function to maintain data integrity on the source and may also lock the destination device prior to starting the copy operation. The persistent reservation management method may be used to perform the locking function. Other methods may also perform the locking function.

To accomplish a third party persistent reservation the following steps are recommended:

1) the application client uses the REGISTER service action to register an I_T nexus with a logical unit (e.g., a tape drive logical unit);
2) the application client uses the RESERVE service action to establish a persistent reservation with the Exclusive Access type;
3) the application client prepares the logical unit for access (e.g., medium is loaded and positioned);
4) the application client uses the REGISTER AND MOVE service action to register the I_T nexus that the copy manager is expected to use and to move the persistent reservation to that I_T nexus;
5) the application client sends the EXTENDED COPY command to the copy manager that includes a third party persistent reservations source I_T nexus segment descriptor (see 6.6.6.18);
6) copy manager processes all segment descriptors in the received EXTENDED COPY command except the third party persistent reservations source I_T nexus segment descriptor; and
7) the copy manager sends a REGISTER AND MOVE service action, using the reservation key and I_T nexus specified in the third party persistent reservations source I_T nexus segment descriptor sent by the application client (see step 5), to move the persistent reservation back to the original I_T nexus.

Annex D
(informative)

Third-party copy implementation and usage

D.1 Embedded and dedicated copy manager implementations

D.1.1 Overview

Although a copy manager is always contained in a logical unit, the logical unit may:

a) have a function (e.g., providing access to a block device) in addition to the copy manager function (i.e., the copy manager is embedded (see D.1.2) in another device type); or
b) be dedicated to providing the copy manager function (i.e., the copy manager is contained in a dedicated (see D.1.3) logical unit).

In both implementations:

a) the device server processes commands (e.g., the INQUIRY command) that are not third-party copy commands (see 5.19.3), and the copy manager processes third-party copy commands; and
b) the standard INQUIRY data (see 6.7.2) indicates a logical unit that is accessible, and has a defined device type.

D.1.2 Embedded copy manager implementations

The device type indicated by the standard INQUIRY data (see 6.7.2) for an embedded copy manager is the device type appropriate to the logical unit in which the copy manager is embedded.

In addition to whatever copy manager commands are supported, the commands associated with the device type (e.g., reads and writes) are supported and processed by the device server.

The copy manager is able to support and translate the FFFFh CSCD descriptor ID value (i.e., this logical unit) shown in table 121 (see 6.6.6.1) to the logical unit and device type in which the copy manager is embedded.

D.1.3 Dedicated copy manager implementations

The device type indicated by the standard INQUIRY data (see 6.7.2) for a dedicated copy manager is not constrained by other uses of the logical unit. Any defined device type may be indicated in standard INQUIRY data. One device type often used by dedicated copy managers is the processor device type (see SPC-2).

Very few commands beyond the commands those that table 88 shows to be mandatory for all device types (see 6.1) are supported by the logical unit for a dedicated copy manager.

In most cases, a dedicated copy manager is not able to support and translate the FFFFh CSCD descriptor ID value (i.e., this logical unit) shown in table 121 (see 6.6.6.1).

D.2 Tracking copy operation progress

D.2.1 Overview

The following third-party copy commands provide information that tracks the progress of a copy operation:

    a)   the RECEIVE COPY STATUS command (see 6.23);
    b)   the RECEIVE COPY DATA command (see 6.22); and
    c)   the RECEIVE ROD TOKEN INFORMATION command (see 6.25).

D.2.2 Detecting lack of progress in active copy operations

Although there is a way to determine the progress of an individual data transfer command performed by the copy manager (e.g., in response to the contents of a segment descriptor (see 5.19.8)), the OPERATION COUNTER field in the parameter data for all the commands listed in D.2.1 allows the determination of progress for an active copy operation as follows:

    a)   each time the copy operation completes processing on a data transfer command that moves data the OPERATION COUNTER field is incremented;
    b)   this continues as long as the copy manager is able to move data;
    c)   if the OPERATION COUNTER field reaches the maximum value allowed in the field, the value wraps to zero and the OPERATION COUNTER field continues to be incremented as described in a); and
    d)   if the copy manager stops being able to move data, the value in the OPERATION COUNTER field should stop changing.

Annex E
(informative)

Numeric order codes

E.1 Numeric order codes introduction

This annex contains SCSI additional sense codes, operation codes, diagnostic page codes, log page codes, mode page codes, VPD page codes, version descriptor values, and T10 IEEE binary identifiers in numeric order as a reference. In the event of a conflict between the codes or usage requirements in this annex and equivalent information in the body of this standard or in any command standard, the normative codes and usage information is correct.

The information in this annex was complete and accurate at the time of publication. However, the information is subject to change. Technical Committee T10 of INCITS maintains an electronic copy of this information on its website (http://www.t10.org/). In the event that the T10 website is no longer active, access may be possible via the INCITS website (http://www.incits.org), the ANSI website (http://www.ansi.org), the IEC site (http://www.iec.ch/), the ISO website (http://www.iso.ch/), or the ISO/IEC JTC 1 website (http://www.jtc1.org/).

E.2 Additional sense codes

Table E.1 is a numerical order listing of the additional sense codes (i.e., the ADDITIONAL SENSE CODE field and ADDITIONAL SENSE CODE QUALIFIER field values returned in sense data).

Table E.1 – ASC and ASCQ assignments (part 1 of 21)

```
              D – Direct Access Block Device (SBC-5)                     Device Type
              . Z – Host Managed Zoned Block Device (ZBC-3)              column keys
              .  T – Sequential Access Device (SSC-5)                    blank = code not used
              .   P – Processor Device (SPC-2)                           not blank = code used
              .    . R – C/DVD Device (MMC-6)
              .    .  O – Optical Memory Block Device (SBC)
              .    .    M – Media Changer Device (SMC-3)
              .    .     . A – Storage Array Device (SCC-2)
              .    .     .  E – SCSI Enclosure Services device (SES-3)
              .    .     .   B – Simplified Direct Access (Reduced Block) device (RBC)
              .    .     .    . K – Optical Card Reader/Writer device (OCRW)
              .    .     .     . V – Automation/Device Interface device (ADC-4)
              .    .     .      F – Object-based Storage Device (OSD-2)
              .    .    .    .    .    .
```

ASC	ASCQ	DZTPROMAEBKVF	Description
00h	00h	DZTPROMAEBKVF	NO ADDITIONAL SENSE INFORMATION
00h	01h	T	FILEMARK DETECTED
00h	02h	T	END-OF-PARTITION/MEDIUM DETECTED
00h	03h	T	SETMARK DETECTED
00h	04h	T	BEGINNING-OF-PARTITION/MEDIUM DETECTED
00h	05h	T	END-OF-DATA DETECTED
00h	06h	DZTPROMAEBKVF	I/O PROCESS TERMINATED
00h	07h	T	PROGRAMMABLE EARLY WARNING DETECTED
00h	11h	R	AUDIO PLAY OPERATION IN PROGRESS
00h	12h	R	AUDIO PLAY OPERATION PAUSED
00h	13h	R	AUDIO PLAY OPERATION SUCCESSFULLY COMPLETED
00h	14h	R	AUDIO PLAY OPERATION STOPPED DUE TO ERROR
00h	15h	R	NO CURRENT AUDIO STATUS TO RETURN

^a This additional sense code is used by a device type that is no longer represented in this table.

Table E.1 – ASC and ASCQ assignments (part 2 of 21)

```
              D – Direct Access Block Device (SBC-5)                          Device Type
              . Z – Host Managed Zoned Block Device (ZBC-3)                    column keys
              .   T – Sequential Access Device (SSC-5)                         blank = code not used
              .     P – Processor Device (SPC-2)                               not blank = code used
              .       . R – C/DVD Device (MMC-6)
              .       .   O – Optical Memory Block Device (SBC)
              .       .     M – Media Changer Device (SMC-3)
              .       .       . A – Storage Array Device (SCC-2)
              .       .       .   E – SCSI Enclosure Services device (SES-3)
              .       .       .     B – Simplified Direct Access (Reduced Block) device (RBC)
              .       .       .       . K – Optical Card Reader/Writer device (OCRW)
              .       .       .         . V – Automation/Device Interface device (ADC-4)
              .       .       .           F – Object-based Storage Device (OSD-2)

              .   .   .   .   .   .
```

ASC	ASCQ	D Z T P R O M A E B K V F	Description
00h	16h	D Z T P R O M A E B K V F	OPERATION IN PROGRESS
00h	17h	D Z T R O M A E B K V F	CLEANING REQUESTED
00h	18h	T	ERASE OPERATION IN PROGRESS
00h	19h	T	LOCATE OPERATION IN PROGRESS
00h	1Ah	T	REWIND OPERATION IN PROGRESS
00h	1Bh	T	SET CAPACITY OPERATION IN PROGRESS
00h	1Ch	T	VERIFY OPERATION IN PROGRESS
00h	1Dh	D Z T B	ATA PASS THROUGH INFORMATION AVAILABLE
00h	1Eh	D Z T R M A E B K V	CONFLICTING SA CREATION REQUEST
00h	1Fh	D Z T B	LOGICAL UNIT TRANSITIONING TO ANOTHER POWER CONDITION
00h	20h	D Z T P B	EXTENDED COPY INFORMATION AVAILABLE
00h	21h	D Z	ATOMIC COMMAND ABORTED DUE TO ACA
00h	22h	D Z	DEFERRED MICROCODE IS PENDING
00h	23h	D Z	OVERLAPPING ATOMIC COMMAND IN PROGRESS
01h	00h	D Z O B K	NO INDEX/SECTOR SIGNAL
02h	00h	D Z R O B K	NO SEEK COMPLETE
03h	00h	D Z T O B K	PERIPHERAL DEVICE WRITE FAULT
03h	01h	T	NO WRITE CURRENT
03h	02h	T	EXCESSIVE WRITE ERRORS
04h	00h	D Z T P R O M A E B K V F	LOGICAL UNIT NOT READY, CAUSE NOT REPORTABLE
04h	01h	D Z T P R O M A E B K V F	LOGICAL UNIT IS IN PROCESS OF BECOMING READY
04h	02h	D Z T P R O M A E B K V F	LOGICAL UNIT NOT READY, INITIALIZING COMMAND REQUIRED
04h	03h	D Z T P R O M A E B K V F	LOGICAL UNIT NOT READY, MANUAL INTERVENTION REQUIRED
04h	04h	D Z T R O B	LOGICAL UNIT NOT READY, FORMAT IN PROGRESS
04h	05h	D Z T O A B K F	LOGICAL UNIT NOT READY, REBUILD IN PROGRESS
04h	06h	D Z T O A B K	LOGICAL UNIT NOT READY, RECALCULATION IN PROGRESS
04h	07h	D Z T P R O M A E B K V F	LOGICAL UNIT NOT READY, OPERATION IN PROGRESS
04h	08h	R	LOGICAL UNIT NOT READY, LONG WRITE IN PROGRESS
04h	09h	D Z T P R O M A E B K V F	LOGICAL UNIT NOT READY, SELF-TEST IN PROGRESS
04h	0Ah	D Z T P R O M A E B K V F	LOGICAL UNIT NOT ACCESSIBLE, ASYMMETRIC ACCESS STATE TRANSITION
04h	0Bh	D Z T P R O M A E B K V F	LOGICAL UNIT NOT ACCESSIBLE, TARGET PORT IN STANDBY STATE
04h	0Ch	D Z T P R O M A E B K V F	LOGICAL UNIT NOT ACCESSIBLE, TARGET PORT IN UNAVAILABLE STATE
04h	0Dh	F	LOGICAL UNIT NOT READY, STRUCTURE CHECK REQUIRED
04h	0Eh	D Z T R M A E B K V F	LOGICAL UNIT NOT READY, SECURITY SESSION IN PROGRESS
04h	10h	D Z T R O M B	LOGICAL UNIT NOT READY, AUXILIARY MEMORY NOT ACCESSIBLE
04h	11h	D Z T R O A E B V F	LOGICAL UNIT NOT READY, NOTIFY (ENABLE SPINUP) REQUIRED
04h	12h	M V	LOGICAL UNIT NOT READY, OFFLINE
04h	13h	D Z T R M A E B K V	LOGICAL UNIT NOT READY, SA CREATION IN PROGRESS
04h	14h	D Z B	LOGICAL UNIT NOT READY, SPACE ALLOCATION IN PROGRESS

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a This additional sense code is used by a device type that is no longer represented in this table.

Table E.1 – ASC and ASCQ assignments (part 3 of 21)

			Device Type
	D – Direct Access Block Device (SBC-5)		column keys
	. Z – Host Managed Zoned Block Device (ZBC-3)		blank = code not used
	. T – Sequential Access Device (SSC-5)		not blank = code used
	. P – Processor Device (SPC-2)		
	. . R – C/DVD Device (MMC-6)		
	. . O – Optical Memory Block Device (SBC)		
	. . M – Media Changer Device (SMC-3)		
	. . . A – Storage Array Device (SCC-2)		
	. . . E – SCSI Enclosure Services device (SES-3)		
	. . . B – Simplified Direct Access (Reduced Block) device (RBC)		
	. . . . K – Optical Card Reader/Writer device (OCRW)		
	. . . . V – Automation/Device Interface device (ADC-4)		
	. . . . F – Object-based Storage Device (OSD-2)		

ASC	ASCQ	DZTPROMAEBKVF	Description
04h	15h	M	LOGICAL UNIT NOT READY, ROBOTICS DISABLED
04h	16h	M	LOGICAL UNIT NOT READY, CONFIGURATION REQUIRED
04h	17h	M	LOGICAL UNIT NOT READY, CALIBRATION REQUIRED
04h	18h	M	LOGICAL UNIT NOT READY, A DOOR IS OPEN
04h	19h	M	LOGICAL UNIT NOT READY, OPERATING IN SEQUENTIAL MODE
04h	1Ah	DZ B	LOGICAL UNIT NOT READY, START STOP UNIT COMMAND IN PROGRESS
04h	1Bh	DZ B	LOGICAL UNIT NOT READY, SANITIZE IN PROGRESS
04h	1Ch	DZT MAEB	LOGICAL UNIT NOT READY, ADDITIONAL POWER USE NOT YET GRANTED
04h	1Dh	DZ	LOGICAL UNIT NOT READY, CONFIGURATION IN PROGRESS
04h	1Eh	DZ	LOGICAL UNIT NOT READY, MICROCODE ACTIVATION REQUIRED
04h	1Fh	DZTPROMAEBKVF	LOGICAL UNIT NOT READY, MICROCODE DOWNLOAD REQUIRED
04h	20h	DZTPROMAEBKVF	LOGICAL UNIT NOT READY, LOGICAL UNIT RESET REQUIRED
04h	21h	DZTPROMAEBKVF	LOGICAL UNIT NOT READY, HARD RESET REQUIRED
04h	22h	DZTPROMAEBKVF	LOGICAL UNIT NOT READY, POWER CYCLE REQUIRED
04h	23h	DZ	LOGICAL UNIT NOT READY, AFFILIATION REQUIRED
04h	24h	DZ	DEPOPULATION IN PROGRESS
04h	25h	DZ	DEPOPULATION RESTORATION IN PROGRESS
05h	00h	DZT ROMAEBKVF	LOGICAL UNIT DOES NOT RESPOND TO SELECTION
06h	00h	DZ ROM BK	NO REFERENCE POSITION FOUND
07h	00h	DZT ROM BK	MULTIPLE PERIPHERAL DEVICES SELECTED
08h	00h	DZT ROMAEBKVF	LOGICAL UNIT COMMUNICATION FAILURE
08h	01h	DZT ROMAEBKVF	LOGICAL UNIT COMMUNICATION TIME-OUT
08h	02h	DZT ROMAEBKVF	LOGICAL UNIT COMMUNICATION PARITY ERROR
08h	03h	DZT ROM BK	LOGICAL UNIT COMMUNICATION CRC ERROR (ULTRA-DMA/32)
08h	04h	DZTPRO K	UNREACHABLE COPY TARGET
09h	00h	DZT RO B	TRACK FOLLOWING ERROR
09h	01h	RO K	TRACKING SERVO FAILURE
09h	02h	RO K	FOCUS SERVO FAILURE
09h	03h	RO	SPINDLE SERVO FAILURE
09h	04h	DZT RO B	HEAD SELECT FAULT
09h	05h	DZT RO B	VIBRATION INDUCED TRACKING ERROR
0Ah	00h	DZTPROMAEBKVF	ERROR LOG OVERFLOW
0Bh	00h	DZTPROMAEBKVF	WARNING
0Bh	01h	DZTPROMAEBKVF	WARNING - SPECIFIED TEMPERATURE EXCEEDED
0Bh	02h	DZTPROMAEBKVF	WARNING - ENCLOSURE DEGRADED
0Bh	03h	DZTPROMAEBKVF	WARNING - BACKGROUND SELF-TEST FAILED
0Bh	04h	DZTPRO AEBKVF	WARNING - BACKGROUND PRE-SCAN DETECTED MEDIUM ERROR
0Bh	05h	DZTPRO AEBKVF	WARNING - BACKGROUND MEDIUM SCAN DETECTED MEDIUM ERROR
0Bh	06h	DZTPROMAEBKVF	WARNING - NON-VOLATILE CACHE NOW VOLATILE

_a_ This additional sense code is used by a device type that is no longer represented in this table.

Table E.1 – ASC and ASCQ assignments (part 4 of 21)

```
                  D – Direct Access Block Device (SBC-5)                    Device Type
                  . Z – Host Managed Zoned Block Device (ZBC-3)             column keys
                  .   T – Sequential Access Device (SSC-5)                  blank = code not used
                  .     P – Processor Device (SPC-2)                        not blank = code used
                  .     . R – C/DVD Device (MMC-6)
                  .     .   O – Optical Memory Block Device (SBC)
                  .     .     M – Media Changer Device (SMC-3)
                  .     .     . A – Storage Array Device (SCC-2)
                  .     .     .   E – SCSI Enclosure Services device (SES-3)
                  .     .     .     B – Simplified Direct Access (Reduced Block) device (RBC)
                  .     .     .     . K – Optical Card Reader/Writer device (OCRW)
                  .     .     .     .   V – Automation/Device Interface device (ADC-4)
                  .     .     .     .     F – Object-based Storage Device (OSD-2)

                  .     .     .     .     .
ASC ASCQ  D Z T P R O M A E B K V F  Description
```

ASC	ASCQ	D Z T P R O M A E B K V F	Description
0Bh	07h	D Z T P R O M A E B K V F	WARNING - DEGRADED POWER TO NON-VOLATILE CACHE
0Bh	08h	D Z T P R O M A E B K V F	WARNING - POWER LOSS EXPECTED
0Bh	09h	D Z	WARNING - DEVICE STATISTICS NOTIFICATION ACTIVE
0Bh	0Ah	D Z T P R O M A E B K V	WARNING - HIGH CRITICAL TEMPERATURE LIMIT EXCEEDED
0Bh	0Bh	D Z T P R O M A E B K V	WARNING - LOW CRITICAL TEMPERATURE LIMIT EXCEEDED
0Bh	0Ch	D Z T P R O M A E B K V	WARNING - HIGH OPERATING TEMPERATURE LIMIT EXCEEDED
0Bh	0Dh	D Z T P R O M A E B K V	WARNING - LOW OPERATING TEMPERATURE LIMIT EXCEEDED
0Bh	0Eh	D Z T P R O M A E B K V	WARNING - HIGH CRITICAL HUMIDITY LIMIT EXCEEDED
0Bh	0Fh	D Z T P R O M A E B K V	WARNING - LOW CRITICAL HUMIDITY LIMIT EXCEEDED
0Bh	10h	D Z T P R O M A E B K V	WARNING - HIGH OPERATING HUMIDITY LIMIT EXCEEDED
0Bh	11h	D Z T P R O M A E B K V	WARNING - LOW OPERATING HUMIDITY LIMIT EXCEEDED
0Bh	12h	D Z T P R O M A E B K V F	WARNING - MICROCODE SECURITY AT RISK
0Bh	13h	D Z T P R O M A E B K V F	WARNING - MICROCODE DIGITAL SIGNATURE VALIDATION FAILURE
0Bh	14h	D Z	WARNING - PHYSICAL ELEMENT STATUS CHANGE
0Ch	00h	D Z T R	WRITE ERROR
0Ch	01h	D Z K	WRITE ERROR - RECOVERED WITH AUTO REALLOCATION
0Ch	02h	D Z O B K	WRITE ERROR - AUTO REALLOCATION FAILED
0Ch	03h	D Z O B K	WRITE ERROR - RECOMMEND REASSIGNMENT
0Ch	04h	D Z T O B	COMPRESSION CHECK MISCOMPARE ERROR
0Ch	05h	D Z T O B	DATA EXPANSION OCCURRED DURING COMPRESSION
0Ch	06h	D Z T O B	BLOCK NOT COMPRESSIBLE
0Ch	07h	D Z R	WRITE ERROR - RECOVERY NEEDED
0Ch	08h	R	WRITE ERROR - RECOVERY FAILED
0Ch	09h	R	WRITE ERROR - LOSS OF STREAMING
0Ch	0Ah	R	WRITE ERROR - PADDING BLOCKS ADDED
0Ch	0Bh	D Z T R O M B	AUXILIARY MEMORY WRITE ERROR
0Ch	0Ch	D Z T P R O A E B K V F	WRITE ERROR - UNEXPECTED UNSOLICITED DATA
0Ch	0Dh	D Z T P R O A E B K V F	WRITE ERROR - NOT ENOUGH UNSOLICITED DATA
0Ch	0Eh	D Z T O B K	MULTIPLE WRITE ERRORS
0Ch	0Fh	R	DEFECTS IN ERROR WINDOW
0Ch	10h	D Z	INCOMPLETE MULTIPLE ATOMIC WRITE OPERATIONS
0Ch	11h	D Z	WRITE ERROR - RECOVERY SCAN NEEDED
0Ch	12h	D Z	WRITE ERROR - INSUFFICIENT ZONE RESOURCES
0Dh	00h	D Z T P R O A K	ERROR DETECTED BY THIRD PARTY TEMPORARY INITIATOR
0Dh	01h	D Z T P R O A K	THIRD PARTY DEVICE FAILURE
0Dh	02h	D Z T P R O A K	COPY TARGET DEVICE NOT REACHABLE
0Dh	03h	D Z T P R O A K	INCORRECT COPY TARGET DEVICE TYPE
0Dh	04h	D Z T P R O A K	COPY TARGET DEVICE DATA UNDERRUN
0Dh	05h	D Z T P R O A K	COPY TARGET DEVICE DATA OVERRUN
0Eh	00h	D Z T P R O M A E B K F	INVALID INFORMATION UNIT
0Eh	01h	D Z T P R O M A E B K F	INFORMATION UNIT TOO SHORT

^a This additional sense code is used by a device type that is no longer represented in this table.

Table E.1 – ASC and ASCQ assignments (part 5 of 21)

```
          D – Direct Access Block Device (SBC-5)                    Device Type
          . Z – Host Managed Zoned Block Device (ZBC-3)             column keys
          .  T – Sequential Access Device (SSC-5)                   blank = code not used
          .   P – Processor Device (SPC-2)                          not blank = code used
          .    . R – C/DVD Device (MMC-6)
          .    .  O – Optical Memory Block Device (SBC)
          .    .   M – Media Changer Device (SMC-3)
          .    .    . A – Storage Array Device (SCC-2)
          .    .    . E – SCSI Enclosure Services device (SES-3)
          .    .    .  B – Simplified Direct Access (Reduced Block) device (RBC)
          .    .    .   . K – Optical Card Reader/Writer device (OCRW)
          .    .    .    . V – Automation/Device Interface device (ADC-4)
          .    .    .    . F – Object-based Storage Device (OSD-2)
          .    .    .    .
```

ASC	ASCQ	D Z T P R O M A E B K V F	Description
0Eh	02h	DZTPROMAEBK F	INFORMATION UNIT TOO LONG
0Eh	03h	DZTPR MAEBK F	INVALID FIELD IN COMMAND INFORMATION UNIT
0Fh	00h		
10h	00h	DZ O BK	ID CRC OR ECC ERROR
10h	01h	DZT O	LOGICAL BLOCK GUARD CHECK FAILED
10h	02h	DZT O	LOGICAL BLOCK APPLICATION TAG CHECK FAILED
10h	03h	DZT O	LOGICAL BLOCK REFERENCE TAG CHECK FAILED
10h	04h	T	LOGICAL BLOCK PROTECTION ERROR ON RECOVER BUFFERED DATA
10h	05h	T	LOGICAL BLOCK PROTECTION METHOD ERROR
11h	00h	DZT RO BK	UNRECOVERED READ ERROR
11h	01h	DZT RO BK	READ RETRIES EXHAUSTED
11h	02h	DZT RO BK	ERROR TOO LONG TO CORRECT
11h	03h	DZT O BK	MULTIPLE READ ERRORS
11h	04h	DZ O BK	UNRECOVERED READ ERROR - AUTO REALLOCATE FAILED
11h	05h	RO B	L-EC UNCORRECTABLE ERROR
11h	06h	RO B	CIRC UNRECOVERED ERROR
11h	07h	O B	DATA RE-SYNCHRONIZATION ERROR
11h	08h	T	INCOMPLETE BLOCK READ
11h	09h	T	NO GAP FOUND
11h	0Ah	DZT O BK	MISCORRECTED ERROR
11h	0Bh	DZ O BK	UNRECOVERED READ ERROR - RECOMMEND REASSIGNMENT
11h	0Ch	DZ O BK	UNRECOVERED READ ERROR - RECOMMEND REWRITE THE DATA
11h	0Dh	DZT RO B	DE-COMPRESSION CRC ERROR
11h	0Eh	DZT RO B	CANNOT DECOMPRESS USING DECLARED ALGORITHM
11h	0Fh	R	ERROR READING UPC/EAN NUMBER
11h	10h	R	ERROR READING ISRC NUMBER
11h	11h	R	READ ERROR - LOSS OF STREAMING
11h	12h	DZT ROM B	AUXILIARY MEMORY READ ERROR
11h	13h	DZTPRO AEBKVF	READ ERROR - FAILED RETRANSMISSION REQUEST
11h	14h	DZ	READ ERROR - LBA MARKED BAD BY APPLICATION CLIENT
11h	15h	DZ	WRITE AFTER SANITIZE REQUIRED
12h	00h	DZ O BK	ADDRESS MARK NOT FOUND FOR ID FIELD
13h	00h	DZ O BK	ADDRESS MARK NOT FOUND FOR DATA FIELD
14h	00h	DZT RO BK	RECORDED ENTITY NOT FOUND
14h	01h	DZT RO BK	RECORD NOT FOUND
14h	02h	T	FILEMARK OR SETMARK NOT FOUND
14h	03h	T	END-OF-DATA NOT FOUND
14h	04h	T	BLOCK SEQUENCE ERROR
14h	05h	DZT O BK	RECORD NOT FOUND - RECOMMEND REASSIGNMENT
14h	06h	DZT O BK	RECORD NOT FOUND - DATA AUTO-REALLOCATED
14h	07h	T	LOCATE OPERATION FAILURE

a This additional sense code is used by a device type that is no longer represented in this table.

Table E.1 – ASC and ASCQ assignments (part 6 of 21)

		D – Direct Access Block Device (SBC-5)	Device Type
		. Z – Host Managed Zoned Block Device (ZBC-3)	column keys
		. T – Sequential Access Device (SSC-5)	blank = code not used
		. P – Processor Device (SPC-2)	not blank = code used
		. R – C/DVD Device (MMC-6)	
		. . O – Optical Memory Block Device (SBC)	
		. . M – Media Changer Device (SMC-3)	
		. . . A – Storage Array Device (SCC-2)	
		. . . E – SCSI Enclosure Services device (SES-3)	
		. . . B – Simplified Direct Access (Reduced Block) device (RBC)	
		. . . . K – Optical Card Reader/Writer device (OCRW)	
		. . . . V – Automation/Device Interface device (ADC-4)	
		. . . . F – Object-based Storage Device (OSD-2)	

ASC	ASCQ	DZTPROMAEBKVF	Description
15h	00h	DZT ROM BK	RANDOM POSITIONING ERROR
15h	01h	DZT ROM BK	MECHANICAL POSITIONING ERROR
15h	02h	DZT RO BK	POSITIONING ERROR DETECTED BY READ OF MEDIUM
16h	00h	DZ O BK	DATA SYNCHRONIZATION MARK ERROR
16h	01h	DZ O BK	DATA SYNC ERROR - DATA REWRITTEN
16h	02h	DZ O BK	DATA SYNC ERROR - RECOMMEND REWRITE
16h	03h	DZ O BK	DATA SYNC ERROR - DATA AUTO-REALLOCATED
16h	04h	DZ O BK	DATA SYNC ERROR - RECOMMEND REASSIGNMENT
17h	00h	DZT RO BK	RECOVERED DATA WITH NO ERROR CORRECTION APPLIED
17h	01h	DZT RO BK	RECOVERED DATA WITH RETRIES
17h	02h	DZT RO BK	RECOVERED DATA WITH POSITIVE HEAD OFFSET
17h	03h	DZT RO BK	RECOVERED DATA WITH NEGATIVE HEAD OFFSET
17h	04h	RO B	RECOVERED DATA WITH RETRIES AND/OR CIRC APPLIED
17h	05h	DZ RO BK	RECOVERED DATA USING PREVIOUS SECTOR ID
17h	06h	DZ O BK	RECOVERED DATA WITHOUT ECC - DATA AUTO-REALLOCATED
17h	07h	DZ RO BK	RECOVERED DATA WITHOUT ECC - RECOMMEND REASSIGNMENT
17h	08h	DZ RO BK	RECOVERED DATA WITHOUT ECC - RECOMMEND REWRITE
17h	09h	DZ RO BK	RECOVERED DATA WITHOUT ECC - DATA REWRITTEN
18h	00h	DZT RO BK	RECOVERED DATA WITH ERROR CORRECTION APPLIED
18h	01h	DZ RO BK	RECOVERED DATA WITH ERROR CORR. & RETRIES APPLIED
18h	02h	DZ RO BK	RECOVERED DATA - DATA AUTO-REALLOCATED
18h	03h	R	RECOVERED DATA WITH CIRC
18h	04h	R	RECOVERED DATA WITH L-EC
18h	05h	DZ RO BK	RECOVERED DATA - RECOMMEND REASSIGNMENT
18h	06h	DZ RO BK	RECOVERED DATA - RECOMMEND REWRITE
18h	07h	DZ O BK	RECOVERED DATA WITH ECC - DATA REWRITTEN
18h	08h	R	RECOVERED DATA WITH LINKING
19h	00h	DZ O K	DEFECT LIST ERROR
19h	01h	DZ O K	DEFECT LIST NOT AVAILABLE
19h	02h	DZ O K	DEFECT LIST ERROR IN PRIMARY LIST
19h	03h	DZ O K	DEFECT LIST ERROR IN GROWN LIST
1Ah	00h	DZTPROMAEBKVF	PARAMETER LIST LENGTH ERROR
1Bh	00h	DZTPROMAEBKVF	SYNCHRONOUS DATA TRANSFER ERROR
1Ch	00h	DZ O BK	DEFECT LIST NOT FOUND
1Ch	01h	DZ O BK	PRIMARY DEFECT LIST NOT FOUND
1Ch	02h	DZ O BK	GROWN DEFECT LIST NOT FOUND
1Dh	00h	DZT RO BK	MISCOMPARE DURING VERIFY OPERATION
1Dh	01h	DZ B	MISCOMPARE VERIFY OF UNMAPPED LBA
1Eh	00h	DZ O BK	RECOVERED ID WITH ECC CORRECTION
1Fh	00h	DZ O K	PARTIAL DEFECT LIST TRANSFER
20h	00h	DZTPROMAEBKVF	INVALID COMMAND OPERATION CODE

^a This additional sense code is used by a device type that is no longer represented in this table.

Table E.1 – ASC and ASCQ assignments (part 7 of 21)

	D – Direct Access Block Device (SBC-5)		Device Type
	. Z – Host Managed Zoned Block Device (ZBC-3)		column keys
	. T – Sequential Access Device (SSC-5)		blank = code not used
	. P – Processor Device (SPC-2)		not blank = code used
	. . R – C/DVD Device (MMC-6)		
	. . O – Optical Memory Block Device (SBC)		
	. . M – Media Changer Device (SMC-3)		
	. . . A – Storage Array Device (SCC-2)		
	. . . E – SCSI Enclosure Services device (SES-3)		
	. . . B – Simplified Direct Access (Reduced Block) device (RBC)		
	. . . . K – Optical Card Reader/Writer device (OCRW)		
	. . . . V – Automation/Device Interface device (ADC-4)		
	. . . . F – Object-based Storage Device (OSD-2)		

ASC	ASCQ	DZTPROMAEBKVF	Description
20h	01h	DZTPROMAEBK	ACCESS DENIED - INITIATOR PENDING-ENROLLED
20h	02h	DZTPROMAEBK	ACCESS DENIED - NO ACCESS RIGHTS
20h	03h	DZTPROMAEBK	ACCESS DENIED - INVALID MGMT ID KEY
20h	04h	T	ILLEGAL COMMAND WHILE IN WRITE CAPABLE STATE
20h	05h	T	Obsolete
20h	06h	T	ILLEGAL COMMAND WHILE IN EXPLICIT ADDRESS MODE
20h	07h	T	ILLEGAL COMMAND WHILE IN IMPLICIT ADDRESS MODE
20h	08h	DZTPROMAEBK	ACCESS DENIED - ENROLLMENT CONFLICT
20h	09h	DZTPROMAEBK	ACCESS DENIED - INVALID LU IDENTIFIER
20h	0Ah	DZTPROMAEBK	ACCESS DENIED - INVALID PROXY TOKEN
20h	0Bh	DZTPROMAEBK	ACCESS DENIED - ACL LUN CONFLICT
20h	0Ch	T	ILLEGAL COMMAND WHEN NOT IN APPEND-ONLY MODE
20h	0Dh	D	NOT AN ADMINISTRATIVE LOGICAL UNIT
20h	0Eh	D	NOT A SUBSIDIARY LOGICAL UNIT
20h	0Fh	D	NOT A CONGLOMERATE LOGICAL UNIT
21h	00h	DZT RO BK	LOGICAL BLOCK ADDRESS OUT OF RANGE
21h	01h	DZT ROM BK	INVALID ELEMENT ADDRESS
21h	02h	R	INVALID ADDRESS FOR WRITE
21h	03h	R	INVALID WRITE CROSSING LAYER JUMP
21h	04h	DZ	UNALIGNED WRITE COMMAND
21h	05h	DZ	WRITE BOUNDARY VIOLATION
21h	06h	DZ	ATTEMPT TO READ INVALID DATA
21h	07h	DZ	READ BOUNDARY VIOLATION
21h	08h	DZ	MISALIGNED WRITE COMMAND
21h	09h	DZ	ATTEMPT TO ACCESS GAP ZONE
22h	00h	DZ	ILLEGAL FUNCTION (USE 20 00, 24 00, OR 26 00)
23h	00h	DZTP B	INVALID TOKEN OPERATION, CAUSE NOT REPORTABLE
23h	01h	DZTP B	INVALID TOKEN OPERATION, UNSUPPORTED TOKEN TYPE
23h	02h	DZTP B	INVALID TOKEN OPERATION, REMOTE TOKEN USAGE NOT SUPPORTED
23h	03h	DZTP B	INVALID TOKEN OPERATION, REMOTE ROD TOKEN CREATION NOT SUPPORTED
23h	04h	DZTP B	INVALID TOKEN OPERATION, TOKEN UNKNOWN
23h	05h	DZTP B	INVALID TOKEN OPERATION, TOKEN CORRUPT
23h	06h	DZTP B	INVALID TOKEN OPERATION, TOKEN REVOKED
23h	07h	DZTP B	INVALID TOKEN OPERATION, TOKEN EXPIRED
23h	08h	DZTP B	INVALID TOKEN OPERATION, TOKEN CANCELLED
23h	09h	DZTP B	INVALID TOKEN OPERATION, TOKEN DELETED
23h	0Ah	DZTP B	INVALID TOKEN OPERATION, INVALID TOKEN LENGTH
24h	00h	DZTPROMAEBKVF	INVALID FIELD IN CDB
24h	01h	DZTPRO AEBKVF	CDB DECRYPTION ERROR

a	This additional sense code is used by a device type that is no longer represented in this table.

Table E.1 – ASC and ASCQ assignments (part 8 of 21)

				Device Type
		D – Direct Access Block Device (SBC-5)		Device Type
		. Z – Host Managed Zoned Block Device (ZBC-3)		column keys
		. T – Sequential Access Device (SSC-5)		blank = code not used
		. P – Processor Device (SPC-2)		not blank = code used
		. . R – C/DVD Device (MMC-6)		
		. . O – Optical Memory Block Device (SBC)		
		. . M – Media Changer Device (SMC-3)		
		. . . A – Storage Array Device (SCC-2)		
		. . . E – SCSI Enclosure Services device (SES-3)		
		. . . B – Simplified Direct Access (Reduced Block) device (RBC)		
		. . . . K – Optical Card Reader/Writer device (OCRW)		
		. . . . V – Automation/Device Interface device (ADC-4)		
		. . . F – Object-based Storage Device (OSD-2)		

ASC	ASCQ	D Z T P R O M A E B K V F	Description
24h	02h	T	Obsolete
24h	03h	T	Obsolete
24h	04h	F	SECURITY AUDIT VALUE FROZEN
24h	05h	F	SECURITY WORKING KEY FROZEN
24h	06h	F	NONCE NOT UNIQUE
24h	07h	F	NONCE TIMESTAMP OUT OF RANGE
24h	08h	D Z T R M A E B K V	INVALID XCDB
24h	09h	D Z	INVALID FAST FORMAT
25h	00h	D Z T P R O M A E B K V F	LOGICAL UNIT NOT SUPPORTED
26h	00h	D Z T P R O M A E B K V F	INVALID FIELD IN PARAMETER LIST
26h	01h	D Z T P R O M A E B K V F	PARAMETER NOT SUPPORTED
26h	02h	D Z T P R O M A E B K V F	PARAMETER VALUE INVALID
26h	03h	D Z T P R O M A E K	THRESHOLD PARAMETERS NOT SUPPORTED
26h	04h	D Z T P R O M A E B K V F	INVALID RELEASE OF PERSISTENT RESERVATION
26h	05h	D Z T P R O A B K	DATA DECRYPTION ERROR
26h	06h	D Z T P R O K	TOO MANY TARGET DESCRIPTORS
26h	07h	D Z T P R O K	UNSUPPORTED TARGET DESCRIPTOR TYPE CODE
26h	08h	D Z T P R O K	TOO MANY SEGMENT DESCRIPTORS
26h	09h	D Z T P R O K	UNSUPPORTED SEGMENT DESCRIPTOR TYPE CODE
26h	0Ah	D Z T P R O K	UNEXPECTED INEXACT SEGMENT
26h	0Bh	D Z T P R O K	INLINE DATA LENGTH EXCEEDED
26h	0Ch	D Z T P R O K	INVALID OPERATION FOR COPY SOURCE OR DESTINATION
26h	0Dh	D Z T P R O K	COPY SEGMENT GRANULARITY VIOLATION
26h	0Eh	D Z T P R O M A E B K	INVALID PARAMETER WHILE PORT IS ENABLED
26h	0Fh	F	INVALID DATA-OUT BUFFER INTEGRITY CHECK VALUE
26h	10h	T	DATA DECRYPTION KEY FAIL LIMIT REACHED
26h	11h	T	INCOMPLETE KEY-ASSOCIATED DATA SET
26h	12h	T	VENDOR SPECIFIC KEY REFERENCE NOT FOUND
26h	13h	D	APPLICATION TAG MODE PAGE IS INVALID
26h	14h	T	TAPE STREAM MIRRORING PREVENTED
26h	15h	T	COPY SOURCE OR COPY DESTINATION NOT AUTHORIZED
26h	16h	D Z	FAST COPY NOT POSSIBLE
27h	00h	D Z T R O B K	WRITE PROTECTED
27h	01h	D Z T R O B K	HARDWARE WRITE PROTECTED
27h	02h	D Z T R O B K	LOGICAL UNIT SOFTWARE WRITE PROTECTED
27h	03h	T R	ASSOCIATED WRITE PROTECT
27h	04h	T R	PERSISTENT WRITE PROTECT
27h	05h	T R	PERMANENT WRITE PROTECT
27h	06h	R F	CONDITIONAL WRITE PROTECT
27h	07h	D Z B	SPACE ALLOCATION FAILED WRITE PROTECT
27h	08h	D Z	ZONE IS READ ONLY

a This additional sense code is used by a device type that is no longer represented in this table.

Table E.1 – ASC and ASCQ assignments (part 9 of 21)

		D – Direct Access Block Device (SBC-5)	Device Type
		. Z – Host Managed Zoned Block Device (ZBC-3)	column keys
		. T – Sequential Access Device (SSC-5)	blank = code not used
		. P – Processor Device (SPC-2)	not blank = code used
		. . R – C/DVD Device (MMC-6)	
		. . O – Optical Memory Block Device (SBC)	
		. . M – Media Changer Device (SMC-3)	
		. . . A – Storage Array Device (SCC-2)	
		. . . E – SCSI Enclosure Services device (SES-3)	
		. . . B – Simplified Direct Access (Reduced Block) device (RBC)	
		. . . . K – Optical Card Reader/Writer device (OCRW)	
		. . . . V – Automation/Device Interface device (ADC-4)	
		. . . . F – Object-based Storage Device (OSD-2)	

ASC	ASCQ	DZTPROMAEBKVF	Description
28h	00h	DZTPROMAEBKVF	NOT READY TO READY CHANGE, MEDIUM MAY HAVE CHANGED
28h	01h	DZT ROM B	IMPORT OR EXPORT ELEMENT ACCESSED
28h	02h	R	FORMAT-LAYER MAY HAVE CHANGED
28h	03h	M	IMPORT/EXPORT ELEMENT ACCESSED, MEDIUM CHANGED
29h	00h	DZTPROMAEBKVF	POWER ON, RESET, OR BUS DEVICE RESET OCCURRED
29h	01h	DZTPROMAEBKVF	POWER ON OCCURRED
29h	02h	DZTPROMAEBKVF	SCSI BUS RESET OCCURRED
29h	03h	DZTPROMAEBKVF	BUS DEVICE RESET FUNCTION OCCURRED
29h	04h	DZTPROMAEBKVF	DEVICE INTERNAL RESET
29h	05h	DZTPROMAEBKVF	TRANSCEIVER MODE CHANGED TO SINGLE-ENDED
29h	06h	DZTPROMAEBKVF	TRANSCEIVER MODE CHANGED TO LVD
29h	07h	DZTPROMAEBKVF	I_T NEXUS LOSS OCCURRED
2Ah	00h	DZT ROMAEBKVF	PARAMETERS CHANGED
2Ah	01h	DZT ROMAEBKVF	MODE PARAMETERS CHANGED
2Ah	02h	DZT ROMAE K	LOG PARAMETERS CHANGED
2Ah	03h	DZTPROMAE K	RESERVATIONS PREEMPTED
2Ah	04h	DZTPROMAE	RESERVATIONS RELEASED
2Ah	05h	DZTPROMAE	REGISTRATIONS PREEMPTED
2Ah	06h	DZTPROMAEBKVF	ASYMMETRIC ACCESS STATE CHANGED
2Ah	07h	DZTPROMAEBKVF	IMPLICIT ASYMMETRIC ACCESS STATE TRANSITION FAILED
2Ah	08h	DZT ROMAEBKVF	PRIORITY CHANGED
2Ah	09h	DZ	CAPACITY DATA HAS CHANGED
2Ah	0Ah	DZT	ERROR HISTORY I_T NEXUS CLEARED
2Ah	0Bh	DZT	ERROR HISTORY SNAPSHOT RELEASED
2Ah	0Ch	F	ERROR RECOVERY ATTRIBUTES HAVE CHANGED
2Ah	0Dh	T	DATA ENCRYPTION CAPABILITIES CHANGED
2Ah	10h	DZT M E V	TIMESTAMP CHANGED
2Ah	11h	T	DATA ENCRYPTION PARAMETERS CHANGED BY ANOTHER I_T NEXUS
2Ah	12h	T	DATA ENCRYPTION PARAMETERS CHANGED BY VENDOR SPECIFIC EVENT
2Ah	13h	T	DATA ENCRYPTION KEY INSTANCE COUNTER HAS CHANGED
2Ah	14h	DZT R MAEBKV	SA CREATION CAPABILITIES DATA HAS CHANGED
2Ah	15h	T M V	MEDIUM REMOVAL PREVENTION PREEMPTED
2Ah	16h	DZ	ZONE RESET WRITE POINTER RECOMMENDED
2Bh	00h	DZTPRO K	COPY CANNOT EXECUTE SINCE HOST CANNOT DISCONNECT
2Ch	00h	DZTPROMAEBKVF	COMMAND SEQUENCE ERROR
2Ch	01h		TOO MANY WINDOWS SPECIFIED [a]
2Ch	02h		INVALID COMBINATION OF WINDOWS SPECIFIED [a]
2Ch	03h	R	CURRENT PROGRAM AREA IS NOT EMPTY
2Ch	04h	R	CURRENT PROGRAM AREA IS EMPTY
2Ch	05h	B	ILLEGAL POWER CONDITION REQUEST

[a] This additional sense code is used by a device type that is no longer represented in this table.

Table E.1 – ASC and ASCQ assignments (part 10 of 21)

	D – Direct Access Block Device (SBC-5)		Device Type	
	. Z – Host Managed Zoned Block Device (ZBC-3)		column keys	
	. T – Sequential Access Device (SSC-5)		blank = code not used	
	. P – Processor Device (SPC-2)		not blank = code used	
	. . R – C/DVD Device (MMC-6)			
	. . O – Optical Memory Block Device (SBC)			
	. . M – Media Changer Device (SMC-3)			
	. . . A – Storage Array Device (SCC-2)			
	. . . E – SCSI Enclosure Services device (SES-3)			
	. . . B – Simplified Direct Access (Reduced Block) device (RBC)			
	. . . . K – Optical Card Reader/Writer device (OCRW)			
	. . . . V – Automation/Device Interface device (ADC-4)			
	. . . . F – Object-based Storage Device (OSD-2)			

ASC	ASCQ	DZTPROMAEBKVF	Description
2Ch	06h	R	PERSISTENT PREVENT CONFLICT
2Ch	07h	DZTPROMAEBKVF	PREVIOUS BUSY STATUS
2Ch	08h	DZTPROMAEBKVF	PREVIOUS TASK SET FULL STATUS
2Ch	09h	DZTPROM EBKVF	PREVIOUS RESERVATION CONFLICT STATUS
2Ch	0Ah	F	PARTITION OR COLLECTION CONTAINS USER OBJECTS
2Ch	0Bh	T	NOT RESERVED
2Ch	0Ch	DZ	ORWRITE GENERATION DOES NOT MATCH
2Ch	0Dh	DZ	RESET WRITE POINTER NOT ALLOWED
2Ch	0Eh	DZ	ZONE IS OFFLINE
2Ch	0Fh	DZ	STREAM NOT OPEN
2Ch	10h	DZ	UNWRITTEN DATA IN ZONE
2Ch	11h	D	DESCRIPTOR FORMAT SENSE DATA REQUIRED
2Ch	12h	DZ	ZONE IS INACTIVE
2Ch	13h	DZTPROMAEBKVF	WELL KNOWN LOGICAL UNIT ACCESS REQUIRED
2Dh	00h	T	OVERWRITE ERROR ON UPDATE IN PLACE
2Eh	00h	DZ ROM B	INSUFFICIENT TIME FOR OPERATION
2Eh	01h	DZ OM B	COMMAND TIMEOUT BEFORE PROCESSING
2Eh	02h	DZ OM B	COMMAND TIMEOUT DURING PROCESSING
2Eh	03h	DZ OM B	COMMAND TIMEOUT DURING PROCESSING DUE TO ERROR RECOVERY
2Fh	00h	DZTPROMAEBKVF	COMMANDS CLEARED BY ANOTHER INITIATOR
2Fh	01h	DZ	COMMANDS CLEARED BY POWER LOSS NOTIFICATION
2Fh	02h	DZTPROMAEBKVF	COMMANDS CLEARED BY DEVICE SERVER
2Fh	03h	DZTPROMAEBKVF	SOME COMMANDS CLEARED BY QUEUING LAYER EVENT
30h	00h	DZT ROM BK	INCOMPATIBLE MEDIUM INSTALLED
30h	01h	DZT RO BK	CANNOT READ MEDIUM - UNKNOWN FORMAT
30h	02h	DZT RO BK	CANNOT READ MEDIUM - INCOMPATIBLE FORMAT
30h	03h	DZT R M K	CLEANING CARTRIDGE INSTALLED
30h	04h	DZT RO BK	CANNOT WRITE MEDIUM - UNKNOWN FORMAT
30h	05h	DZT RO BK	CANNOT WRITE MEDIUM - INCOMPATIBLE FORMAT
30h	06h	DZT RO B	CANNOT FORMAT MEDIUM - INCOMPATIBLE MEDIUM
30h	07h	DZT ROMAEBKVF	CLEANING FAILURE
30h	08h	R	CANNOT WRITE - APPLICATION CODE MISMATCH
30h	09h	R	CURRENT SESSION NOT FIXATED FOR APPEND
30h	0Ah	DZT RO AEBK	CLEANING REQUEST REJECTED
30h	0Ch	T	WORM MEDIUM - OVERWRITE ATTEMPTED
30h	0Dh	T	WORM MEDIUM - INTEGRITY CHECK
30h	10h	R	MEDIUM NOT FORMATTED
30h	11h	M	INCOMPATIBLE VOLUME TYPE
30h	12h	M	INCOMPATIBLE VOLUME QUALIFIER
30h	13h	M	CLEANING VOLUME EXPIRED

[a] This additional sense code is used by a device type that is no longer represented in this table.

Table E.1 – ASC and ASCQ assignments (part 11 of 21)

			Device Type
	D – Direct Access Block Device (SBC-5)		column keys
	. Z – Host Managed Zoned Block Device (ZBC-3)		blank = code not used
	. T – Sequential Access Device (SSC-5)		not blank = code used
	. P – Processor Device (SPC-2)		
	. R – C/DVD Device (MMC-6)		
	. . O – Optical Memory Block Device (SBC)		
	. . M – Media Changer Device (SMC-3)		
	. . . A – Storage Array Device (SCC-2)		
	. . . E – SCSI Enclosure Services device (SES-3)		
	. . . B – Simplified Direct Access (Reduced Block) device (RBC)		
	. . . . K – Optical Card Reader/Writer device (OCRW)		
	. . . . V – Automation/Device Interface device (ADC-4)		
	. . . . F – Object-based Storage Device (OSD-2)		

ASC	ASCQ	DZTPROMAEBKVF	Description
31h	00h	D Z T R O B K	MEDIUM FORMAT CORRUPTED
31h	01h	D Z R O B	FORMAT COMMAND FAILED
31h	02h	R	ZONED FORMATTING FAILED DUE TO SPARE LINKING
31h	03h	D Z B	SANITIZE COMMAND FAILED
31h	04h	D Z	DEPOPULATION FAILED
31h	05h	D Z	DEPOPULATION RESTORATION FAILED
32h	00h	D Z O B K	NO DEFECT SPARE LOCATION AVAILABLE
32h	01h	D Z O B K	DEFECT LIST UPDATE FAILURE
33h	00h	T	TAPE LENGTH ERROR
34h	00h	D Z T P R O M A E B K V F	ENCLOSURE FAILURE
35h	00h	D Z T P R O M A E B K V F	ENCLOSURE SERVICES FAILURE
35h	01h	D Z T P R O M A E B K V F	UNSUPPORTED ENCLOSURE FUNCTION
35h	02h	D Z T P R O M A E B K V F	ENCLOSURE SERVICES UNAVAILABLE
35h	03h	D Z T P R O M A E B K V F	ENCLOSURE SERVICES TRANSFER FAILURE
35h	04h	D Z T P R O M A E B K V F	ENCLOSURE SERVICES TRANSFER REFUSED
35h	05h	D Z T R O M A E B K V F	ENCLOSURE SERVICES CHECKSUM ERROR
36h	00h		RIBBON, INK, OR TONER FAILURE [a]
37h	00h	D Z T R O M A E B K V F	ROUNDED PARAMETER
38h	00h	B	EVENT STATUS NOTIFICATION
38h	02h	B	ESN - POWER MANAGEMENT CLASS EVENT
38h	04h	B	ESN - MEDIA CLASS EVENT
38h	06h	B	ESN - DEVICE BUSY CLASS EVENT
38h	07h	D Z	THIN PROVISIONING SOFT THRESHOLD REACHED
38h	08h	D Z	DEPOPULATION INTERRUPTED
38h	09h	D Z	DEPOPULATION RESTORATION INTERRUPTED
39h	00h	D Z T R O M A E K	SAVING PARAMETERS NOT SUPPORTED
3Ah	00h	D Z T R O M B K	MEDIUM NOT PRESENT
3Ah	01h	D Z T R O M B K	MEDIUM NOT PRESENT - TRAY CLOSED
3Ah	02h	D Z T R O M B K	MEDIUM NOT PRESENT - TRAY OPEN
3Ah	03h	D Z T R O M B	MEDIUM NOT PRESENT - LOADABLE
3Ah	04h	D Z T R O B	MEDIUM NOT PRESENT - MEDIUM AUXILIARY MEMORY ACCESSIBLE
3Bh	00h	T	SEQUENTIAL POSITIONING ERROR
3Bh	01h	T	TAPE POSITION ERROR AT BEGINNING-OF-MEDIUM
3Bh	02h	T	TAPE POSITION ERROR AT END-OF-MEDIUM
3Bh	03h		TAPE OR ELECTRONIC VERTICAL FORMS UNIT NOT READY [a]
3Bh	04h		SLEW FAILURE [a]
3Bh	05h		PAPER JAM [a]
3Bh	06h		FAILED TO SENSE TOP-OF-FORM [a]
3Bh	07h		FAILED TO SENSE BOTTOM-OF-FORM [a]
3Bh	08h	T	REPOSITION ERROR
3Bh	09h		READ PAST END OF MEDIUM [a]

[a] This additional sense code is used by a device type that is no longer represented in this table.

Table E.1 – ASC and ASCQ assignments (part 12 of 21)

		D – Direct Access Block Device (SBC-5)				Device Type
		. Z – Host Managed Zoned Block Device (ZBC-3)				column keys
		. T – Sequential Access Device (SSC-5)				blank = code not used
		. P – Processor Device (SPC-2)				not blank = code used
		. . R – C/DVD Device (MMC-6)				
		. . O – Optical Memory Block Device (SBC)				
		. . M – Media Changer Device (SMC-3)				
		. . . A – Storage Array Device (SCC-2)				
		. . . E – SCSI Enclosure Services device (SES-3)				
		. . . B – Simplified Direct Access (Reduced Block) device (RBC)				
		. . . . K – Optical Card Reader/Writer device (OCRW)				
		. . . . V – Automation/Device Interface device (ADC-4)				
		. . . . F – Object-based Storage Device (OSD-2)				

ASC	ASCQ	DZTPROMAEBKVF	Description
3Bh	0Ah		READ PAST BEGINNING OF MEDIUM [a]
3Bh	0Bh		POSITION PAST END OF MEDIUM [a]
3Bh	0Ch	T	POSITION PAST BEGINNING OF MEDIUM
3Bh	0Dh	DZT ROM BK	MEDIUM DESTINATION ELEMENT FULL
3Bh	0Eh	DZT ROM BK	MEDIUM SOURCE ELEMENT EMPTY
3Bh	0Fh	R	END OF MEDIUM REACHED
3Bh	11h	DZT ROM BK	MEDIUM MAGAZINE NOT ACCESSIBLE
3Bh	12h	DZT ROM BK	MEDIUM MAGAZINE REMOVED
3Bh	13h	DZT ROM BK	MEDIUM MAGAZINE INSERTED
3Bh	14h	DZT ROM BK	MEDIUM MAGAZINE LOCKED
3Bh	15h	DZT ROM BK	MEDIUM MAGAZINE UNLOCKED
3Bh	16h	R	MECHANICAL POSITIONING OR CHANGER ERROR
3Bh	17h	F	READ PAST END OF USER OBJECT
3Bh	18h	M	ELEMENT DISABLED
3Bh	19h	M	ELEMENT ENABLED
3Bh	1Ah	M	DATA TRANSFER DEVICE REMOVED
3Bh	1Bh	M	DATA TRANSFER DEVICE INSERTED
3Bh	1Ch	T	TOO MANY LOGICAL OBJECTS ON PARTITION TO SUPPORT OPERATION
3Bh	20h	M	ELEMENT STATIC INFORMATION CHANGED
3Ch	00h		
3Dh	00h	DZTPROMAE K	INVALID BITS IN IDENTIFY MESSAGE
3Eh	00h	DZTPROMAEBKVF	LOGICAL UNIT HAS NOT SELF-CONFIGURED YET
3Eh	01h	DZTPROMAEBKVF	LOGICAL UNIT FAILURE
3Eh	02h	DZTPROMAEBKVF	TIMEOUT ON LOGICAL UNIT
3Eh	03h	DZTPROMAEBKVF	LOGICAL UNIT FAILED SELF-TEST
3Eh	04h	DZTPROMAEBKVF	LOGICAL UNIT UNABLE TO UPDATE SELF-TEST LOG
3Fh	00h	DZTPROMAEBKVF	TARGET OPERATING CONDITIONS HAVE CHANGED
3Fh	01h	DZTPROMAEBKVF	MICROCODE HAS BEEN CHANGED
3Fh	02h	DZTPROM BK	CHANGED OPERATING DEFINITION
3Fh	03h	DZTPROMAEBKVF	INQUIRY DATA HAS CHANGED
3Fh	04h	DZT ROMAEBK	COMPONENT DEVICE ATTACHED
3Fh	05h	DZT ROMAEBK	DEVICE IDENTIFIER CHANGED
3Fh	06h	DZT ROMAEB	REDUNDANCY GROUP CREATED OR MODIFIED
3Fh	07h	DZT ROMAEB	REDUNDANCY GROUP DELETED
3Fh	08h	DZT ROMAEB	SPARE CREATED OR MODIFIED
3Fh	09h	DZT ROMAEB	SPARE DELETED
3Fh	0Ah	DZT ROMAEBK	VOLUME SET CREATED OR MODIFIED
3Fh	0Bh	DZT ROMAEBK	VOLUME SET DELETED
3Fh	0Ch	DZT ROMAEBK	VOLUME SET DEASSIGNED
3Fh	0Dh	DZT ROMAEBK	VOLUME SET REASSIGNED

[a] This additional sense code is used by a device type that is no longer represented in this table.

Table E.1 – ASC and ASCQ assignments (part 13 of 21)

```
              D – Direct Access Block Device (SBC-5)                        Device Type
            . Z – Host Managed Zoned Block Device (ZBC-3)                    column keys
            .   T – Sequential Access Device (SSC-5)                         blank = code not used
            .     P – Processor Device (SPC-2)                               not blank = code used
            .     . R – C/DVD Device (MMC-6)
            .     .   O – Optical Memory Block Device (SBC)
            .     .     M – Media Changer Device (SMC-3)
            .     .     . A – Storage Array Device (SCC-2)
            .     .     .   E – SCSI Enclosure Services device (SES-3)
            .     .     .     B – Simplified Direct Access (Reduced Block) device (RBC)
            .     .     .     . K – Optical Card Reader/Writer device (OCRW)
            .     .     .     .   V – Automation/Device Interface device (ADC-4)
            .     .     .     .     F – Object-based Storage Device (OSD-2)

            .     .     .     .     .
ASC ASCQ  D Z T P R O M A E B K V F  Description
```

ASC	ASCQ	D Z T P R O M A E B K V F	Description
3Fh	0Eh	D Z T P R O M A E	REPORTED LUNS DATA HAS CHANGED
3Fh	0Fh	D Z T P R O M A E B K V F	ECHO BUFFER OVERWRITTEN
3Fh	10h	D Z T R O M B	MEDIUM LOADABLE
3Fh	11h	D Z T R O M B	MEDIUM AUXILIARY MEMORY ACCESSIBLE
3Fh	12h	D Z T P R M A E B K F	iSCSI IP ADDRESS ADDED
3Fh	13h	D Z T P R M A E B K F	iSCSI IP ADDRESS REMOVED
3Fh	14h	D Z T P R M A E B K F	iSCSI IP ADDRESS CHANGED
3Fh	15h	D Z T P R M A E B K	INSPECT REFERRALS SENSE DESCRIPTORS
3Fh	16h	D Z T P R O M A E B K V F	MICROCODE HAS BEEN CHANGED WITHOUT RESET
3Fh	17h	D Z	ZONE TRANSITION TO FULL
3Fh	18h	D	BIND COMPLETED
3Fh	19h	D	BIND REDIRECTED
3Fh	1Ah	D	SUBSIDIARY BINDING CHANGED
40h	00h	D Z	RAM FAILURE (SHOULD USE 40 NN)
40h	NNh	D Z T P R O M A E B K V F	DIAGNOSTIC FAILURE ON COMPONENT NN (80h-FFh)
41h	00h	D Z	DATA PATH FAILURE (SHOULD USE 40 NN)
42h	00h	D Z	POWER-ON OR SELF-TEST FAILURE (SHOULD USE 40 NN)
43h	00h	D Z T P R O M A E B K V F	MESSAGE ERROR
44h	00h	D Z T P R O M A E B K V F	INTERNAL TARGET FAILURE
44h	01h	D Z T P M A E B K V F	PERSISTENT RESERVATION INFORMATION LOST
44h	71h	D Z T B	ATA DEVICE FAILED SET FEATURES
45h	00h	D Z T P R O M A E B K V F	SELECT OR RESELECT FAILURE
46h	00h	D Z T P R O M B K	UNSUCCESSFUL SOFT RESET
47h	00h	D Z T P R O M A E B K V F	SCSI PARITY ERROR
47h	01h	D Z T P R O M A E B K V F	DATA PHASE CRC ERROR DETECTED
47h	02h	D Z T P R O M A E B K V F	SCSI PARITY ERROR DETECTED DURING ST DATA PHASE
47h	03h	D Z T P R O M A E B K V F	INFORMATION UNIT iuCRC ERROR DETECTED
47h	04h	D Z T P R O M A E B K V F	ASYNCHRONOUS INFORMATION PROTECTION ERROR DETECTED
47h	05h	D Z T P R O M A E B K V F	PROTOCOL SERVICE CRC ERROR
47h	06h	D Z T M A E B K V F	PHY TEST FUNCTION IN PROGRESS
47h	7Fh	D Z T P R O M A E B K	SOME COMMANDS CLEARED BY ISCSI PROTOCOL EVENT
48h	00h	D Z T P R O M A E B K V F	INITIATOR DETECTED ERROR MESSAGE RECEIVED
49h	00h	D Z T P R O M A E B K V F	INVALID MESSAGE ERROR
4Ah	00h	D Z T P R O M A E B K V F	COMMAND PHASE ERROR
4Bh	00h	D Z T P R O M A E B K V F	DATA PHASE ERROR
4Bh	01h	D Z T P R O M A E B K	INVALID TARGET PORT TRANSFER TAG RECEIVED
4Bh	02h	D Z T P R O M A E B K	TOO MUCH WRITE DATA
4Bh	03h	D Z T P R O M A E B K	ACK/NAK TIMEOUT
4Bh	04h	D Z T P R O M A E B K	NAK RECEIVED
4Bh	05h	D Z T P R O M A E B K	DATA OFFSET ERROR
4Bh	06h	D Z T P R O M A E B K	INITIATOR RESPONSE TIMEOUT

> a This additional sense code is used by a device type that is no longer represented in this table.

Table E.1 – ASC and ASCQ assignments (part 14 of 21)

			Device Type
	D – Direct Access Block Device (SBC-5)		
	. Z – Host Managed Zoned Block Device (ZBC-3)		column keys
	. T – Sequential Access Device (SSC-5)		blank = code not used
	. P – Processor Device (SPC-2)		not blank = code used
	. . R – C/DVD Device (MMC-6)		
	. . O – Optical Memory Block Device (SBC)		
	. . M – Media Changer Device (SMC-3)		
	. . . A – Storage Array Device (SCC-2)		
	. . . E – SCSI Enclosure Services device (SES-3)		
	. . . B – Simplified Direct Access (Reduced Block) device (RBC)		
	. . . . K – Optical Card Reader/Writer device (OCRW)		
	. . . . V – Automation/Device Interface device (ADC-4)		
	. . . . F – Object-based Storage Device (OSD-2)		

ASC	ASCQ	D Z T P R O M A E B K V F	Description
4Bh	07h	D Z T P R O M A E B K F	CONNECTION LOST
4Bh	08h	D Z T P R O M A E B K F	DATA-IN BUFFER OVERFLOW - DATA BUFFER SIZE
4Bh	09h	D Z T P R O M A E B K F	DATA-IN BUFFER OVERFLOW - DATA BUFFER DESCRIPTOR AREA
4Bh	0Ah	D Z T P R O M A E B K F	DATA-IN BUFFER ERROR
4Bh	0Bh	D Z T P R O M A E B K F	DATA-OUT BUFFER OVERFLOW - DATA BUFFER SIZE
4Bh	0Ch	D Z T P R O M A E B K F	DATA-OUT BUFFER OVERFLOW - DATA BUFFER DESCRIPTOR AREA
4Bh	0Dh	D Z T P R O M A E B K F	DATA-OUT BUFFER ERROR
4Bh	0Eh	D Z T P R O M A E B K F	PCIE FABRIC ERROR
4Bh	0Fh	D Z T P R O M A E B K F	PCIE COMPLETION TIMEOUT
4Bh	10h	D Z T P R O M A E B K F	PCIE COMPLETER ABORT
4Bh	11h	D Z T P R O M A E B K F	PCIE POISONED TLP RECEIVED
4Bh	12h	D Z T P R O M A E B K F	PCIE ECRC CHECK FAILED
4Bh	13h	D Z T P R O M A E B K F	PCIE UNSUPPORTED REQUEST
4Bh	14h	D Z T P R O M A E B K F	PCIE ACS VIOLATION
4Bh	15h	D Z T P R O M A E B K F	PCIE TLP PREFIX BLOCKED
4Ch	00h	D Z T P R O M A E B K V F	LOGICAL UNIT FAILED SELF-CONFIGURATION
4Dh	NNh	D Z T P R O M A E B K V F	TAGGED OVERLAPPED COMMANDS (NN = TASK TAG)
4Eh	00h	D Z T P R O M A E B K V F	OVERLAPPED COMMANDS ATTEMPTED
4Fh	00h		
50h	00h	T	WRITE APPEND ERROR
50h	01h	T	WRITE APPEND POSITION ERROR
50h	02h	T	POSITION ERROR RELATED TO TIMING
51h	00h	D Z T R O	ERASE FAILURE
51h	01h	D Z R	ERASE FAILURE - INCOMPLETE ERASE OPERATION DETECTED
52h	00h	T	CARTRIDGE FAULT
53h	00h	D Z T R O M B K	MEDIA LOAD OR EJECT FAILED
53h	01h	T	UNLOAD TAPE FAILURE
53h	02h	D Z T R O M B K	MEDIUM REMOVAL PREVENTED
53h	03h	M	MEDIUM REMOVAL PREVENTED BY DATA TRANSFER ELEMENT
53h	04h	T	MEDIUM THREAD OR UNTHREAD FAILURE
53h	05h	M	VOLUME IDENTIFIER INVALID
53h	06h	M	VOLUME IDENTIFIER MISSING
53h	07h	M	DUPLICATE VOLUME IDENTIFIER
53h	08h	M	ELEMENT STATUS UNKNOWN
53h	09h	M	DATA TRANSFER DEVICE ERROR - LOAD FAILED
53h	0Ah	M	DATA TRANSFER DEVICE ERROR - UNLOAD FAILED
53h	0Bh	M	DATA TRANSFER DEVICE ERROR - UNLOAD MISSING
53h	0Ch	M	DATA TRANSFER DEVICE ERROR - EJECT FAILED
53h	0Dh	M	DATA TRANSFER DEVICE ERROR - LIBRARY COMMUNICATION FAILED
54h	00h	P	SCSI TO HOST SYSTEM INTERFACE FAILURE
55h	00h	P	SYSTEM RESOURCE FAILURE

a   This additional sense code is used by a device type that is no longer represented in this table.

Table E.1 – ASC and ASCQ assignments (part 15 of 21)

				Device Type
	D – Direct Access Block Device (SBC-5)			Device Type
	. Z – Host Managed Zoned Block Device (ZBC-3)			column keys
	. T – Sequential Access Device (SSC-5)			blank = code not used
	. P – Processor Device (SPC-2)			not blank = code used
	. . R – C/DVD Device (MMC-6)			
	. . O – Optical Memory Block Device (SBC)			
	. . M – Media Changer Device (SMC-3)			
	. . . A – Storage Array Device (SCC-2)			
	. . . E – SCSI Enclosure Services device (SES-3)			
	. . . B – Simplified Direct Access (Reduced Block) device (RBC)			
	. . . . K – Optical Card Reader/Writer device (OCRW)			
	. . . . V – Automation/Device Interface device (ADC-4)			
	. . . . F – Object-based Storage Device (OSD-2)			

ASC	ASCQ	DZTPROMAEBKVF	Description
55h	01h	D Z O BK	SYSTEM BUFFER FULL
55h	02h	D Z T P R O M A E K	INSUFFICIENT RESERVATION RESOURCES
55h	03h	D Z T P R O M A E K	INSUFFICIENT RESOURCES
55h	04h	D Z T P R O M A E K	INSUFFICIENT REGISTRATION RESOURCES
55h	05h	D Z T P R O M A E B K	INSUFFICIENT ACCESS CONTROL RESOURCES
55h	06h	D Z T R O M B	AUXILIARY MEMORY OUT OF SPACE
55h	07h	F	QUOTA ERROR
55h	08h	T	MAXIMUM NUMBER OF SUPPLEMENTAL DECRYPTION KEYS EXCEEDED
55h	09h	M	MEDIUM AUXILIARY MEMORY NOT ACCESSIBLE
55h	0Ah	D Z M	DATA CURRENTLY UNAVAILABLE
55h	0Bh	D Z T P R O M A E B K V F	INSUFFICIENT POWER FOR OPERATION
55h	0Ch	D Z T P B	INSUFFICIENT RESOURCES TO CREATE ROD
55h	0Dh	D Z T P B	INSUFFICIENT RESOURCES TO CREATE ROD TOKEN
55h	0Eh	D Z	INSUFFICIENT ZONE RESOURCES
55h	0Fh	D Z	INSUFFICIENT ZONE RESOURCES TO COMPLETE WRITE
55h	10h	D Z	MAXIMUM NUMBER OF STREAMS OPEN
55h	11h	D	INSUFFICIENT RESOURCES TO BIND
56h	00h		
57h	00h	R	UNABLE TO RECOVER TABLE-OF-CONTENTS
58h	00h	O	GENERATION DOES NOT EXIST
59h	00h	O	UPDATED BLOCK READ
5Ah	00h	D Z T P R O BK	OPERATOR REQUEST OR STATE CHANGE INPUT
5Ah	01h	D Z T R O M BK	OPERATOR MEDIUM REMOVAL REQUEST
5Ah	02h	D Z T R O A BK	OPERATOR SELECTED WRITE PROTECT
5Ah	03h	D Z T R O A BK	OPERATOR SELECTED WRITE PERMIT
5Bh	00h	D Z T P R O M K	LOG EXCEPTION
5Bh	01h	D Z T P R O M K	THRESHOLD CONDITION MET
5Bh	02h	D Z T P R O M K	LOG COUNTER AT MAXIMUM
5Bh	03h	D Z T P R O M K	LOG LIST CODES EXHAUSTED
5Ch	00h	D Z O	RPL STATUS CHANGE
5Ch	01h	D Z O	SPINDLES SYNCHRONIZED
5Ch	02h	D Z O	SPINDLES NOT SYNCHRONIZED
5Dh	00h	D Z T P R O M A E B K V F	FAILURE PREDICTION THRESHOLD EXCEEDED
5Dh	01h	R B	MEDIA FAILURE PREDICTION THRESHOLD EXCEEDED
5Dh	02h	R	LOGICAL UNIT FAILURE PREDICTION THRESHOLD EXCEEDED
5Dh	03h	R	SPARE AREA EXHAUSTION PREDICTION THRESHOLD EXCEEDED
5Dh	10h	D Z B	HARDWARE IMPENDING FAILURE GENERAL HARD DRIVE FAILURE
5Dh	11h	D Z B	HARDWARE IMPENDING FAILURE DRIVE ERROR RATE TOO HIGH
5Dh	12h	D Z B	HARDWARE IMPENDING FAILURE DATA ERROR RATE TOO HIGH
5Dh	13h	D Z B	HARDWARE IMPENDING FAILURE SEEK ERROR RATE TOO HIGH

a   This additional sense code is used by a device type that is no longer represented in this table.

Table E.1 – ASC and ASCQ assignments (part 16 of 21)

		D – Direct Access Block Device (SBC-5)														Device Type		
		. Z – Host Managed Zoned Block Device (ZBC-3)														column keys		
		. T – Sequential Access Device (SSC-5)														blank = code not used		
		. P – Processor Device (SPC-2)														not blank = code used		
		. . R – C/DVD Device (MMC-6)																
		. . O – Optical Memory Block Device (SBC)																
		. . M – Media Changer Device (SMC-3)																
		. . . A – Storage Array Device (SCC-2)																
		. . . E – SCSI Enclosure Services device (SES-3)																
		. . . B – Simplified Direct Access (Reduced Block) device (RBC)																
		. . . . K – Optical Card Reader/Writer device (OCRW)																
		. . . . V – Automation/Device Interface device (ADC-4)																
		. . . . F – Object-based Storage Device (OSD-2)																
		. . . . . .																

ASC	ASCQ	D	Z	T	P	R	O	M	A	E	B	K	V	F	Description
5Dh	14h	D	Z								B				HARDWARE IMPENDING FAILURE TOO MANY BLOCK REASSIGNS
5Dh	15h	D	Z								B				HARDWARE IMPENDING FAILURE ACCESS TIMES TOO HIGH
5Dh	16h	D	Z								B				HARDWARE IMPENDING FAILURE START UNIT TIMES TOO HIGH
5Dh	17h	D	Z								B				HARDWARE IMPENDING FAILURE CHANNEL PARAMETRICS
5Dh	18h	D	Z								B				HARDWARE IMPENDING FAILURE CONTROLLER DETECTED
5Dh	19h	D	Z								B				HARDWARE IMPENDING FAILURE THROUGHPUT PERFORMANCE
5Dh	1Ah	D	Z								B				HARDWARE IMPENDING FAILURE SEEK TIME PERFORMANCE
5Dh	1Bh	D	Z								B				HARDWARE IMPENDING FAILURE SPIN-UP RETRY COUNT
5Dh	1Ch	D	Z								B				HARDWARE IMPENDING FAILURE DRIVE CALIBRATION RETRY COUNT
5Dh	1Dh	D	Z								B				HARDWARE IMPENDING FAILURE POWER LOSS PROTECTION CIRCUIT
5Dh	20h	D	Z								B				CONTROLLER IMPENDING FAILURE GENERAL HARD DRIVE FAILURE
5Dh	21h	D	Z								B				CONTROLLER IMPENDING FAILURE DRIVE ERROR RATE TOO HIGH
5Dh	22h	D	Z								B				CONTROLLER IMPENDING FAILURE DATA ERROR RATE TOO HIGH
5Dh	23h	D	Z								B				CONTROLLER IMPENDING FAILURE SEEK ERROR RATE TOO HIGH
5Dh	24h	D	Z								B				CONTROLLER IMPENDING FAILURE TOO MANY BLOCK REASSIGNS
5Dh	25h	D	Z								B				CONTROLLER IMPENDING FAILURE ACCESS TIMES TOO HIGH
5Dh	26h	D	Z								B				CONTROLLER IMPENDING FAILURE START UNIT TIMES TOO HIGH
5Dh	27h	D	Z								B				CONTROLLER IMPENDING FAILURE CHANNEL PARAMETRICS
5Dh	28h	D	Z								B				CONTROLLER IMPENDING FAILURE CONTROLLER DETECTED
5Dh	29h	D	Z								B				CONTROLLER IMPENDING FAILURE THROUGHPUT PERFORMANCE
5Dh	2Ah	D	Z								B				CONTROLLER IMPENDING FAILURE SEEK TIME PERFORMANCE
5Dh	2Bh	D	Z								B				CONTROLLER IMPENDING FAILURE SPIN-UP RETRY COUNT
5Dh	2Ch	D	Z								B				CONTROLLER IMPENDING FAILURE DRIVE CALIBRATION RETRY COUNT
5Dh	30h	D	Z								B				DATA CHANNEL IMPENDING FAILURE GENERAL HARD DRIVE FAILURE
5Dh	31h	D	Z								B				DATA CHANNEL IMPENDING FAILURE DRIVE ERROR RATE TOO HIGH
5Dh	32h	D	Z								B				DATA CHANNEL IMPENDING FAILURE DATA ERROR RATE TOO HIGH
5Dh	33h	D	Z								B				DATA CHANNEL IMPENDING FAILURE SEEK ERROR RATE TOO HIGH
5Dh	34h	D	Z								B				DATA CHANNEL IMPENDING FAILURE TOO MANY BLOCK REASSIGNS
5Dh	35h	D	Z								B				DATA CHANNEL IMPENDING FAILURE ACCESS TIMES TOO HIGH
5Dh	36h	D	Z								B				DATA CHANNEL IMPENDING FAILURE START UNIT TIMES TOO HIGH
5Dh	37h	D	Z								B				DATA CHANNEL IMPENDING FAILURE CHANNEL PARAMETRICS
5Dh	38h	D	Z								B				DATA CHANNEL IMPENDING FAILURE CONTROLLER DETECTED
5Dh	39h	D	Z								B				DATA CHANNEL IMPENDING FAILURE THROUGHPUT PERFORMANCE
5Dh	3Ah	D	Z								B				DATA CHANNEL IMPENDING FAILURE SEEK TIME PERFORMANCE
5Dh	3Bh	D	Z								B				DATA CHANNEL IMPENDING FAILURE SPIN-UP RETRY COUNT
5Dh	3Ch	D	Z								B				DATA CHANNEL IMPENDING FAILURE DRIVE CALIBRATION RETRY COUNT
5Dh	40h	D	Z								B				SERVO IMPENDING FAILURE GENERAL HARD DRIVE FAILURE
5Dh	41h	D	Z								B				SERVO IMPENDING FAILURE DRIVE ERROR RATE TOO HIGH
5Dh	42h	D	Z								B				SERVO IMPENDING FAILURE DATA ERROR RATE TOO HIGH

^a This additional sense code is used by a device type that is no longer represented in this table.

Table E.1 – ASC and ASCQ assignments (part 17 of 21)

			Device Type
	D – Direct Access Block Device (SBC-5)		column keys
	. Z – Host Managed Zoned Block Device (ZBC-3)		blank = code not used
	. T – Sequential Access Device (SSC-5)		not blank = code used
	. P – Processor Device (SPC-2)		
	. . R – C/DVD Device (MMC-6)		
	. . O – Optical Memory Block Device (SBC)		
	. . M – Media Changer Device (SMC-3)		
	. . . A – Storage Array Device (SCC-2)		
	. . . E – SCSI Enclosure Services device (SES-3)		
	. . . B – Simplified Direct Access (Reduced Block) device (RBC)		
	. . . . K – Optical Card Reader/Writer device (OCRW)		
	. . . . V – Automation/Device Interface device (ADC-4)		
	. . . . F – Object-based Storage Device (OSD-2)		

ASC	ASCQ	DZTPROMAEBKVF	Description
5Dh	43h	DZ B	SERVO IMPENDING FAILURE SEEK ERROR RATE TOO HIGH
5Dh	44h	DZ B	SERVO IMPENDING FAILURE TOO MANY BLOCK REASSIGNS
5Dh	45h	DZ B	SERVO IMPENDING FAILURE ACCESS TIMES TOO HIGH
5Dh	46h	DZ B	SERVO IMPENDING FAILURE START UNIT TIMES TOO HIGH
5Dh	47h	DZ B	SERVO IMPENDING FAILURE CHANNEL PARAMETRICS
5Dh	48h	DZ B	SERVO IMPENDING FAILURE CONTROLLER DETECTED
5Dh	49h	DZ B	SERVO IMPENDING FAILURE THROUGHPUT PERFORMANCE
5Dh	4Ah	DZ B	SERVO IMPENDING FAILURE SEEK TIME PERFORMANCE
5Dh	4Bh	DZ B	SERVO IMPENDING FAILURE SPIN-UP RETRY COUNT
5Dh	4Ch	DZ B	SERVO IMPENDING FAILURE DRIVE CALIBRATION RETRY COUNT
5Dh	50h	DZ B	SPINDLE IMPENDING FAILURE GENERAL HARD DRIVE FAILURE
5Dh	51h	DZ B	SPINDLE IMPENDING FAILURE DRIVE ERROR RATE TOO HIGH
5Dh	52h	DZ B	SPINDLE IMPENDING FAILURE DATA ERROR RATE TOO HIGH
5Dh	53h	DZ B	SPINDLE IMPENDING FAILURE SEEK ERROR RATE TOO HIGH
5Dh	54h	DZ B	SPINDLE IMPENDING FAILURE TOO MANY BLOCK REASSIGNS
5Dh	55h	DZ B	SPINDLE IMPENDING FAILURE ACCESS TIMES TOO HIGH
5Dh	56h	DZ B	SPINDLE IMPENDING FAILURE START UNIT TIMES TOO HIGH
5Dh	57h	DZ B	SPINDLE IMPENDING FAILURE CHANNEL PARAMETRICS
5Dh	58h	DZ B	SPINDLE IMPENDING FAILURE CONTROLLER DETECTED
5Dh	59h	DZ B	SPINDLE IMPENDING FAILURE THROUGHPUT PERFORMANCE
5Dh	5Ah	DZ B	SPINDLE IMPENDING FAILURE SEEK TIME PERFORMANCE
5Dh	5Bh	DZ B	SPINDLE IMPENDING FAILURE SPIN-UP RETRY COUNT
5Dh	5Ch	DZ B	SPINDLE IMPENDING FAILURE DRIVE CALIBRATION RETRY COUNT
5Dh	60h	DZ B	FIRMWARE IMPENDING FAILURE GENERAL HARD DRIVE FAILURE
5Dh	61h	DZ B	FIRMWARE IMPENDING FAILURE DRIVE ERROR RATE TOO HIGH
5Dh	62h	DZ B	FIRMWARE IMPENDING FAILURE DATA ERROR RATE TOO HIGH
5Dh	63h	DZ B	FIRMWARE IMPENDING FAILURE SEEK ERROR RATE TOO HIGH
5Dh	64h	DZ B	FIRMWARE IMPENDING FAILURE TOO MANY BLOCK REASSIGNS
5Dh	65h	DZ B	FIRMWARE IMPENDING FAILURE ACCESS TIMES TOO HIGH
5Dh	66h	DZ B	FIRMWARE IMPENDING FAILURE START UNIT TIMES TOO HIGH
5Dh	67h	DZ B	FIRMWARE IMPENDING FAILURE CHANNEL PARAMETRICS
5Dh	68h	DZ B	FIRMWARE IMPENDING FAILURE CONTROLLER DETECTED
5Dh	69h	DZ B	FIRMWARE IMPENDING FAILURE THROUGHPUT PERFORMANCE
5Dh	6Ah	DZ B	FIRMWARE IMPENDING FAILURE SEEK TIME PERFORMANCE
5Dh	6Bh	DZ B	FIRMWARE IMPENDING FAILURE SPIN-UP RETRY COUNT
5Dh	6Ch	DZ B	FIRMWARE IMPENDING FAILURE DRIVE CALIBRATION RETRY COUNT
5Dh	73h	DZ B	MEDIA IMPENDING FAILURE ENDURANCE LIMIT MET
5Dh	FFh	DZTPROMAEBKVF	FAILURE PREDICTION THRESHOLD EXCEEDED (FALSE)
5Eh	00h	DZTPRO A K	LOW POWER CONDITION ON
5Eh	01h	DZTPRO A K	IDLE CONDITION ACTIVATED BY TIMER
5Eh	02h	DZTPRO A K	STANDBY CONDITION ACTIVATED BY TIMER

a This additional sense code is used by a device type that is no longer represented in this table.

Table E.1 – ASC and ASCQ assignments (part 18 of 21)

```
            D – Direct Access Block Device (SBC-5)                      Device Type
            . Z – Host Managed Zoned Block Device (ZBC-3)               column keys
            .  T – Sequential Access Device (SSC-5)                     blank = code not used
            .     P – Processor Device (SPC-2)                          not blank = code used
            .     . R – C/DVD Device (MMC-6)
            .     .  O – Optical Memory Block Device (SBC)
            .     .   M – Media Changer Device (SMC-3)
            .     .   . A – Storage Array Device (SCC-2)
            .     .   .  E – SCSI Enclosure Services device (SES-3)
            .     .   .   B – Simplified Direct Access (Reduced Block) device (RBC)
            .     .   .   . K – Optical Card Reader/Writer device (OCRW)
            .     .   .   .  V – Automation/Device Interface device (ADC-4)
            .     .   .   .   F – Object-based Storage Device (OSD-2)
            .     .   .   .   .
```

ASC	ASCQ	DZTPROMAEBKVF	Description
5Eh	03h	DZTPRO A K	IDLE CONDITION ACTIVATED BY COMMAND
5Eh	04h	DZTPRO A K	STANDBY CONDITION ACTIVATED BY COMMAND
5Eh	05h	DZTPRO A K	IDLE_B CONDITION ACTIVATED BY TIMER
5Eh	06h	DZTPRO A K	IDLE_B CONDITION ACTIVATED BY COMMAND
5Eh	07h	DZTPRO A K	IDLE_C CONDITION ACTIVATED BY TIMER
5Eh	08h	DZTPRO A K	IDLE_C CONDITION ACTIVATED BY COMMAND
5Eh	09h	DZTPRO A K	STANDBY_Y CONDITION ACTIVATED BY TIMER
5Eh	0Ah	DZTPRO A K	STANDBY_Y CONDITION ACTIVATED BY COMMAND
5Eh	41h	B	POWER STATE CHANGE TO ACTIVE
5Eh	42h	B	POWER STATE CHANGE TO IDLE
5Eh	43h	B	POWER STATE CHANGE TO STANDBY
5Eh	45h	B	POWER STATE CHANGE TO SLEEP
5Eh	47h	BK	POWER STATE CHANGE TO DEVICE CONTROL
5Fh	00h		
60h	00h		LAMP FAILURE [a]
61h	00h		VIDEO ACQUISITION ERROR [a]
61h	01h		UNABLE TO ACQUIRE VIDEO [a]
61h	02h		OUT OF FOCUS [a]
62h	00h		SCAN HEAD POSITIONING ERROR [a]
63h	00h	R	END OF USER AREA ENCOUNTERED ON THIS TRACK
63h	01h	R	PACKET DOES NOT FIT IN AVAILABLE SPACE
64h	00h	R	ILLEGAL MODE FOR THIS TRACK
64h	01h	R	INVALID PACKET SIZE
65h	00h	DZTPROMAEBKVF	VOLTAGE FAULT
66h	00h		AUTOMATIC DOCUMENT FEEDER COVER UP [a]
66h	01h		AUTOMATIC DOCUMENT FEEDER LIFT UP [a]
66h	02h		DOCUMENT JAM IN AUTOMATIC DOCUMENT FEEDER [a]
66h	03h		DOCUMENT MISS FEED AUTOMATIC IN DOCUMENT FEEDER [a]
67h	00h	A	CONFIGURATION FAILURE
67h	01h	A	CONFIGURATION OF INCAPABLE LOGICAL UNITS FAILED
67h	02h	A	ADD LOGICAL UNIT FAILED
67h	03h	A	MODIFICATION OF LOGICAL UNIT FAILED
67h	04h	A	EXCHANGE OF LOGICAL UNIT FAILED
67h	05h	A	REMOVE OF LOGICAL UNIT FAILED
67h	06h	A	ATTACHMENT OF LOGICAL UNIT FAILED
67h	07h	A	CREATION OF LOGICAL UNIT FAILED
67h	08h	A	ASSIGN FAILURE OCCURRED
67h	09h	A	MULTIPLY ASSIGNED LOGICAL UNIT
67h	0Ah	DZTPROMAEBKVF	SET TARGET PORT GROUPS COMMAND FAILED
67h	0Bh	DZT B	ATA DEVICE FEATURE NOT ENABLED
67h	0Ch	D	COMMAND REJECTED

[a] This additional sense code is used by a device type that is no longer represented in this table.

Table E.1 – ASC and ASCQ assignments (part 19 of 21)

```
              D – Direct Access Block Device (SBC-5)                    Device Type
            . Z – Host Managed Zoned Block Device (ZBC-3)               column keys
            .   T – Sequential Access Device (SSC-5)                    blank = code not used
            .     P – Processor Device (SPC-2)                          not blank = code used
            .       . R – C/DVD Device (MMC-6)
            .       .   O – Optical Memory Block Device (SBC)
            .       .     M – Media Changer Device (SMC-3)
            .       .       . A – Storage Array Device (SCC-2)
            .       .       .   E – SCSI Enclosure Services device (SES-3)
            .       .       .     B – Simplified Direct Access (Reduced Block) device (RBC)
            .       .       .       . K – Optical Card Reader/Writer device (OCRW)
            .       .       .       .  V – Automation/Device Interface device (ADC-4)
            .       .       .       .    F – Object-based Storage Device (OSD-2)

            .       .       .       .    .
 ASC ASCQ   D Z T P R O M A E B K V F     Description
```

ASC	ASCQ	D Z T P R O M A E B K V F	Description
67h	0Dh	D	EXPLICIT BIND NOT ALLOWED
68h	00h	A	LOGICAL UNIT NOT CONFIGURED
68h	01h	D Z	SUBSIDIARY LOGICAL UNIT NOT CONFIGURED
69h	00h	A	DATA LOSS ON LOGICAL UNIT
69h	01h	A	MULTIPLE LOGICAL UNIT FAILURES
69h	02h	A	PARITY/DATA MISMATCH
6Ah	00h	A	INFORMATIONAL, REFER TO LOG
6Bh	00h	A	STATE CHANGE HAS OCCURRED
6Bh	01h	A	REDUNDANCY LEVEL GOT BETTER
6Bh	02h	A	REDUNDANCY LEVEL GOT WORSE
6Ch	00h	A	REBUILD FAILURE OCCURRED
6Dh	00h	A	RECALCULATE FAILURE OCCURRED
6Eh	00h	A	COMMAND TO LOGICAL UNIT FAILED
6Fh	00h	R	COPY PROTECTION KEY EXCHANGE FAILURE - AUTHENTICATION FAILURE
6Fh	01h	R	COPY PROTECTION KEY EXCHANGE FAILURE - KEY NOT PRESENT
6Fh	02h	R	COPY PROTECTION KEY EXCHANGE FAILURE - KEY NOT ESTABLISHED
6Fh	03h	R	READ OF SCRAMBLED SECTOR WITHOUT AUTHENTICATION
6Fh	04h	R	MEDIA REGION CODE IS MISMATCHED TO LOGICAL UNIT REGION
6Fh	05h	R	DRIVE REGION MUST BE PERMANENT/REGION RESET COUNT ERROR
6Fh	06h	R	INSUFFICIENT BLOCK COUNT FOR BINDING NONCE RECORDING
6Fh	07h	R	CONFLICT IN BINDING NONCE RECORDING
6Fh	08h	R	INSUFFICIENT PERMISSION
6Fh	09h	R	INVALID DRIVE-HOST PAIRING SERVER
6Fh	0Ah	R	DRIVE-HOST PAIRING SUSPENDED
70h	NNh	T	DECOMPRESSION EXCEPTION SHORT ALGORITHM ID OF NN
71h	00h	T	DECOMPRESSION EXCEPTION LONG ALGORITHM ID
72h	00h	R	SESSION FIXATION ERROR
72h	01h	R	SESSION FIXATION ERROR WRITING LEAD-IN
72h	02h	R	SESSION FIXATION ERROR WRITING LEAD-OUT
72h	03h	R	SESSION FIXATION ERROR - INCOMPLETE TRACK IN SESSION
72h	04h	R	EMPTY OR PARTIALLY WRITTEN RESERVED TRACK
72h	05h	R	NO MORE TRACK RESERVATIONS ALLOWED
72h	06h	R	RMZ EXTENSION IS NOT ALLOWED
72h	07h	R	NO MORE TEST ZONE EXTENSIONS ARE ALLOWED
73h	00h	R	CD CONTROL ERROR
73h	01h	R	POWER CALIBRATION AREA ALMOST FULL
73h	02h	R	POWER CALIBRATION AREA IS FULL
73h	03h	R	POWER CALIBRATION AREA ERROR
73h	04h	R	PROGRAM MEMORY AREA UPDATE FAILURE
73h	05h	R	PROGRAM MEMORY AREA IS FULL

[a] This additional sense code is used by a device type that is no longer represented in this table.

Table E.1 – ASC and ASCQ assignments (part 20 of 21)

```
           D – Direct Access Block Device (SBC-5)                      Device Type
         . Z – Host Managed Zoned Block Device (ZBC-3)                  column keys
         .  T – Sequential Access Device (SSC-5)                        blank = code not used
         .     P – Processor Device (SPC-2)                             not blank = code used
         .     . R – C/DVD Device (MMC-6)
         .     .  O – Optical Memory Block Device (SBC)
         .     .   M – Media Changer Device (SMC-3)
         .     .    . A – Storage Array Device (SCC-2)
         .     .     E – SCSI Enclosure Services device (SES-3)
         .     .       B – Simplified Direct Access (Reduced Block) device (RBC)
         .     .      . K – Optical Card Reader/Writer device (OCRW)
         .     .       . V – Automation/Device Interface device (ADC-4)
         .     .        F – Object-based Storage Device (OSD-2)

         .     .    .     .   .
ASC ASCQ  D Z T P R O M A E B K V F   Description
```

ASC	ASCQ	D	Z	T	P	R	O	M	A	E	B	K	V	F	Description
73h	06h					R									RMA/PMA IS ALMOST FULL
73h	10h					R									CURRENT POWER CALIBRATION AREA ALMOST FULL
73h	11h					R									CURRENT POWER CALIBRATION AREA IS FULL
73h	17h					R									RDZ IS FULL
74h	00h			T											SECURITY ERROR
74h	01h			T											UNABLE TO DECRYPT DATA
74h	02h			T											UNENCRYPTED DATA ENCOUNTERED WHILE DECRYPTING
74h	03h			T											INCORRECT DATA ENCRYPTION KEY
74h	04h			T											CRYPTOGRAPHIC INTEGRITY VALIDATION FAILED
74h	05h			T											ERROR DECRYPTING DATA
74h	06h			T											UNKNOWN SIGNATURE VERIFICATION KEY
74h	07h			T											ENCRYPTION PARAMETERS NOT USEABLE
74h	08h	D	Z	T		R		M		E			V	F	DIGITAL SIGNATURE VALIDATION FAILURE
74h	09h			T											ENCRYPTION MODE MISMATCH ON READ
74h	0Ah			T											ENCRYPTED BLOCK NOT RAW READ ENABLED
74h	0Bh			T											INCORRECT ENCRYPTION PARAMETERS
74h	0Ch	D	Z	T		R		M	A	E	B	K	V		UNABLE TO DECRYPT PARAMETER LIST
74h	0Dh			T											ENCRYPTION ALGORITHM DISABLED
74h	10h	D	Z	T		R		M	A	E	B	K	V		SA CREATION PARAMETER VALUE INVALID
74h	11h	D	Z	T		R		M	A	E	B	K	V		SA CREATION PARAMETER VALUE REJECTED
74h	12h	D	Z	T		R		M	A	E	B	K	V		INVALID SA USAGE
74h	21h			T											DATA ENCRYPTION CONFIGURATION PREVENTED
74h	30h	D	Z	T		R		M	A	E	B	K	V		SA CREATION PARAMETER NOT SUPPORTED
74h	40h	D	Z	T		R		M	A	E	B	K	V		AUTHENTICATION FAILED
74h	61h												V		EXTERNAL DATA ENCRYPTION KEY MANAGER ACCESS ERROR
74h	62h												V		EXTERNAL DATA ENCRYPTION KEY MANAGER ERROR
74h	63h												V		EXTERNAL DATA ENCRYPTION KEY NOT FOUND
74h	64h												V		EXTERNAL DATA ENCRYPTION REQUEST NOT AUTHORIZED
74h	6Eh			T											EXTERNAL DATA ENCRYPTION CONTROL TIMEOUT
74h	6Fh			T											EXTERNAL DATA ENCRYPTION CONTROL ERROR
74h	71h	D	Z	T		R		M		E			V		LOGICAL UNIT ACCESS NOT AUTHORIZED
74h	79h	D	Z												SECURITY CONFLICT IN TRANSLATED DEVICE
75h	00h														
76h	00h														
77h	00h														
78h	00h														
79h	00h														
7Ah	00h														
7Bh	00h														
7Ch	00h														
7Dh	00h														

a This additional sense code is used by a device type that is no longer represented in this table.

Table E.1 – ASC and ASCQ assignments (part 21 of 21)

		D – Direct Access Block Device (SBC-5)												Device Type
		. Z – Host Managed Zoned Block Device (ZBC-3)												<u>column keys</u>
		. T – Sequential Access Device (SSC-5)												blank = code not used
		. P – Processor Device (SPC-2)												not blank = code used
		. . R – C/DVD Device (MMC-6)												
		. . O – Optical Memory Block Device (SBC)												
		. . M – Media Changer Device (SMC-3)												
		. . . A – Storage Array Device (SCC-2)												
		. . . E – SCSI Enclosure Services device (SES-3)												
		. . . B – Simplified Direct Access (Reduced Block) device (RBC)												
		. . . . K – Optical Card Reader/Writer device (OCRW)												
		. . . . V – Automation/Device Interface device (ADC-4)												
		. . . . F – Object-based Storage Device (OSD-2)												
		. . . . . .												
ASC	ASCQ	D Z T P R O M A E B K V F											Description	

ASC	ASCQ	D Z T P R O M A E B K V F	Description
7Eh	00h		
7Fh	00h		
80h	xxh	\	
Through		>	Vendor specific
FFh	xxh	/	
xxh	80h	\	
Through		>	Vendor specific qualification of standard ASC
xxh	FFh	/	

All codes not shown are reserved.

^a This additional sense code is used by a device type that is no longer represented in this table.

E.3 Operation codes

E.3.1 Operation codes

Table E.1 is a numerical order listing of the command operation codes.

Table E.1 – Operation codes (part 1 of 6)

```
        D – Direct Access Block Device (SBC-5)                    Device Column key
        . Z – Host Managed Zoned Block Device (ZBC-3)             M = Mandatory
        .  T – Sequential Access Device (SSC-5)                   O = Optional
        .   P – Processor Device (SPC-2)                          V = Vendor specific
        .    R – C/DVD Device (MMC-6)                             Z = Obsolete
        .     O – Optical Memory Block Device (SBC)
        .      M – Media Changer Device (SMC-3)
        .      . A – Storage Array Device (SCC-2)
        .      .  E – SCSI Enclosure Services Device (SES-3)
        .      .   B – Simplified Direct Access (Reduced Block) device (RBC)
        .      .    K – Optical Card Reader/Writer device (OCRW)
        .      .     V – Automation/Device Interface device (ADC-4)
        .      .      F – Object-based Storage Device (OSD-2)
   OP   D Z T P R O M A E B K V F    Description
   00h  M M M M M M M M M M M M M    TEST UNIT READY
   01h      M                        REWIND
   01h  Z       Z Z Z                REZERO UNIT
   02h  V   V V V   V                
   03h  M M M M M M M M M O M M M    REQUEST SENSE
   04h  M O     O O                  FORMAT UNIT
   04h        O                      FORMAT MEDIUM
   05h  V   M V V   V                READ BLOCK LIMITS
   06h  V   V V V   V                
   07h  O   V     O V                REASSIGN BLOCKS
   07h              O                INITIALIZE ELEMENT STATUS
   08h  Z   M     O V                READ(6)
   08h        O                      RECEIVE
   09h  V   V V V   V                
   0Ah  Z   O     O V                WRITE(6)
   0Ah        M                      SEND(6)
   0Ah                               SEND MESSAGE(6)
   0Ah                               PRINT
   0Bh  Z       O Z V                SEEK(6)
   0Bh      O                        SET CAPACITY
   0Ch  V   V V V   V                
   0Dh  V   V V V   V                
   0Eh  V   V V V   V                
   0Fh  V   O V V   V                READ REVERSE(6)
   10h  V   M V V                    WRITE FILEMARKS(6)
   10h                               SYNCHRONIZE BUFFER
   11h  V   M V V                    SPACE(6)
   12h  M M M M M M M M M M M M M    INQUIRY
   13h  V       V V                  
   13h        O                      VERIFY(6)
   14h  V   O V V                    RECOVER BUFFERED DATA
   15h  Z   Z     Z Z Z Z   Z Z      MODE SELECT(6)
   16h  Z   Z Z   O O O Z   O        RESERVE(6)
   16h              Z                RESERVE ELEMENT(6)
   17h  Z   Z Z   O O O Z   O        RELEASE(6)
   17h              Z                RELEASE ELEMENT(6)
```

Table E.1 – Operation codes (part 2 of 6)

```
              D – Direct Access Block Device (SBC-5)                        Device Column key
             . Z – Host Managed Zoned Block Device (ZBC-3)                   M = Mandatory
             .  T – Sequential Access Device (SSC-5)                         O = Optional
             .    P – Processor Device (SPC-2)                               V = Vendor specific
             .     . R – C/DVD Device (MMC-6)                                Z = Obsolete
             .     .   O – Optical Memory Block Device (SBC)
             .     .   M – Media Changer Device (SMC-3)
             .     .   . A – Storage Array Device (SCC-2)
             .     .   .  E – SCSI Enclosure Services Device (SES-3)
             .     .   .    B – Simplified Direct Access (Reduced Block) device (RBC)
             .     .   .    . K – Optical Card Reader/Writer device (OCRW)
             .     .   .    .  V – Automation/Device Interface device (ADC-4)
             .     .   .    .    F – Object-based Storage Device (OSD-2)
    OP   D Z T P R O M A E B K V F    Description
```

OP	D	Z	T	P	R	O	M	A	E	B	K	V	F	Description
18h	Z		Z	Z	Z	O						Z		COPY
19h	V		M	V	V									ERASE(6)
1Ah	Z		Z			Z	Z	Z	Z			Z	Z	MODE SENSE(6)
1Bh	O	M			O	O		O		M	O		O	START STOP UNIT
1Bh			O								M			LOAD UNLOAD
1Bh							O							OPEN/CLOSE IMPORT/EXPORT ELEMENT
1Ch	O		O	O		O	O	O	M		O	O	O	RECEIVE DIAGNOSTIC RESULTS
1Dh	M	O	M	M		M	M	O	M		M	M	M	SEND DIAGNOSTIC
1Eh	O		O		O	O	O				O		O	PREVENT ALLOW MEDIUM REMOVAL
1Fh														
20h	V			V	V				V					
21h	V			V	V				V					
22h	V			V	V				V					
23h	V				V				V					
23h						O								READ FORMAT CAPACITIES
24h	V				V									SET WINDOW
25h	M					M			M					READ CAPACITY(10)
25h						O								READ CAPACITY
25h											M			READ CARD CAPACITY
25h														GET WINDOW
26h	V				V									
27h	V				V									
28h	M				O	M			M	M				READ(10)
28h														GET MESSAGE(10)
29h	V				V	O								READ GENERATION
2Ah	O				O	M			M	O				WRITE(10)
2Ah														SEND(10)
2Ah														SEND MESSAGE(10)
2Bh	Z				O	O				O				SEEK(10)
2Bh			M											LOCATE(10)
2Bh							O							POSITION TO ELEMENT
2Ch	V				O	O								ERASE(10)
2Dh						O								READ UPDATED BLOCK
2Dh	V													
2Eh	O				O	O			M	O				WRITE AND VERIFY(10)
2Fh	O				O	O								VERIFY(10)
30h	Z				Z	Z								SEARCH DATA HIGH(10)
31h	Z				Z	Z								SEARCH DATA EQUAL(10)
32h	Z				Z	Z								SEARCH DATA LOW(10)
33h	Z				Z	O								SET LIMITS(10)
34h	O				O				O					PRE-FETCH(10)
34h			M											READ POSITION
34h														GET DATA BUFFER STATUS

Table E.1 – Operation codes (part 3 of 6)

	D – Direct Access Block Device (SBC-5)	Device Column key
	. Z – Host Managed Zoned Block Device (ZBC-3)	M = Mandatory
	. T – Sequential Access Device (SSC-5)	O = Optional
	. P – Processor Device (SPC-2)	V = Vendor specific
	. . R – C/DVD Device (MMC-6)	Z = Obsolete
	. . O – Optical Memory Block Device (SBC)	
	. . M – Media Changer Device (SMC-3)	
	. . . A – Storage Array Device (SCC-2)	
	. . . E – SCSI Enclosure Services Device (SES-3)	
	. . . B – Simplified Direct Access (Reduced Block) device (RBC)	
	. . . . K – Optical Card Reader/Writer device (OCRW)	
	. . . . V – Automation/Device Interface device (ADC-4)	
	. . . . F – Object-based Storage Device (OSD-2)	

OP	D Z T P R O M A E B K V F	Description
35h	O OO MO	SYNCHRONIZE CACHE(10)
36h	Z O O	LOCK UNLOCK CACHE(10)
37h	O O	READ DEFECT DATA(10)
37h	O	INITIALIZE ELEMENT STATUS WITH RANGE
38h	OO	FORMAT WITH PRESET
38h	O O	MEDIUM SCAN
39h	Z ZZZO Z	COMPARE
3Ah	Z ZZZO Z	COPY AND VERIFY
3Bh	OOOOOOOOOMOOO	WRITE BUFFER
3Ch	OOOOOOOOO OOO	READ BUFFER(10)
3Dh	O	UPDATE BLOCK
3Eh	Z Z	READ LONG(10)
3Fh	O O	WRITE LONG(10)
40h	Z ZZZOZ	CHANGE DEFINITION
41h	O	WRITE SAME(10)
42h	O	UNMAP
42h	O	READ SUB-CHANNEL
43h	O	READ TOC/PMA/ATIP
44h	M M	REPORT DENSITY SUPPORT
44h		READ HEADER
45h	O	PLAY AUDIO(10)
46h	M	GET CONFIGURATION
47h	O	PLAY AUDIO MSF
48h	OO O	SANITIZE
49h		
4Ah	M	GET EVENT STATUS NOTIFICATION
4Bh	O	PAUSE/RESUME
4Ch	OOOO OOOO OOO	LOG SELECT
4Dh	OMOO OOOO OMO	LOG SENSE
4Eh	O	STOP PLAY/SCAN
4Fh		
50h	Z	XDWRITE(10)
51h	Z	XPWRITE(10)
51h	O	READ DISC INFORMATION
52h	Z	XDREAD(10)
52h	O	READ TRACK INFORMATION
53h	Z	XDWRITEREAD(10)
53h	O	RESERVE TRACK
54h	O	SEND OPC INFORMATION
55h	OMO MOOOOMOMO	MODE SELECT(10)
56h	Z ZZ OOOZ	RESERVE(10)
56h	Z	RESERVE ELEMENT(10)
57h	Z ZZ OOOZ	RELEASE(10)

Table E.1 – Operation codes (part 4 of 6)

```
        D – Direct Access Block Device (SBC-5)                      Device Column key
        . Z – Host Managed Zoned Block Device (ZBC-3)               M = Mandatory
        .   T – Sequential Access Device (SSC-5)                    O = Optional
        .     P – Processor Device (SPC-2)                          V = Vendor specific
        .       . R – C/DVD Device (MMC-6)                          Z = Obsolete
        .       .   O – Optical Memory Block Device (SBC)
        .       .     M – Media Changer Device (SMC-3)
        .       .       . A – Storage Array Device (SCC-2)
        .       .       .   E – SCSI Enclosure Services Device (SES-3)
        .       .       .     B – Simplified Direct Access (Reduced Block) device (RBC)
        .       .       .       . K – Optical Card Reader/Writer device (OCRW)
        .       .       .         V – Automation/Device Interface device (ADC-4)
        .       .       .           F – Object-based Storage Device (OSD-2)
OP      D Z T P R O M A E B K V F   Description
57h               Z                 RELEASE ELEMENT(10)
58h         O                       REPAIR TRACK
59h
5Ah     O M O   M O O O O M O M O   MODE SENSE(10)
5Bh         O                       CLOSE TRACK/SESSION
5Ch         O                       READ BUFFER CAPACITY
5Dh         O                       SEND CUE SHEET
5Eh     O O M O   O O O O       M   PERSISTENT RESERVE IN
5Fh     O O M O   O O O O       M   PERSISTENT RESERVE OUT
7Eh     O   O O   O O O O   O       extended CDB
7Fh     O                       M   variable length CDB (more than 16 bytes)
80h     Z                           XDWRITE EXTENDED(16)
80h         M                       WRITE FILEMARKS(16)
81h     Z                           REBUILD(16)
81h         O                       READ REVERSE(16)
82h     Z                           REGENERATE(16)
82h         O                       ALLOW OVERWRITE
83h     O   O O O           O O     Third-party Copy OUT
84h     O   O O O           O O     Third-party Copy IN
85h     O O             O           ATA PASS-THROUGH(16)
86h     Z   Z Z Z Z Z Z Z Z Z       ACCESS CONTROL IN
87h     Z   Z Z Z Z Z Z Z Z Z       ACCESS CONTROL OUT
88h     M M O     O     O           READ(16)
89h     O                           COMPARE AND WRITE
8Ah     O M O     O     O           WRITE(16)
8Bh     O                           ORWRITE
8Ch     O O     O O     O   M       READ ATTRIBUTE
8Dh     O O     O O     O   O       WRITE ATTRIBUTE
8Eh     O       O     O             WRITE AND VERIFY(16)
8Fh     O O O   O     O             VERIFY(16)
90h     O       O     O             PRE-FETCH(16)
91h     O M     O     O             SYNCHRONIZE CACHE(16)
91h         O                       SPACE(16)
92h     Z           O               LOCK UNLOCK CACHE(16)
92h         M                       LOCATE(16)
93h     O M                         WRITE SAME(16)
93h         M                       ERASE(16)
94h     O M                         ZBC OUT
95h     O M                         ZBC IN
96h
97h
98h
99h
```

Table E.1 – Operation codes (part 5 of 6)

```
            D – Direct Access Block Device (SBC-5)                 Device Column key
          . Z – Host Managed Zoned Block Device (ZBC-3)            M = Mandatory
          .  T – Sequential Access Device (SSC-5)                  O = Optional
          .    P – Processor Device (SPC-2)                        V = Vendor specific
          .      R – C/DVD Device (MMC-6)                          Z = Obsolete
          .      .  O – Optical Memory Block Device (SBC)
          .      .   M – Media Changer Device (SMC-3)
          .      .   . A – Storage Array Device (SCC-2)
          .      .   .  E – SCSI Enclosure Services Device (SES-3)
          .      .   .   B – Simplified Direct Access (Reduced Block) device (RBC)
          .      .   .   . K – Optical Card Reader/Writer device (OCRW)
          .      .   .   .  V – Automation/Device Interface device (ADC-4)
          .      .   .   .   F – Object-based Storage Device (OSD-2)
```

OP	D	Z	T	P	R	O	M	A	E	B	K	V	F	Description
9Ah	O	O												WRITE STREAM(16)
9Bh	O	O	O			O	O	O				O		READ BUFFER(16)
9Ch	O													WRITE ATOMIC(16)
9Dh														SERVICE ACTION BIDIRECTIONAL
9Eh	O	M												SERVICE ACTION IN(16)
9Fh													M	SERVICE ACTION OUT(16)
A0h	M	M	M	O		O	M	M	M		O	M	O	REPORT LUNS
A1h			O											BLANK
A1h	O	O								O				ATA PASS-THROUGH(12)
A2h	O	O	O	O									O	SECURITY PROTOCOL IN
A3h	O	M	O			O	O	M	O	O	O	M		MAINTENANCE IN
A3h					O									SEND KEY
A4h	O	O	O			O	O	O	O	O	O	O		MAINTENANCE OUT
A4h					O									REPORT KEY
A5h			Z			O	M							MOVE MEDIUM
A5h					O									PLAY AUDIO(12)
A6h							O							EXCHANGE MEDIUM
A6h					O									LOAD/UNLOAD C/DVD
A7h	Z		Z				O							MOVE MEDIUM ATTACHED
A7h	O													SET READ AHEAD
A8h	O				O	O								READ(12)
A9h												O		SERVICE ACTION OUT(12)
AAh	O				O	O								WRITE(12)
AAh														SEND MESSAGE(12)
ABh					O							O		SERVICE ACTION IN(12)
ACh					O									ERASE(12)
ACh					O									GET PERFORMANCE
ADh					O									READ DVD STRUCTURE
AEh	O					O								WRITE AND VERIFY(12)
AFh	O					O								VERIFY(12)
B0h						Z	Z							SEARCH DATA HIGH(12)
B1h						Z	Z							SEARCH DATA EQUAL(12)
B2h						Z	Z							SEARCH DATA LOW(12)
B3h	Z					Z	O							SET LIMITS(12)
B4h	Z		Z			Z	O							READ ELEMENT STATUS ATTACHED
B5h	O	O	O	O									O	SECURITY PROTOCOL OUT
B5h							O							REQUEST VOLUME ELEMENT ADDRESS
B6h							O							SEND VOLUME TAG
B6h					O									SET STREAMING
B7h	O	O				O								READ DEFECT DATA(12)
B8h			Z		Z	O	M							READ ELEMENT STATUS
B9h					O									READ CD MSF
BAh	O					O	O	M	O					REDUNDANCY GROUP (IN)

Table E.1 – Operation codes (part 6 of 6)

OP	D	Z	T	P	R	O	M	A	E	B	K	V	F	Description

(Device Column key: M = Mandatory, O = Optional, V = Vendor specific, Z = Obsolete)

Device column legend:
- D – Direct Access Block Device (SBC-5)
- Z – Host Managed Zoned Block Device (ZBC-3)
- T – Sequential Access Device (SSC-5)
- P – Processor Device (SPC-2)
- R – C/DVD Device (MMC-6)
- O – Optical Memory Block Device (SBC)
- M – Media Changer Device (SMC-3)
- A – Storage Array Device (SCC-2)
- E – SCSI Enclosure Services Device (SES-3)
- B – Simplified Direct Access (Reduced Block) device (RBC)
- K – Optical Card Reader/Writer device (OCRW)
- V – Automation/Device Interface device (ADC-4)
- F – Object-based Storage Device (OSD-2)

OP	D	Z	T	P	R	O	M	A	E	B	K	V	F	Description
BAh				O										SCAN
BBh	O					O	O	O	O					REDUNDANCY GROUP (OUT)
BBh				O										SET CD SPEED
BCh	O					O	O	M	O					SPARE (IN)
BDh	O					O	O	O	O					SPARE (OUT)
BDh				O										MECHANISM STATUS
BEh	O					O	O	M	O					VOLUME SET (IN)
BEh				O										READ CD
BFh	O					O	O	O	O					VOLUME SET (OUT)
BFh				O										SEND DVD STRUCTURE

E.3.2 Additional operation codes for devices with the ENCSERV bit set to one

Table E.2 is a numerical order listing of the additional command operation codes used by devices that have the ENCSERV bit set to one in their standard INQUIRY data. The operation codes listed in table E.2 are in addition to the operation codes listed in E.3.1 for the device type indicated by the standard INQUIRY data having the ENCSERV bit set to one.

Table E.2 – Additional operation codes for devices with the ENCSERV bit set to one

Device column legend:
- D – Direct Access Block Device (SBC-5)
- Z – Host Managed Zoned Block Device (ZBC-3)
- T – Sequential Access Device (SSC-5)
- P – Processor Device (SPC-2)
- R – C/DVD Device (MMC-6)
- O – Optical Memory Block Device (SBC)
- M – Media Changer Device (SMC-3)
- A – Storage Array Device (SCC-2)
- E – SCSI Enclosure Services Device (SES-3)
- B – Simplified Direct Access (Reduced Block) device (RBC)
- K – Optical Card Reader/Writer device (OCRW)
- V – Automation/Device Interface device (ADC-4)
- F – Object-based Storage Device (OSD-2)

(Device Column key: M = Mandatory, O = Optional, V = Vendor specific, Z = Obsolete)

OP	D	Z	T	P	R	O	M	A	E	B	K	V	F	Description
1C	M	M	M	M	M	M	M	M	M	M	M	M	M	RECEIVE DIAGNOSTIC RESULTS
1D	M	M	M	M	M	M	M	M	M	M	M	M	M	SEND DIAGNOSTIC

E.3.3 MAINTENANCE IN service actions and MAINTENANCE OUT service actions

The assignment of service action codes for the MAINTENANCE IN operation codes and MAINTENANCE OUT operation codes by this standard is shown in table E.3. The MAINTENANCE IN service actions and

MAINTENANCE OUT service actions that may be assigned by other command standards are noted as restricted but their specific usage is not described.

Table E.3 – MAINTENANCE IN service actions and MAINTENANCE OUT service actions

Service Action	Description
MAINTENANCE IN [operation code A3h]	
00h to 04h	Restricted (see SCC-2)
05h	REPORT IDENTIFYING INFORMATION
06h to 09h	Restricted (see SCC-2)
0Ah	REPORT TARGET PORT GROUPS
0Bh	REPORT ALIASES
0Ch	REPORT SUPPORTED OPERATION CODES
0Dh	REPORT SUPPORTED TASK MANAGEMENT FUNCTIONS
0Eh	REPORT PRIORITY
0Fh	REPORT TIMESTAMP
10h	MANAGEMENT PROTOCOL IN
11h to 1Ch	Reserved
1Dh	Restricted (see SBC-5, SSC-5, and ADC-3)
1Eh	Restricted (see SSC-5 and ADC-3)
1Fh	Vendor specific
MAINTENANCE OUT [operation code A4h]	
00h to 05h	Restricted (see SCC-2)
06h	SET IDENTIFYING INFORMATION
07h to 09h	Restricted (see SCC-2)
0Ah	SET TARGET PORT GROUPS
0Bh	CHANGE ALIASES
0Ch	REMOVE I_T NEXUS
0Dh	Reserved
0Eh	SET PRIORITY
0Fh	SET TIMESTAMP
10h	MANAGEMENT PROTOCOL OUT
11h to 1Ch	Reserved
1Dh to 1Eh	Restricted (see SSC-5, ADC-3, and SMC-3)
1Fh	Vendor specific

E.3.4 SERVICE ACTION IN service actions and SERVICE ACTION OUT service actions

The assignment of service action codes for the SERVICE ACTION IN(12) operation codes and SERVICE ACTION OUT(12) operation codes by this standard is shown in table E.4. The SERVICE ACTION IN(12) service actions and SERVICE ACTION OUT(12) service actions that may be assigned by other command standards are noted as restricted but their specific usage is not described.

Table E.4 – SERVICE ACTION IN(12) service actions and SERVICE ACTION OUT(12) service actions

Service Action	Description
SERVICE ACTION IN(12) [operation code ABh]	
00h	Reserved
01h	READ MEDIA SERIAL NUMBER
02h to 1Fh	Reserved
SERVICE ACTION OUT(12) [operation code A9h]	
00h to 1Eh	Reserved
1Fh	Restricted (see applicable command standard)

The assignment of service action codes for the SERVICE ACTION IN(16) operation codes and SERVICE ACTION OUT(16) operation codes by this standard is shown in table E.5. The SERVICE ACTION IN(16) service actions and SERVICE ACTION OUT(16) service actions that may be assigned by other command standards are noted as restricted but their specific usage is not described.

Table E.5 – SERVICE ACTION IN(16) service actions and SERVICE ACTION OUT(16) service actions

Service Action	Description
SERVICE ACTION IN(16) [operation code 9Eh]	
00h to 0Eh	Reserved
0Fh	RECEIVE BINDING REPORT
10h to 1Fh	Restricted (see applicable command standard)
SERVICE ACTION OUT(16) [operation code 9Fh]	
00h to 0Ah	Reserved
0Bh	TEST BIND
0Ch	PREPARE BINDING REPORT
0Dh	SET AFFILIATION
0Eh	BIND
0Fh	UNBIND
10h to 1Fh	Restricted (see applicable command standard)

E.3.5 SERVICE ACTION BIDIRECTIONAL service actions

The assignment of service action codes for the SERVICE ACTION BIDIRECTIONAL operation codes by this standard is shown in table E.6. The SERVICE ACTION BIDIRECTIONAL service actions that may be assigned by other command standards are noted as restricted but their specific usage is not described.

Table E.6 – SERVICE ACTION BIDIRECTIONAL service actions

Service Action	Description
SERVICE ACTION BIDIRECTIONAL [operation code 9Dh]	
00h to 0Fh	Reserved
10h to 1Fh	Restricted (see applicable command standard)

E.3.6 Variable length CDB service action codes

Only one operation code is assigned to the variable length CDB (see 4.2.3). Therefore, the service action code is effectively the operation code for variable length CDB uses. To allow command standards to assign uses of the variable length CDB without consulting this standard, ranges of service action codes are assigned to command sets as shown in table E.7.

Table E.7 – Variable Length CDB Service Action Code Ranges

Service Action Code Range	Doc.	Description
0000h to 07FFh	SBC-5	Direct access block device (e.g., magnetic disk)
0800h to 0FFFh	SSC-5	Sequential access device (e.g., magnetic tape)
1000h to 17FFh		Reserved
1800h to 1FFFh	this standard	Commands for all device types (see table E.8)
2000h to 27FFh		Reserved
2800h to 2FFFh	MMC-6	CD-ROM device
3800h to 3FFFh		Reserved
4000h to 47FFh	SMC-3	Media changer device (e.g., jukeboxes)
5000h to 5FFFh		Defined by ASC IT8 (Graphic arts pre-press devices)
6000h to 67FFh	SCC-2	Storage array controller device (e.g., RAID)
7000h to 77FFh	RBC	Simplified direct access device (e.g., magnetic disk)
7800h to 7FFFh	OCRW	Optical card reader/writer device
8800h to 8FFFh	OSD-2	Object-based storage device
3000h to 37FFh		Reserved
4800h to 4FFFh		Reserved
6800h to 6FFFh		Reserved
8000h to 87FFh		Reserved
9000h to F7FFh		Reserved
F800h to FFFFh		Vendor specific

The variable length CDB service action codes assigned by this standard are shown in table E.8.

Table E.8 – Variable Length CDB Service Action Codes Used by All Device Types

Service Action Code	Description
1800h	Obsolete
1801h to 1FF7h	Reserved
1FF8h to 1FFFh	Restricted (see FC-SB-4)

E.4 Diagnostic page codes

Table E.9 is a numerical order listing of the diagnostic page codes.

Table E.9 – Diagnostic page codes

	Device Column key
D – Direct Access Block Device (SBC-5)	Device Column key
. Z – Host Managed Zoned Block Device (ZBC-3)	blank = code not used
. T – Sequential Access Device (SSC-5)	not blank = code used
. P – Processor Device (SPC-2)	
. . R – C/DVD Device (MMC-6)	
. . O – Optical Memory Block Device (SBC)	
. . M – Media Changer Device (SMC-3)	
. . . A – Storage Array Device (SCC-2)	
. . . E – SCSI Enclosure Services device (SES-3)	
. . . B – Simplified Direct Access (Reduced Block) device (RBC)	
. . . . K – Optical Card Reader/Writer device (OCRW)	
. . . . V – Automation/Device Interface device (ADC-4)	
. . . . F – Object-based Storage Device (OSD-2)	

Diagnostic Page Code	D Z T P R O M A E B K V F	Diagnostic Page Name
00h	D Z T P R O M A E K V F	Supported Diagnostic Pages
01h	E	Configuration
02h	E	Enclosure Status/Control
03h	E	Help Text
04h	E	String In/Out
05h	E	Threshold In/Out
06h	E	Obsolete
07h	E	Element Descriptor
08h	E	Short Enclosure Status
09h	E	Enclosure Busy
0Ah	E	Additional Element Status
0Bh	E	Subenclosure Help Text
0Ch	E	Subenclosure String In/Out
0Dh	E	Supported SES Diagnostic Pages
0Eh	E	Download Microcode Status/Control
0Fh	E	Subenclosure Nickname Status/Control
10h to 1Fh		SES vendor specific
3Fh		Protocol Specific diagnostic page
40h	D Z O	Translate Address In/Out
41h	D Z O	Device Status In/Out
42h	D Z	Rebuild Assist
80h to FFh		Vendor specific
		All codes not shown are restricted or reserved.

E.5 Log page codes

Table E.10 is a numerical order listing of the log page codes.

Table E.10 – Log page codes (part 1 of 3)

Device Column key
blank = code not used
not blank = code used

- D – Direct Access Block Device (SBC-5)
- Z – Host Managed Zoned Block Device (ZBC-3)
- T – Sequential Access Device (SSC-5)
- P – Processor Device (SPC-2)
- R – C/DVD Device (MMC-6)
- O – Optical Memory Block Device (SBC)
- M – Media Changer Device (SMC-3)
- A – Storage Array Device (SCC-2)
- E – SCSI Enclosure Services device (SES-3)
- B – Simplified Direct Access (Reduced Block) device (RBC)
- K – Optical Card Reader/Writer device (OCRW)
- V – Automation/Device Interface device (ADC-4)
- F – Object-based Storage Device (OSD-2)

Log Page Code	Log Subpage Code	D	Z	T	P	R	O	M	A	E	B	K	V	F	Log Page Name
00h	00h	D	Z	T	P	R	O	M	A	E		K	V	F	Supported Log Pages
00h	FFh	D	Z	T	P	R	O	M	A	E		K	V	F	Supported Log Pages and Subpages
01h to 3Fh	FFh	D	Z	T	P	R	O	M	A	E		K	V	F	Supported Subpages
01h	00h	D	Z	T	P	R	O		A			K	V	F	Buffer Over-Run/Under-Run
02h	00h	D	Z	T		R	O					K	V		Write Error Counters
03h	00h	D	Z	T		R	O					K	V		Read Error Counters
04h	00h			T									V		Read Reverse Error Counters
05h	00h	D	Z	T		R	O					K	V		Verify Error Counters
06h	00h	D		T	P	R	O	M	A	E		K	V	F	Non-Medium Error
07h	00h	D		T	P	R	O	M	A	E		K	V	F	Last n Error Events
08h	00h	D					O						V		Format Status
09h	00h to FEh						O								Reserved to the MS59 Std. (contact AIIM C21 comm.)
0Ah	00h to FEh						O								Reserved to the MS59 Std. (contact AIIM C21 comm.)
0Bh	00h	D		T	P	R	O	M	A	E			V	F	Last n Deferred Error or Asynchronous Events
0Bh	01h	D			P	R	O	M	A	E			V	F	Last n Inquiry Data Changed
0Bh	02h	D			P	R	O	M	A	E			V	F	Last n Mode Page Data Changed
0Ch	00h	D													Logical Block Provisioning
0Ch	00h			T									V		Sequential Access Device
0Dh	00h	D	Z	T	P	R	O	M	A	E			V		Temperature
0Dh	01h	D	Z	T	P	R	O	M	A	E			V		Environmental Reporting
0Dh	02h	D	Z	T	P	R	O	M	A	E			V		Environmental Limits
0Eh	00h	D	Z	T	P	R	O	M	A	E			V		Start-Stop Cycle Counter
0Eh	01h	D	Z												Utilization
0Fh	00h	D	Z	T	P	R	O	M	A	E			V		Application Client
10h	00h	D	Z	T	P	R	O	M	A	E			V		Self-Test Results
11h	00h	D													Solid State Media
11h	00h			T									V		DT Device Status
12h	00h												V		TapeAlert Response
13h	00h												V		Requested Recovery
14h	00h			T									V		Device Statistics
14h	01h	D	Z												Zoned Block Device Statistics
15h	00h	D	Z												Background Scan Results
15h	00h												V		Service Buffers Information
15h	01h	D	Z												Pending Defects
15h	02h	D	Z												Background Operation
15h	03h	D	Z												LPS Misalignment
16h	00h	D	Z												ATA PASS-THROUGH Results

Table E.10 – Log page codes (part 2 of 3)

		D – Direct Access Block Device (SBC-5)	Device Column key
		. Z – Host Managed Zoned Block Device (ZBC-3)	blank = code not used
		. T – Sequential Access Device (SSC-5)	not blank = code used
		. P – Processor Device (SPC-2)	
		. R – C/DVD Device (MMC-6)	
		. O – Optical Memory Block Device (SBC)	
		. M – Media Changer Device (SMC-3)	
		. A – Storage Array Device (SCC-2)	
		. E – SCSI Enclosure Services device (SES-3)	
		. B – Simplified Direct Access (Reduced Block) device (RBC)	
		. K – Optical Card Reader/Writer device (OCRW)	
		. V – Automation/Device Interface device (ADC-4)	
Log Page Code	Log Subpage Code	. . . . F – Object-based Storage Device (OSD-2) . . . . . D Z T P R O M A E B K V F	Log Page Name
16h	00h	T V	Tape Diagnostic Data
17h	00h	D	Non-Volatile Cache
17h	00h to 0Fh	T	Volume Statistics
18h	xxh	D Z T P R O M A E K V	Protocol Specific Port (see table E.11)
19h	00h	D	General Statistics and Performance
19h	01h	D	Group Statistics and Performance (1)
19h	02h	D	Group Statistics and Performance (2)
19h	03h	D	Group Statistics and Performance (3)
19h	04h	D	Group Statistics and Performance (4)
19h	05h	D	Group Statistics and Performance (5)
19h	06h	D	Group Statistics and Performance (6)
19h	07h	D	Group Statistics and Performance (7)
19h	08h	D	Group Statistics and Performance (8)
19h	09h	D	Group Statistics and Performance (9)
19h	0Ah	D	Group Statistics and Performance (10)
19h	0Bh	D	Group Statistics and Performance (11)
19h	0Ch	D	Group Statistics and Performance (12)
19h	0Dh	D	Group Statistics and Performance (13)
19h	0Eh	D	Group Statistics and Performance (14)
19h	0Fh	D	Group Statistics and Performance (15)
19h	10h	D	Group Statistics and Performance (16)
19h	11h	D	Group Statistics and Performance (17)
19h	12h	D	Group Statistics and Performance (18)
19h	13h	D	Group Statistics and Performance (19)
19h	14h	D	Group Statistics and Performance (20)
19h	15h	D	Group Statistics and Performance (21)
19h	16h	D	Group Statistics and Performance (22)
19h	17h	D	Group Statistics and Performance (23)
19h	18h	D	Group Statistics and Performance (24)
19h	19h	D	Group Statistics and Performance (25)
19h	1Ah	D	Group Statistics and Performance (26)
19h	1Bh	D	Group Statistics and Performance (27)
19h	1Ch	D	Group Statistics and Performance (28)
19h	1Dh	D	Group Statistics and Performance (29)
19h	1Eh	D	Group Statistics and Performance (30)
19h	1Fh	D	Group Statistics and Performance (31)
1Ah	00h	D Z T P R O A K	Power Condition Transitions

Table E.10 – Log page codes (part 3 of 3)

		D – Direct Access Block Device (SBC-5)		Device Column key
		. Z – Host Managed Zoned Block Device (ZBC-3)		blank = code not used
		. T – Sequential Access Device (SSC-5)		not blank = code used
		. P – Processor Device (SPC-2)		
		. . R – C/DVD Device (MMC-6)		
		. . O – Optical Memory Block Device (SBC)		
		. . M – Media Changer Device (SMC-3)		
		. . . A – Storage Array Device (SCC-2)		
		. . . E – SCSI Enclosure Services device (SES-3)		
		. . . B – Simplified Direct Access (Reduced Block) device (RBC)		
		. . . . K – Optical Card Reader/Writer device (OCRW)		
		. . . . V – Automation/Device Interface device (ADC-4)		
Log	Log	. . . . F – Object-based Storage Device (OSD-2)		
Page Code	Subpage Code	D Z T P R O M A E B K V F	Log Page Name	
1Bh	00h	T	Data Compression	
2Dh	00h	T	Current Service Information	
2Eh	00h	T M	TapeAlert	
2Fh	00h	D Z T P R O M A E K V	Informational Exceptions	
30h to 3Eh	00h to FEh		Vendor specific	
3Fh	00h to FEh		Reserved	
			All codes not shown here or in table E.11 are restricted or reserved.	

Table E.11 is a numerical order listing of the log page codes used by SCSI transport protocols.

Table E.11 – Transport protocol specific log page codes

		F – Fibre Channel Protocol for SCSI (FCP-5)		Device Column key
		. S – SAS Serial SCSI Protocol (SPL-5)		blank = code not used
		. V – Automation/Drive Interface Transport Protocol (ADT-3)		not blank = code used
Log Page Code	Log Subpage Code	. U – USB Attached SCSI (UAS)		
		F S V U	Log Page Name	
18h	00h	S	Protocol Specific Port	
			See table E.10 for information on the codes not shown here.	

E.6 Mode page codes

Table E.12 is a numerical order listing of the mode page codes.

Table E.12 – Mode page codes (part 1 of 2)

D – Direct Access Block Device (SBC-5)
. Z – Host Managed Zoned Block Device (ZBC-3)
. T – Sequential Access Device (SSC-5)
.   P – Processor Device (SPC-2)
.   . R – C/DVD Device (MMC-6)
.   . O – Optical Memory Block Device (SBC)
.   M – Media Changer Device (SMC-3)
.   . A – Storage Array Device (SCC-2)
.   . E – SCSI Enclosure Services device (SES-3)
.   B – Simplified Direct Access (Reduced Block) device (RBC)
.   . K – Optical Card Reader/Writer device (OCRW)
.   . V – Automation/Device Interface device (ADC-4)
.   .   F – Object-based Storage Device (OSD-2)

Device Column key
blank = code not used
not blank = code used

Mode Page Code	Mode Subpage Code	D	Z	T	P	R	O	M	A	E	B	K	V	F	Mode Page Name
01h	00h	D	Z	T		R	O					K			Read-Write Error Recovery
02h	00h	D	Z	T		R	O	M	A	E		K	V	F	Disconnect-Reconnect
03h	00h	D													obsolete (Format Device)
03h	00h					R									MRW CD-RW
04h	00h	D													obsolete (Rigid Disk Geometry)
05h	00h	D													obsolete (Flexible Disk)
05h	00h					R									Write Parameters
06h	00h						O								Optical Memory
06h	00h										B				RBC Device Parameters
07h	00h	D	Z				O					K			Verify Error Recovery
08h	00h	D	Z			R	O					K			Caching
09h	00h	D		T		R	O		A	E		K			obsolete (Peripheral Device)
0Ah	00h	D	Z	T		R	O	M	A	E		K	V	F	Control
0Ah	01h	D	Z	T		R	O	M	A	E		K	V	F	Control Extension
0Ah	02h	D	Z												Application Tag
0Ah	03h	D	Z			R	O	M	A	E		K	V	F	Command Duration Limit A
0Ah	04h	D	Z			R	O	M	A	E		K	V	F	Command Duration Limit B
0Ah	05h	D	Z												IO Advice Hints Grouping
0Ah	06h	D	Z												Background Operation Control
0Ah	F0h			T											Control Data Protection
0Ah	F1h	D													PATA Control
0Ah	F2h	D	Z												ATA Feature Control
0Bh	00h	D					O					K			obsolete (Medium Types Supported)
0Ch	00h	D													obsolete (Notch and Partition)
0Dh	00h	D													obsolete (Power Condition)
0Dh	00h					R									CD Device Parameters
0Eh	00h					R									CD Audio Control
0Eh	01h												V		Target Device
0Eh	02h												V		DT Device Primary Port
0Eh	03h												V		Logical Unit
0Eh	04h												V		Target Device Serial Number
0Fh	00h			T											Data Compression
10h	00h	D													obsolete (XOR Control)
10h	00h			T											Device Configuration
10h	01h			T											Device Configuration Extension
11h	00h			T											Medium Partition
12h															

Table E.12 – Mode page codes (part 2 of 2)

D – Direct Access Block Device (SBC-5)
. Z – Host Managed Zoned Block Device (ZBC-3)
. T – Sequential Access Device (SSC-5)
. P – Processor Device (SPC-2)
. . R – C/DVD Device (MMC-6)
. . O – Optical Memory Block Device (SBC)
. . M – Media Changer Device (SMC-3)
. . . A – Storage Array Device (SCC-2)
. . . E – SCSI Enclosure Services device (SES-3)
. . . B – Simplified Direct Access (Reduced Block) device (RBC)
. . . . K – Optical Card Reader/Writer device (OCRW)
. . . . V – Automation/Device Interface device (ADC-4)
. . . . F – Object-based Storage Device (OSD-2)

Device Column key
blank = code not used
not blank = code used

Mode Page Code	Mode Subpage Code	D	Z	T	P	R	O	M	A	E	B	K	V	F	Mode Page Name
13h															
14h	00h	D	Z		P	R	O	M	A	E	B	K		F	Enclosure Services Management
14h	00h			T											Medium Partition (4)
15h															Extended
16h															Extended Device Type Specific
17h															
18h	xxh	D	Z	T			R	O	M	A	E			V	F	Protocol Specific Logical Unit (see table E.13)
19h	xxh	D	Z	T			R	O	M	A	E			V	F	Protocol Specific Port (see table E.13)
1Ah	00h	D	Z	T			R	O	M	A	E			V		Power Condition
1Ah	01h	D														Power Consumption
1Ah	F1h	D	Z								B				ATA Power Condition
1Bh	00h								A						LUN Mapping
1Ch	00h	D	Z						A	E					Informational Exceptions Control
1Ch	00h			T				M					V		Informational Exceptions Control (tapes-specific format)
1Ch	00h					R									Fault/Failure Reporting
1Ch	00h						O								Informational Exceptions Control (see SBC)
1Ch	01h	D	Z												Background Control
1Ch	02h	D													Logical Block Provisioning
1Dh	00h			T											Medium Configuration
1Dh	00h					R									C/DVD Time-Out and Protect
1Dh	00h							M							Element Address Assignments
1Eh	00h							M							Transport Geometry Parameters
1Fh	00h							M							Device Capabilities
00h															Vendor specific (does not require page format)
20h to 29h															Device type specific (vendor specific in common usage)
2Ah		D	Z	T			O	M	A	E	B	K	V	F	Device type specific (vendor specific in common usage)
2Ah	00h					R									CD Capabilities and Mechanical Status
2Bh to 3Eh															Device type specific (vendor specific in common usage)
3Fh	xxh														Return all pages and/or subpages (MODE SENSE only)
xxh	FFh														Return all subpages (MODE SENSE only)

All codes not shown here or in table E.13 are restricted or reserved.

Table E.13 is a numerical order listing of the mode page codes used by SCSI transport protocols.

Table E.13 – Transport protocol specific mode page codes

Mode Page Code	Mode Subpage Code	F S V U	Mode Page Name	Device Column key
		F – Fibre Channel Protocol for SCSI (FCP-5)		blank = code not used
		. S – SAS Serial SCSI Protocol (SPL-5)		not blank = code used
		. V – Automation/Drive Interface Transport Protocol (ADT-3)		
		. U – USB Attached SCSI (UAS)		
18h	00h	F S	Protocol Specific Logical Unit	
19h	00h	F S	Protocol Specific Port	
19h	01h	S	Phy Control And Discover	
19h	02h	S	Shared Port Control	
			See table E.12 for information on the codes not shown here.	

E.7 VPD page codes

Table E.14 is a numerical order listing of the VPD page codes.

Table E.14 – VPD page codes (part 1 of 2)

	D	Z	T	P	R	O	M	A	E	B	K	V	F	
	D – Direct Access Block Device (SBC-5)													Device Column key
	. Z – Host Managed Zoned Block Device (ZBC-3)													blank = code not used
	. T – Sequential Access Device (SSC-5)													not blank = code used
	. P – Processor Device (SPC-2)													
	. . R – C/DVD Device (MMC-6)													
	. . O – Optical Memory Block Device (SBC)													
	. . M – Media Changer Device (SMC-3)													
	. . . A – Storage Array Device (SCC-2)													
	. . . E – SCSI Enclosure Services device (SES-3)													
	. . . B – Simplified Direct Access (Reduced Block) device (RBC)													
	. . . . K – Optical Card Reader/Writer device (OCRW)													
	. . . . V – Automation/Device Interface device (ADC-4)													
	. . . . F – Object-based Storage Device (OSD-2)													
VPD Page Code	D	Z	T	P	R	O	M	A	E	B	K	V	F	VPD Page Name
00h	D	Z	T	P	R	O	M	A	E	B	K	V	F	Supported VPD Pages
01h to 7Fh	D	Z	T	P	R	O	M	A	E	B	K	V	F	ASCII Information
80h	D	Z	T	P	R	O	M	A	E	B	K	V	F	Unit Serial Number
81h	D		T	P	R	O	M	A	E	B	K	V	F	obsolete
82h	D		T	P	R	O	M	A	E	B	K	V	F	obsolete
83h	D	Z	T	P	R	O	M	A	E	B	K	V	F	Device Identification
84h	D	Z	T	P	R	O	M	A	E	B	K	V	F	Software Interface Identification
85h	D	Z	T	P	R	O	M	A	E	B	K	V	F	Management Network Addresses
86h	D	Z	T	P	R	O	M	A	E	B	K	V	F	Extended INQUIRY Data
87h	D	Z	T	P	R	O	M	A	E	B	K	V	F	Mode Page Policy
88h	D	Z	T	P	R	O	M	A	E	B	K	V	F	SCSI Ports
89h	D	Z												ATA Information
8Ah	D	Z	T	P	R	O		A				V		Power Condition
8Bh			T				M							Device Constituents
8Ch	D									B				CFA Profile Information
8Dh	D		T											Power Consumption
8Fh	D		T	P	R					B				Third-party Copy
90h	D	Z	T		R	O	M	A	E			V	F	Protocol Specific Logical Unit Information
91h	D	Z	T		R	O	M	A	E			V	F	Protocol Specific Port Information
92h	D	Z	T							B				SCSI Feature Sets
B0h	D	Z												Block Limits
B0h			T											Sequential access Device Capabilities
B0h													F	OSD information
B1h	D	Z												Block Device Characteristics
B1h			T									V		Manufacturer-assigned Serial Number
B1h													F	Security Token
B2h	D													Logical Block Provisioning
B2h			T											TapeAlert Supported Flags
B3h	D													Referrals
B3h			T											Automation Device Serial Number
B4h	D	Z												Supported Block Lengths and Protection Types
B4h			T											Data Transfer Device Element Address
B5h	D	Z												Block Device Characteristics Extension
B6h		Z												Zoned Block Device Characteristics
B7h	D	Z												Block Limits Extension

Table E.14 – VPD page codes (part 2 of 2)

	D – Direct Access Block Device (SBC-5)	Device Column key
	. Z – Host Managed Zoned Block Device (ZBC-3)	blank = code not used
	. T – Sequential Access Device (SSC-5)	not blank = code used
	. P – Processor Device (SPC-2)	
	. . R – C/DVD Device (MMC-6)	
	. . O – Optical Memory Block Device (SBC)	
	. . M – Media Changer Device (SMC-3)	
	. . . A – Storage Array Device (SCC-2)	
	. . . E – SCSI Enclosure Services device (SES-3)	
	. . . B – Simplified Direct Access (Reduced Block) device (RBC)	
	. . . . K – Optical Card Reader/Writer device (OCRW)	
	. . . . V – Automation/Device Interface device (ADC-4)	
	. . . . . F – Object-based Storage Device (OSD-2)	
VPD Page	. . . . . .	
Code	D Z T P R O M A E B K V F	VPD Page Name
B8h	D Z	Format Presets
B9h	D Z	Concurrent Positioning Ranges
BAh	D Z	Capacity/Product Identification Mapping
C0h to FFh		Vendor specific
	All codes not shown here or in table E.15 are restricted or reserved.	

Table E.15 is a numerical order listing of the VPD page codes used by SCSI transport protocols.

Table E.15 – Transport protocol specific VPD page codes

	F – Fibre Channel Protocol for SCSI (FCP-5)	Device Column key
	. S – SAS Serial SCSI Protocol (SPL-5)	blank = code not used
	. V – Automation/Drive Interface Transport Protocol (ADT-3)	not blank = code used
	. U – USB Attached SCSI (UAS)	
VPD Page	. .	
Code	F S V U	VPD Page Name
90h	S	Protocol Specific Logical Unit Information
91h	S	Protocol Specific Port Information
	See table E.14 for information on the codes not shown here.	

E.8 ROD type codes

Table E.16 is a numerical order listing of the ROD types.

Table E.16 – ROD type codes

	D – Direct Access Block Device (SBC-5)	
	. Z – Host Managed Zoned Block Device (ZBC-3)	Device Column key
	. T – Sequential Access Device (SSC-5)	blank = code not used
	. P – Processor Device (SPC-2)	not blank = code used
	. . R – C/DVD Device (MMC-6)	
	. . O – Optical Memory Block Device (SBC)	
	. . M – Media Changer Device (SMC-3)	
	. . . A – Storage Array Device (SCC-2)	
	. . . E – SCSI Enclosure Services device (SES-3)	
	. . . B – Simplified Direct Access (Reduced Block) device (RBC)	
	. . . . K – Optical Card Reader/Writer device (OCRW)	
	. . . . V – Automation/Device Interface device (ADC-4)	
	. . . . F – Object-based Storage Device (OSD-2)	

ROD Type Code	D Z T P R O M A E B K V F	ROD type	ROD tokens allowed — Output	ROD tokens allowed — Input
0000 0000h	D T	Internal use ROD or unused ROD type	No	No
0001 0000h	D T	Access upon reference	Yes	Yes
0080 0000h	D T	Point in time copy – default	Yes	Yes
0080 0001h	D T	Point in time copy – change vulnerable	Yes	Yes
0080 0002h	D T	Point in time copy – persistent	Yes	Yes
0080 0003h	D	Point in time copy – copy on write	Yes	Yes
0080 FFFFh	D T	Point in time copy – any	Yes	Yes
FFFF 0001h	D	Block device zero ROD token	Yes [a]	Yes
		All codes not shown are restricted or reserved.		

[a] Output of this ROD type code is allowed only in the ROD tokens returned by the POPULATE TOKEN command (see SBC-5).

E.9 Version descriptor values

Table E.17 is a numerical order listing of the version descriptor values used in the standard INQUIRY data. Each version descriptor value is computed from a coded value identifying the standard and a coded value representing the revision of the standard. The formula is ((standard×32)+revision). Table E.17 shows all three code values and the associated standard name. The version descriptor code is shown in both decimal and hexadecimal.

Table E.17 – Version descriptor assignments (part 1 of 21)

Standard Code	Revision Code	Version Descriptor Code		Standard
		decimal	hex	
0	0	0	0000h	Version Descriptor Not Supported or No Standard Identified
1	0	32	0020h	SAM (no version claimed)
1	27	59	003Bh	SAM T10/0994-D revision 18
1	28	60	003Ch	SAM INCITS 270-1996
1	29	61	003Dh	SAM ISO/IEC 14776-411
2	0	64	0040h	SAM-2 (no version claimed)
2	20	84	0054h	SAM-2 T10/1157-D revision 23
2	21	85	0055h	SAM-2 T10/1157-D revision 24
2	28	92	005Ch	SAM-2 INCITS 366-2003
2	30	94	005Eh	SAM-2 ISO/IEC 14776-412
3	0	96	0060h	SAM-3 (no version claimed)
3	2	98	0062h	SAM-3 T10/1561-D revision 7
3	21	117	0075h	SAM-3 T10/1561-D revision 13
3	22	118	0076h	SAM-3 T10/1561-D revision 14
3	23	119	0077h	SAM-3 INCITS 402-2005
3	25	121	0079h	SAM-3 ISO/IEC 14776-413
4	0	128	0080h	SAM-4 (no version claimed)
4	7	135	0087h	SAM-4 T10/1683-D revision 13
4	11	139	008Bh	SAM-4 T10/1683-D revision 14
4	16	144	0090h	SAM-4 INCITS 447-2008
4	18	146	0092h	SAM-4 ISO/IEC 14776-414
5	0	160	00A0h	SAM-5 (no version claimed)
5	2	162	00A2h	SAM-5 T10/2104-D revision 4
5	4	164	00A4h	SAM-5 T10/2104-D revision 20

Table E.17 – Version descriptor assignments (part 2 of 21)

Standard Code	Revision Code	Version Descriptor Code		Standard
		decimal	hex	
5	6	166	00A6h	SAM-5 T10/2104-D revision 21
5	8	168	00A8h	SAM-5 INCITS 515-2016
5	10	170	00AAh	SAM-5 ISO/IEC 14776-415
6	0	192	00C0h	SAM-6 (no version claimed)
6	2	194	00C2h	SAM-6 INCITS 546-2021
6	20	212	00D4h	SAM-6 BSR INCITS 546 revision 10
9	0	288	0120h	SPC (no version claimed)
9	27	315	013Bh	SPC T10/0995-D revision 11a
9	28	316	013Ch	SPC INCITS 301-1997
10	0	320	0140h	MMC (no version claimed)
10	27	347	015Bh	MMC T10/1048-D revision 10a
10	28	348	015Ch	MMC INCITS 304-1997
11	0	352	0160h	SCC (no version claimed)
11	27	379	017Bh	SCC T10/1047-D revision 06c
11	28	380	017Ch	SCC INCITS 276-1997
12	0	384	0180h	SBC (no version claimed)
12	27	411	019Bh	SBC T10/0996-D revision 08c
12	28	412	019Ch	SBC INCITS 306-1998
12	30	414	019Eh	SBC ISO/IEC 14776-321
13	0	416	01A0h	SMC (no version claimed)
13	27	443	01BBh	SMC T10/0999-D revision 10a
13	28	444	01BCh	SMC INCITS 314-1998
13	30	446	01BEh	SMC ISO/IEC 14776-351
14	0	448	01C0h	SES (no version claimed)
14	27	475	01DBh	SES T10/1212-D revision 08b
14	28	476	01DCh	SES INCITS 305-1998
14	29	477	01DDh	SES T10/1212 revision 08b w/ Amendment INCITS 305/AM1-2000
14	30	478	01DEh	SES INCITS 305-1998 w/ Amendment INCITS 305/AM1-2000

Table E.17 – Version descriptor assignments (part 3 of 21)

Standard Code	Revision Code	Version Descriptor Code		Standard
		decimal	hex	
15	0	480	01E0h	SCC-2 (no version claimed)
15	27	507	01FBh	SCC-2 T10/1125-D revision 04
15	28	508	01FCh	SCC-2 INCITS 318-1998
16	0	512	0200h	SSC (no version claimed)
16	1	513	0201h	SSC T10/0997-D revision 17
16	7	519	0207h	SSC T10/0997-D revision 22
16	28	540	021Ch	SSC INCITS 335-2000
16	30	542	021Eh	SSC ISO/IEC 14776-331
17	0	544	0220h	RBC (no version claimed)
17	24	568	0238h	RBC T10/1240-D revision 10a
17	28	572	023Ch	RBC INCITS 330-2000
17	30	574	023Eh	RBC ISO/IEC 14776-326
18	0	576	0240h	MMC-2 (no version claimed)
18	21	597	0255h	MMC-2 T10/1228-D revision 11
18	27	603	025Bh	MMC-2 T10/1228-D revision 11a
18	28	604	025Ch	MMC-2 INCITS 333-2000
19	0	608	0260h	SPC-2 (no version claimed)
19	7	615	0267h	SPC-2 T10/1236-D revision 12
19	9	617	0269h	SPC-2 T10/1236-D revision 18
19	21	629	0275h	SPC-2 T10/1236-D revision 19
19	22	630	0276h	SPC-2 T10/1236-D revision 20
19	23	631	0277h	SPC-2 INCITS 351-2001
19	24	632	0278h	SPC-2 ISO/IEC 14776-452
20	0	640	0280h	OCRW (no version claimed)
20	30	670	029Eh	OCRW ISO/IEC 14776-381
21	0	672	02A0h	MMC-3 (no version claimed)
21	21	693	02B5h	MMC-3 T10/1363-D revision 9
21	22	694	02B6h	MMC-3 T10/1363-D revision 10g
21	24	696	02B8h	MMC-3 INCITS 360-2002

Table E.17 – Version descriptor assignments (part 4 of 21)

Standard Code	Revision Code	Version Descriptor Code		Standard
		decimal	hex	
23	0	736	02E0h	SMC-2 (no version claimed)
23	21	757	02F5h	SMC-2 T10/1383-D revision 5
23	28	764	02FCh	SMC-2 T10/1383-D revision 6
23	29	765	02FDh	SMC-2 T10/1383-D revision 7
23	30	766	02FEh	SMC-2 INCITS 382-2004
24	0	768	0300h	SPC-3 (no version claimed)
24	1	769	0301h	SPC-3 T10/1416-D revision 7
24	7	775	0307h	SPC-3 T10/1416-D revision 21
24	15	783	030Fh	SPC-3 T10/1416-D revision 22
24	18	786	0312h	SPC-3 T10/1416-D revision 23
24	20	788	0314h	SPC-3 INCITS 408-2005
24	22	790	0316h	SPC-3 ISO/IEC 14776-453
25	0	800	0320h	SBC-2 (no version claimed)
25	2	802	0322h	SBC-2 T10/1417-D revision 5a
25	4	804	0324h	SBC-2 T10/1417-D revision 15
25	27	827	033Bh	SBC-2 T10/1417-D revision 16
25	29	829	033Dh	SBC-2 INCITS 405-2005
25	30	830	033Eh	SBC-2 ISO/IEC 14776-322
26	0	832	0340h	OSD (no version claimed)
26	1	833	0341h	OSD T10/1355-D revision 0
26	2	834	0342h	OSD T10/1355-D revision 7a
26	3	835	0343h	OSD T10/1355-D revision 8
26	4	836	0344h	OSD T10/1355-D revision 9
26	21	853	0355h	OSD T10/1355-D revision 10
26	22	854	0356h	OSD INCITS 400-2004
27	0	864	0360h	SSC-2 (no version claimed)
27	20	884	0374h	SSC-2 T10/1434-D revision 7
27	21	885	0375h	SSC-2 T10/1434-D revision 9
27	29	893	037Dh	SSC-2 INCITS 380-2003

Table E.17 – Version descriptor assignments (part 5 of 21)

Standard Code	Revision Code	Version Descriptor Code		Standard
		decimal	hex	
27	30	894	037Eh	SSC-2 ISO/IEC 14776-342
28	0	896	0380h	BCC (no version claimed)
29	0	928	03A0h	MMC-4 (no version claimed)
29	16	944	03B0h	MMC-4 T10/1545-D revision 5
29	17	945	03B1h	MMC-4 T10/1545-D revision 5a
29	29	957	03BDh	MMC-4 T10/1545-D revision 3
29	30	958	03BEh	MMC-4 T10/1545-D revision 3d
29	31	959	03BFh	MMC-4 INCITS 401-2005
30	0	960	03C0h	ADC (no version claimed)
30	21	981	03D5h	ADC T10/1558-D revision 6
30	22	982	03D6h	ADC T10/1558-D revision 7
30	23	983	03D7h	ADC INCITS 403-2005
31	0	992	03E0h	SES-2 (no version claimed)
31	1	993	03E1h	SES-2 T10/1559-D revision 16
31	7	999	03E7h	SES-2 T10/1559-D revision 19
31	11	1003	03EBh	SES-2 T10/1559-D revision 20
31	16	1008	03F0h	SES-2 INCITS 448-2008
31	18	1010	03F2h	SES-2 ISO/IEC 14776-372
32	0	1024	0400h	SSC-3 (no version claimed)
32	3	1027	0403h	SSC-3 T10/1611-D revision 04a
32	7	1031	0407h	SSC-3 T10/1611-D revision 05
32	9	1033	0409h	SSC-3 INCITS 467-2011
32	11	1035	040Bh	SSC-3 ISO/IEC 14776-333
33	0	1056	0420h	MMC-5 (no version claimed)
33	15	1071	042Fh	MMC-5 T10/1675-D revision 03
33	17	1073	0431h	MMC-5 T10/1675-D revision 03b
33	18	1074	0432h	MMC-5 T10/1675-D revision 04
33	20	1076	0434h	MMC-5 INCITS 430-2007
34	0	1088	0440h	OSD-2 (no version claimed)

Table E.17 – Version descriptor assignments (part 6 of 21)

Standard Code	Revision Code	Version Descriptor Code		Standard
		decimal	hex	
34	4	1092	0444h	OSD-2 T10/1729-D revision 4
34	6	1094	0446h	OSD-2 T10/1729-D revision 5
34	8	1096	0448h	OSD-2 INCITS 458-2011
35	0	1120	0460h	SPC-4 (no version claimed)
35	1	1121	0461h	SPC-4 T10/BSR INCITS 513 revision 16
35	2	1122	0462h	SPC-4 T10/BSR INCITS 513 revision 18
35	3	1123	0463h	SPC-4 T10/BSR INCITS 513 revision 23
35	6	1126	0466h	SPC-4 T10/BSR INCITS 513 revision 36
35	8	1128	0468h	SPC-4 T10/BSR INCITS 513 revision 37
35	9	1129	0469h	SPC-4 T10/BSR INCITS 513 revision 37a
35	12	1132	046Ch	SPC-4 INCITS 513-2015
35	14	1134	046Eh	SPC-4 ISO/IEC 14776-454
36	0	1152	0480h	SMC-3 (no version claimed)
36	2	1154	0482h	SMC-3 T10/1730-D revision 15
36	4	1156	0484h	SMC-3 T10/1730-D revision 16
36	6	1158	0486h	SMC-3 INCITS 484-2012
37	0	1184	04A0h	ADC-2 (no version claimed)
37	7	1191	04A7h	ADC-2 T10/1741-D revision 7
37	10	1194	04AAh	ADC-2 T10/1741-D revision 8
37	12	1196	04ACh	ADC-2 INCITS 441-2008
38	0	1216	04C0h	SBC-3 (no version claimed)
38	3	1219	04C3h	SBC-3 T10/BSR INCITS 514 revision 35
38	5	1221	04C5h	SBC-3 T10/BSR INCITS 514 revision 36
38	8	1224	04C8h	SBC-3 INCITS 514-2014
38	10	1226	04CAh	SBC-3 ISO/IEC 14776-323
39	0	1248	04E0h	MMC-6 (no version claimed)
39	3	1251	04E3h	MMC-6 T10/1836-D revision 02b
39	5	1253	04E5h	MMC-6 T10/1836-D revision 02g
39	6	1254	04E6h	MMC-6 INCITS 468-2010

Table E.17 – Version descriptor assignments (part 7 of 21)

Standard Code	Revision Code	Version Descriptor Code		Standard
		decimal	hex	
39	7	1255	04E7h	MMC-6 INCITS 468-2010 + MMC-6/AM1 INCITS 468-2010/AM 1
40	0	1280	0500h	ADC-3 (no version claimed)
40	2	1282	0502h	ADC-3 T10/1895-D revision 04
40	4	1284	0504h	ADC-3 T10/1895-D revision 05
40	6	1286	0506h	ADC-3 T10/1895-D revision 05a
40	10	1290	050Ah	ADC-3 INCITS 497-2012
41	0	1312	0520h	SSC-4 (no version claimed)
41	3	1315	0523h	SSC-4 T10/BSR INCITS 516 revision 2
41	5	1317	0525h	SSC-4 T10/BSR INCITS 516 revision 3
41	7	1319	0527h	SSC-4 INCITS 516-2013
43	0	1376	0560h	OSD-3 (no version claimed)
44	0	1408	0580h	SES-3 (no version claimed)
44	2	1410	0582h	SES-3 T10/BSR INCITS 518 revision 13
44	4	1412	0584h	SES-3 T10/BSR INCITS 518 revision 14
44	17	1425	0591h	SES-3 INCITS 518-2017
45	0	1440	05A0h	SSC-5 (no version claimed)
45	2	1442	05A2h	SSC-5 BSR INCITS 503-2022
45	11	1451	05ABh	SSC-5 BSR INCITS 503 revision 06
45	15	1455	05AFh	SSC-5 AM1 (no version claimed)
46	0	1472	05C0h	SPC-5 (no version claimed)
46	2	1474	05C2h	SPC-5 INCITS 502-2019
46	11	1483	05CBh	SPC-5 BSR INCITS 502 revision 22
47	0	1504	05E0h	SFSC (no version claimed)
47	3	1507	05E3h	SFSC BSR INCITS 501 revision 01
47	5	1509	05E5h	SFSC BSR INCITS 501 revision 02
47	8	1512	05E8h	SFSC INCITS 501-2016
47	10	1514	05EAh	SFSC ISO/IEC 14776-481
48	0	1536	0600h	SBC-4 (no version claimed)

Table E.17 – Version descriptor assignments (part 8 of 21)

Standard Code	Revision Code	Version Descriptor Code		Standard
		decimal	hex	
48	2	1538	0602h	SBC-4 INCITS 506-2021
48	15	1551	060Fh	SBC-4 BSR INCITS 506 revision 20a
48	16	1552	0610h	SBC-4 BSR INCITS 506 revision 22
49	0	1568	0620h	ZBC (no version claimed)
49	2	1570	0622h	ZBC BSR INCITS 536 revision 02
49	4	1572	0624h	ZBC BSR INCITS 536 revision 05
49	8	1576	0628h	ZBC INCITS 536-2016
49	9	1577	0629h	ZBC AM1 INCITS 536-2016/AM1-2019
50	0	1600	0640h	ADC-4 (no version claimed)
50	2	1602	0642h	ADC-4 INCITS 541-2023
50	11	1611	064Bh	ADC-4 BSR INCITS 541 revision 04
50	12	1612	064Ch	ADC-4 BSR INCITS 541 revision 05
51	0	1632	0660h	ZBC-2 (no version claimed)
51	2	1634	0662h	ZBC-2 INCITS 550-2023
51	11	1643	066Bh	ZBC-2 BSR INCITS 550 revision 13
52	0	1664	0680h	SES-4 (no version claimed)
52	2	1666	0682h	SES-4 INCITS 555-2020
52	15	1679	068Fh	SES-4 BSR INCITS 555 revision 03
52	16	1680	0690h	SES-4 BSR INCITS 555 revision 05
53	0	1696	06A0h	ZBC-3 (no version claimed)
54	0	1728	06C0h	SBC-5 (no version claimed)
54	8	1736	06C8h	SBC-5 SCSI/INCITS 571 revision 07
55	0	1760	06E0h	SPC-6 (no version claimed)
55	5	1765	06E5h	SPC-6 SCSI/INCITS 566 revision 13
55	8	1768	06E8h	SPC-6 SCSI/INCITS 566 revision 12
56	0	1792	0700h	SPC-7 (no version claimed)
57	0	1824	0720h	SBC-6 (no version claimed)
65	0	2080	0820h	SSA-TL2 (no version claimed)
65	27	2107	083Bh	SSA-TL2 T10.1/1147-D revision 05b

Table E.17 – Version descriptor assignments (part 9 of 21)

Standard Code	Revision Code	Version Descriptor Code		Standard
		decimal	hex	
65	28	2108	083Ch	SSA-TL2 INCITS 308-1998
66	0	2112	0840h	SSA-TL1 (no version claimed)
66	27	2139	085Bh	SSA-TL1 T10.1/0989-D revision 10b
66	28	2140	085Ch	SSA-TL1 INCITS 295-1996
67	0	2144	0860h	SSA-S3P (no version claimed)
67	27	2171	087Bh	SSA-S3P T10.1/1051-D revision 05b
67	28	2172	087Ch	SSA-S3P INCITS 309-1998
68	0	2176	0880h	SSA-S2P (no version claimed)
68	27	2203	089Bh	SSA-S2P T10.1/1121-D revision 07b
68	28	2204	089Ch	SSA-S2P INCITS 294-1996
69	0	2208	08A0h	SIP (no version claimed)
69	27	2235	08BBh	SIP T10/0856-D revision 10
69	28	2236	08BCh	SIP INCITS 292-1997
70	0	2240	08C0h	FCP (no version claimed)
70	27	2267	08DBh	FCP T10/0993-D revision 12
70	28	2268	08DCh	FCP INCITS 269-1996
71	0	2272	08E0h	SBP-2 (no version claimed)
71	27	2299	08FBh	SBP-2 T10/1155-D revision 04
71	28	2300	08FCh	SBP-2 INCITS 325-1998
72	0	2304	0900h	FCP-2 (no version claimed)
72	1	2305	0901h	FCP-2 T10/1144-D revision 4
72	21	2325	0915h	FCP-2 T10/1144-D revision 7
72	22	2326	0916h	FCP-2 T10/1144-D revision 7a
72	23	2327	0917h	FCP-2 INCITS 350-2003
72	24	2328	0918h	FCP-2 T10/1144-D revision 8
72	26	2330	091Ah	FCP-2 ISO/IEC 14776-222
73	0	2336	0920h	SST (no version claimed)
73	21	2357	0935h	SST T10/1380-D revision 8b
74	0	2368	0940h	SRP (no version claimed)

Table E.17 – Version descriptor assignments (part 10 of 21)

Standard Code	Revision Code	Version Descriptor Code		Standard
		decimal	hex	
74	20	2388	0954h	SRP T10/1415-D revision 10
74	21	2389	0955h	SRP T10/1415-D revision 16a
74	28	2396	095Ch	SRP INCITS 365-2002
75	0	2400	0960h	iSCSI (no version claimed)
75	1 to 31	2401 to 2431	0961h to 097Fh	iSCSI (versions as described via RFC 7144)
76	0	2432	0980h	SBP-3 (no version claimed)
76	2	2434	0982h	SBP-3 T10/1467-D revision 1f
76	20	2452	0994h	SBP-3 T10/1467-D revision 3
76	26	2458	099Ah	SBP-3 T10/1467-D revision 4
76	27	2459	099Bh	SBP-3 T10/1467-D revision 5
76	28	2460	099Ch	SBP-3 INCITS 375-2004
77	0	2464	09A0h	SRP-2 (no version claimed)
77	28	2492	09BCh	SRP-2 INCITS 551-2019
78	0	2496	09C0h	ADP (no version claimed)
79	0	2528	09E0h	ADT (no version claimed)
79	25	2553	09F9h	ADT T10/1557-D revision 11
79	26	2554	09FAh	ADT T10/1557-D revision 14
79	29	2557	09FDh	ADT INCITS 406-2005
80	0	2560	0A00h	FCP-3 (no version claimed)
80	7	2567	0A07h	FCP-3 T10/1560-D revision 3f
80	15	2575	0A0Fh	FCP-3 T10/1560-D revision 4
80	17	2577	0A11h	FCP-3 INCITS 416-2006
80	28	2588	0A1Ch	FCP-3 ISO/IEC 14776-223
81	0	2592	0A20h	ADT-2 (no version claimed)
81	2	2594	0A22h	ADT-2 T10/1742-D revision 06
81	7	2599	0A27h	ADT-2 T10/1742-D revision 08
81	8	2600	0A28h	ADT-2 T10/1742-D revision 09
81	11	2603	0A2Bh	ADT-2 INCITS 472-2011

Table E.17 – Version descriptor assignments (part 11 of 21)

Standard Code	Revision Code	Version Descriptor Code		Standard
		decimal	hex	
82	0	2624	0A40h	FCP-4 (no version claimed)
82	2	2626	0A42h	FCP-4 T10/1828-D revision 01
82	4	2628	0A44h	FCP-4 T10/1828-D revision 02
82	5	2629	0A45h	FCP-4 T10/1828-D revision 02b
82	6	2630	0A46h	FCP-4 INCITS 481-2011
82	16	2640	0A50h	FCP-4 ISO/IEC 14776-224
82	18	2642	0A52h	FCP-4 AM1 INCITS 481-2011/AM1-2018
83	0	2656	0A60h	ADT-3 (no version claimed)
83	2	2658	0A62h	ADT-3 INCITS 542-2022
83	11	2667	0A6Bh	ADT-3 BSR INCITS 542 revision 03
84	0	2688	0A80h	FCP-5 (no version claimed)
84	2	2690	0A82h	FCP-5 INCITS 563-2023
84	11	2699	0A8Bh	FCP-5 BSR INCITS 563 revision 04
85	0	2720	0AA0h	SPI (no version claimed)
85	25	2745	0AB9h	SPI T10/0855-D revision 15a
85	26	2746	0ABAh	SPI INCITS 253-1995
85	27	2747	0ABBh	SPI T10/0855-D revision 15a with SPI Amnd revision 3a
85	28	2748	0ABCh	SPI INCITS 253-1995 with SPI Amnd INCITS 253/AM1-1998
86	0	2752	0AC0h	Fast-20 (no version claimed)
86	27	2779	0ADBh	Fast-20 T10/1071 revision 06
86	28	2780	0ADCh	Fast-20 INCITS 277-1996
87	0	2784	0AE0h	SPI-2 (no version claimed)
87	27	2811	0AFBh	SPI-2 T10/1142-D revision 20b
87	28	2812	0AFCh	SPI-2 INCITS 302-1999
88	0	2816	0B00h	SPI-3 (no version claimed)
88	24	2840	0B18h	SPI-3 T10/1302-D revision 10
88	25	2841	0B19h	SPI-3 T10/1302-D revision 13a
88	26	2842	0B1Ah	SPI-3 T10/1302-D revision 14

Table E.17 – Version descriptor assignments (part 12 of 21)

Standard Code	Revision Code	Version Descriptor Code		Standard
		decimal	hex	
88	28	2844	0B1Ch	SPI-3 INCITS 336-2000
89	0	2848	0B20h	EPI (no version claimed)
89	27	2875	0B3Bh	EPI T10/1134 revision 16
89	28	2876	0B3Ch	EPI INCITS TR-23 1999
90	0	2880	0B40h	SPI-4 (no version claimed)
90	20	2900	0B54h	SPI-4 T10/1365-D revision 7
90	21	2901	0B55h	SPI-4 T10/1365-D revision 9
90	22	2902	0B56h	SPI-4 INCITS 362-2002
90	25	2905	0B59h	SPI-4 T10/1365-D revision 10
91	0	2912	0B60h	SPI-5 (no version claimed)
91	25	2937	0B79h	SPI-5 T10/1525-D revision 3
91	26	2938	0B7Ah	SPI-5 T10/1525-D revision 5
91	27	2939	0B7Bh	SPI-5 T10/1525-D revision 6
91	28	2940	0B7Ch	SPI-5 INCITS 367-2003
95	0	3040	0BE0h	SAS (no version claimed)
95	1	3041	0BE1h	SAS T10/1562-D revision 01
95	21	3061	0BF5h	SAS T10/1562-D revision 03
95	26	3066	0BFAh	SAS T10/1562-D revision 4
95	27	3067	0BFBh	SAS T10/1562-D revision 04
95	28	3068	0BFCh	SAS T10/1562-D revision 05
95	29	3069	0BFDh	SAS INCITS 376-2003
95	30	3070	0BFEh	SAS ISO/IEC 14776-150
96	0	3072	0C00h	SAS-1.1 (no version claimed)
96	7	3079	0C07h	SAS-1.1 T10/1601-D revision 9
96	15	3087	0C0Fh	SAS-1.1 T10/1601-D revision 10
96	17	3089	0C11h	SAS-1.1 INCITS 417-2006
96	18	3090	0C12h	SAS-1.1 ISO/IEC 14776-151
97	0	3104	0C20h	SAS-2 (no version claimed)
97	3	3107	0C23h	SAS-2 T10/1760-D revision 14

Table E.17 – Version descriptor assignments (part 13 of 21)

Standard Code	Revision Code	Version Descriptor Code		Standard
		decimal	hex	
97	7	3111	0C27h	SAS-2 T10/1760-D revision 15
97	8	3112	0C28h	SAS-2 T10/1760-D revision 16
97	10	3114	0C2Ah	SAS-2 INCITS 457-2010
98	0	3136	0C40h	SAS-2.1 (no version claimed)
98	8	3144	0C48h	SAS-2.1 T10/2125-D revision 04
98	10	3146	0C4Ah	SAS-2.1 T10/2125-D revision 06
98	11	3147	0C4Bh	SAS-2.1 T10/2125-D revision 07
98	14	3150	0C4Eh	SAS-2.1 INCITS 478-2011
98	15	3151	0C4Fh	SAS-2.1 INCITS 478-2011 w/ Amnd 1 INCITS 478/AM1-2014
98	18	3154	0C52h	SAS-2.1 ISO/IEC 14776-153
99	0	3168	0C60h	SAS-3 (no version claimed)
99	3	3171	0C63h	SAS-3 T10/BSR INCITS 519 revision 05a
99	5	3173	0C65h	SAS-3 T10/BSR INCITS 519 revision 06
99	8	3176	0C68h	SAS-3 INCITS 519-2014
99	10	3178	0C6Ah	SAS-3 ISO/IEC 14776-154
100	0	3200	0C80h	SAS-4 (no version claimed)
100	2	3202	0C82h	SAS-4 T10/BSR INCITS 534 revision 08a
100	4	3204	0C84h	SAS-4 T10/BSR INCITS 534 revision 09
100	18	3218	0C92h	SAS-4 INCITS 534-2019
101	0	3232	0CA0h	SAS-4.1 (no version claimed)
101	2	3234	0CA2h	SAS-4.1 INCITS 567-2023
101	15	3247	0CAFh	SAS-4.1 BSR INCITS 567 revision 03
101	16	3248	0CB0h	SAS-4.1 BSR INCITS 567 revision 04
105	0	3360	0D20h	FC-PH (no version claimed)
105	27	3387	0D3Bh	FC-PH INCITS 230-1994
105	28	3388	0D3Ch	FC-PH INCITS 230-1994 with Amnd 1 INCITS 230/AM1-1996
106	0	3392	0D40h	FC-AL (no version claimed)
106	28	3420	0D5Ch	FC-AL INCITS 272-1996

Table E.17 – Version descriptor assignments (part 14 of 21)

Standard Code	Revision Code	Version Descriptor Code		Standard
		decimal	hex	
107	0	3424	0D60h	FC-AL-2 (no version claimed)
107	1	3425	0D61h	FC-AL-2 T11/1133-D revision 7.0
107	3	3427	0D63h	FC-AL-2 INCITS 332-1999 with AM1-2003 & AM2-2006
107	4	3428	0D64h	FC-AL-2 INCITS 332-1999 with Amnd 2 AM2-2006
107	5	3429	0D65h	FC-AL-2 ISO/IEC 14165-122 with AM1 & AM2
107	28	3452	0D7Ch	FC-AL-2 INCITS 332-1999
107	29	3453	0D7Dh	FC-AL-2 INCITS 332-1999 with Amnd 1 AM1-2003
108	0	3456	0D80h	FC-PH-3 (no version claimed)
108	28	3484	0D9Ch	FC-PH-3 INCITS 303-1998
109	0	3488	0DA0h	FC-FS (no version claimed)
109	23	3511	0DB7h	FC-FS T11/1331-D revision 1.2
109	24	3512	0DB8h	FC-FS T11/1331-D revision 1.7
109	28	3516	0DBCh	FC-FS INCITS 373-2003
109	29	3517	0DBDh	FC-FS ISO/IEC 14165-251
110	0	3520	0DC0h	FC-PI (no version claimed)
110	28	3548	0DDCh	FC-PI INCITS 352-2002
111	0	3552	0DE0h	FC-PI-2 (no version claimed)
111	2	3554	0DE2h	FC-PI-2 T11/1506-D revision 5.0
111	4	3556	0DE4h	FC-PI-2 INCITS 404-2006
112	0	3584	0E00h	FC-FS-2 (no version claimed)
112	2	3586	0E02h	FC-FS-2 INCITS 242-2007
112	3	3587	0E03h	FC-FS-2 INCITS 242-2007 with AM1 INCITS 242/AM1-2007
113	0	3616	0E20h	FC-LS (no version claimed)
113	1	3617	0E21h	FC-LS T11/1620-D revision 1.62
113	9	3625	0E29h	FC-LS INCITS 433-2007
114	0	3648	0E40h	FC-SP (no version claimed)
114	2	3650	0E42h	FC-SP T11/1570-D revision 1.6
114	5	3653	0E45h	FC-SP INCITS 426-2007

Table E.17 – Version descriptor assignments (part 15 of 21)

Standard Code	Revision Code	Version Descriptor Code		Standard
		decimal	hex	
115	0	3680	0E60h	FC-PI-3 (no version claimed)
115	2	3682	0E62h	FC-PI-3 T11/1625-D revision 2.0
115	8	3688	0E68h	FC-PI-3 T11/1625-D revision 2.1
115	10	3690	0E6Ah	FC-PI-3 T11/1625-D revision 4.0
115	14	3694	0E6Eh	FC-PI-3 INCITS 460-2011
116	0	3712	0E80h	FC-PI-4 (no version claimed)
116	2	3714	0E82h	FC-PI-4 T11/1647-D revision 8.0
116	8	3720	0E88h	FC-PI-4 INCITS 450-2009
117	0	3744	0EA0h	FC 10GFC (no version claimed)
117	2	3746	0EA2h	FC 10GFC INCITS 364-2003
117	3	3747	0EA3h	FC 10GFC ISO/IEC 14165-116
117	5	3749	0EA5h	FC 10GFC ISO/IEC 14165-116 with AM1
117	6	3750	0EA6h	FC 10GFC INCITS 364-2003 with AM1 INCITS 364/AM1-2007
118	0	3776	0EC0h	FC-SP-2 (no version claimed)
119	0	3808	0EE0h	FC-FS-3 (no version claimed)
119	2	3810	0EE2h	FC-FS-3 T11/1861-D revision 0.9
119	7	3815	0EE7h	FC-FS-3 T11/1861-D revision 1.0
119	9	3817	0EE9h	FC-FS-3 T11/1861-D revision 1.10
119	11	3819	0EEBh	FC-FS-3 INCITS 470-2011
120	0	3840	0F00h	FC-LS-2 (no version claimed)
120	3	3843	0F03h	FC-LS-2 T11/2103-D revision 2.11
120	5	3845	0F05h	FC-LS-2 T11/2103-D revision 2.21
120	7	3847	0F07h	FC-LS-2 INCITS 477-2011
121	0	3872	0F20h	FC-PI-5 (no version claimed)
121	7	3879	0F27h	FC-PI-5 T11/2118-D revision 2.00
121	8	3880	0F28h	FC-PI-5 T11/2118-D revision 3.00
121	10	3882	0F2Ah	FC-PI-5 T11/2118-D revision 6.00
121	11	3883	0F2Bh	FC-PI-5 T11/2118-D revision 6.10

Table E.17 – Version descriptor assignments (part 16 of 21)

Standard Code	Revision Code	Version Descriptor Code		Standard
		decimal	hex	
121	14	3886	0F2Eh	FC-PI-5 INCITS 479-2011
122	0	3904	0F40h	FC-PI-6 (no version claimed)
123	0	3936	0F60h	FC-FS-4 (no version claimed)
124	0	3968	0F80h	FC-LS-3 (no version claimed)
149	0	4768	12A0h	FC-SCM (no version claimed)
149	3	4771	12A3h	FC-SCM T11/1824DT revision 1.0
149	5	4773	12A5h	FC-SCM T11/1824DT revision 1.1
149	7	4775	12A7h	FC-SCM T11/1824DT revision 1.4
149	10	4778	12AAh	FC-SCM INCITS TR-47 2012
150	0	4800	12C0h	FC-DA-2 (no version claimed)
150	3	4803	12C3h	FC-DA-2 T11/1870DT revision 1.04
150	5	4805	12C5h	FC-DA-2 T11/1870DT revision 1.06
150	9	4809	12C9h	FC-DA-2 INCITS TR-49 2012
151	0	4832	12E0h	FC-DA (no version claimed)
151	2	4834	12E2h	FC-DA T11/1513-DT revision 3.1
151	8	4840	12E8h	FC-DA INCITS TR-36 2004
151	9	4841	12E9h	FC-DA ISO/IEC 14165-341
152	0	4864	1300h	FC-Tape (no version claimed)
152	1	4865	1301h	FC-Tape T11/1315 revision 1.16
152	27	4891	131Bh	FC-Tape T11/1315 revision 1.17
152	28	4892	131Ch	FC-Tape INCITS TR-24 1999
153	0	4896	1320h	FC-FLA (no version claimed)
153	27	4923	133Bh	FC-FLA T11/1235 revision 7
153	28	4924	133Ch	FC-FLA INCITS TR-20 1998
154	0	4928	1340h	FC-PLDA (no version claimed)
154	27	4955	135Bh	FC-PLDA T11/1162 revision 2.1
154	28	4956	135Ch	FC-PLDA INCITS TR-19 1998
155	0	4960	1360h	SSA-PH2 (no version claimed)
155	27	4987	137Bh	SSA-PH2 T10.1/1145-D revision 09c

Table E.17 – Version descriptor assignments (part 17 of 21)

Standard Code	Revision Code	Version Descriptor Code		Standard
		decimal	hex	
155	28	4988	137Ch	SSA-PH2 INCITS 293-1996
156	0	4992	1380h	SSA-PH3 (no version claimed)
156	27	5019	139Bh	SSA-PH3 T10.1/1146-D revision 05b
156	28	5020	139Ch	SSA-PH3 INCITS 307-1998
165	0	5280	14A0h	IEEE 1394 (no version claimed)
165	29	5309	14BDh	IEEE 1394-1995
166	0	5312	14C0h	IEEE 1394a (no version claimed)
167	0	5344	14E0h	IEEE 1394b (no version claimed)
175	0	5600	15E0h	ATA/ATAPI-6 (no version claimed)
175	29	5629	15FDh	ATA/ATAPI-6 INCITS 361-2002
176	0	5632	1600h	ATA/ATAPI-7 (no version claimed)
176	2	5634	1602h	ATA/ATAPI-7 T13/1532-D revision 3
176	28	5660	161Ch	ATA/ATAPI-7 INCITS 397-2005
176	30	5662	161Eh	ATA/ATAPI-7 ISO/IEC 24739
177	0	5664	1620h	ATA/ATAPI-8 ATA8-AAM (no version claimed)
177	1	5665	1621h	ATA/ATAPI-8 ATA8-APT Parallel Transport (no version claimed)
177	2	5666	1622h	ATA/ATAPI-8 ATA8-AST Serial Transport (no version claimed)
177	3	5667	1623h	ATA/ATAPI-8 ATA8-ACS ATA/ATAPI Command Set (no version claimed)
177	8	5672	1628h	ATA/ATAPI-8 ATA8-AAM INCITS 451-2008
177	10	5674	162Ah	ATA/ATAPI-8 ATA8-ACS INCITS 452-2009 w/ Amendment 1
177	16	5680	1630h	ATA/ATAPI-8 ATA8-ACS ATA/ATAPI Command Set ISO/IEC 17760-101
185	8	5928	1728h	Universal Serial Bus Specification, Revision 1.1
185	9	5929	1729h	Universal Serial Bus Specification, Revision 2.0
185	10	5930	172Ah	Universal Serial Bus 3.2 Specification Revision 1.0
185	11	5931	172Bh	Universal Serial Bus 4 Specification Version 1.0
185	12	5932	172Ch	Universal Serial Bus 4 Specification Version 2.0

Table E.17 – Version descriptor assignments (part 18 of 21)

Standard Code	Revision Code	Version Descriptor Code		Standard
		decimal	hex	
185	16	5936	1730h	USB Mass Storage Class Bulk-Only Transport, Revision 1.0
186	0	5952	1740h	UAS (no version claimed)
186	3	5955	1743h	UAS T10/2095-D revision 02
186	7	5959	1747h	UAS T10/2095-D revision 04
186	8	5960	1748h	UAS INCITS 471-2010
186	9	5961	1749h	UAS ISO/IEC 14776-251
187	1	5985	1761h	ACS-2 (no version claimed)
187	2	5986	1762h	ACS-2 INCITS 482-2013
187	5	5989	1765h	ACS-3 (no version claimed)
187	6	5990	1766h	ACS-3 INCITS 522-2014
187	7	5991	1767h	ACS-4 INCITS 529-2018
187	8	5992	1768h	ACS-4 (no version claimed)
187	9	5993	1769h	ACS-5 (no version claimed)
187	10	5994	176Ah	ACS-5 INCITS 558-2021
187	14	5998	176Eh	ACS-6 (no version claimed)
187	24	6008	1778h	ACS-2 ISO/IEC 17760-102
187	25	6009	1779h	ACS-3 ISO/IEC 17760-103
187	27	6011	177Bh	ACS-5 ISO/IEC 17760-105
188	0	6016	1780h	UAS-2 (no version claimed)
189	3	6051	17A3h	ZAC (no version claimed)
189	4	6052	17A4h	ZAC INCITS 537-2016
189	5	6053	17A5h	ZAC-2 INCITS 549-2022
189	6	6054	17A6h	ZAC-2 (no version claimed)
189	7	6055	17A7h	ZAC-3 (no version claimed)
189	28	6076	17BCh	ZAC AM1 INCITS 537-2016/AM1-2019
190	0	6080	17C0h	UAS-3 (no version claimed)
190	2	6082	17C2h	UAS-3 INCITS 572-2021
190	5	6085	17C5h	UAS-3 BSR INCITS 572 revision 05
192	7	6151	1807h	UAS-3 ISO/IEC 14776-253

Table E.17 – Version descriptor assignments (part 19 of 21)

Standard Code	Revision Code	Version Descriptor Code		Standard
		decimal	hex	
245	0	7840	1EA0h	SAT (no version claimed)
245	7	7847	1EA7h	SAT T10/1711-D revision 8
245	11	7851	1EABh	SAT T10/1711-D revision 9
245	13	7853	1EADh	SAT INCITS 431-2007
246	0	7872	1EC0h	SAT-2 (no version claimed)
246	4	7876	1EC4h	SAT-2 T10/1826-D revision 06
246	8	7880	1EC8h	SAT-2 T10/1826-D revision 09
246	10	7882	1ECAh	SAT-2 INCITS 465-2010
247	0	7904	1EE0h	SAT-3 (no version claimed)
247	2	7906	1EE2h	SAT-3 T10/BSR INCITS 517 revision 4
247	4	7908	1EE4h	SAT-3 T10/BSR INCITS 517 revision 7
247	8	7912	1EE8h	SAT-3 INCITS 517-2015
248	0	7936	1F00h	SAT-4 (no version claimed)
248	2	7938	1F02h	SAT-4 T10/BSR INCITS 491 revision 5
248	4	7940	1F04h	SAT-4 T10/BSR INCITS 491 revision 6
248	12	7948	1F0Ch	SAT-4 INCITS 491-2018
249	0	7968	1F20h	SAT-5 (no version claimed)
249	2	7970	1F22h	SAT-5 INCITS 557-2023
249	5	7973	1F25h	SAT-5 BSR INCITS 577 revision 10
250	0	8000	1F40h	SAT-6 (no version claimed)
251	0	8032	1F60h	SNT (no version claimed)
261	0	8352	20A0h	SPL (no version claimed)
261	3	8355	20A3h	SPL T10/2124-D revision 6a
261	5	8357	20A5h	SPL T10/2124-D revision 7
261	7	8359	20A7h	SPL INCITS 476-2011
261	8	8360	20A8h	SPL INCITS 476-2011 + SPL AM1 INCITS 476/AM1 2012
261	10	8362	20AAh	SPL ISO/IEC 14776-261
262	0	8384	20C0h	SPL-2 (no version claimed)
262	2	8386	20C2h	SPL-2 T10/BSR INCITS 505 revision 4

Table E.17 – Version descriptor assignments (part 20 of 21)

Standard Code	Revision Code	Version Descriptor Code		Standard
		decimal	hex	
262	4	8388	20C4h	SPL-2 T10/BSR INCITS 505 revision 5
262	8	8392	20C8h	SPL-2 INCITS 505-2013
262	9	8393	20C9h	SPL-2 ISO/IEC 14776-262
263	0	8416	20E0h	SPL-3 (no version claimed)
263	4	8420	20E4h	SPL-3 T10/BSR INCITS 492 revision 6
263	6	8422	20E6h	SPL-3 T10/BSR INCITS 492 revision 7
263	8	8424	20E8h	SPL-3 INCITS 492-2015
263	9	8425	20E9h	SPL-3 ISO/IEC 14776-263
264	0	8448	2100h	SPL-4 (no version claimed)
264	2	8450	2102h	SPL-4 T10/BSR INCITS 538 revision 08a
264	4	8452	2104h	SPL-4 T10/BSR INCITS 538 revision 10
264	5	8453	2105h	SPL-4 T10/BSR INCITS 538 revision 11
264	7	8455	2107h	SPL-4 T10/BSR INCITS 538 revision 13
264	16	8464	2110h	SPL-4 INCITS 538-2018
265	0	8480	2120h	SPL-5 (no version claimed)
265	2	8482	2122h	SPL-5 INCITS 554-2023
265	14	8494	212Eh	SPL-5 BSR INCITS 554 revision 14
265	15	8495	212Fh	SPL-5 BSR INCITS 554 revision 15
271	0	8672	21E0h	SOP (no version claimed)
271	4	8676	21E4h	SOP T10/BSR INCITS 489 revision 4
271	6	8678	21E6h	SOP T10/BSR INCITS 489 revision 5
271	8	8680	21E8h	SOP INCITS 489-2014
272	0	8704	2200h	PQI (no version claimed)
272	4	8708	2204h	PQI T10/BSR INCITS 490 revision 6
272	6	8710	2206h	PQI T10/BSR INCITS 490 revision 7
272	8	8712	2208h	PQI INCITS 490-2014
273	0	8736	2220h	SOP-2 (no draft published)
274	0	8768	2240h	PQI-2 (no version claimed)
274	2	8770	2242h	PQI-2 T10/BSR INCITS 507 revision 01

Table E.17 – Version descriptor assignments (part 21 of 21)

Standard Code	Revision Code	Version Descriptor Code		Standard
		decimal	hex	
274	4	8772	2244h	PQI-2 INCITS 507-2016
291	0	9312	2460h	ADT-4 (no version claimed)
291	11	9323	246Bh	ADT-4 INCITS 541-2023
2046	0	65472	FFC0h	IEEE 1667 (no version claimed)
2046	1	65473	FFC1h	IEEE 1667-2006
2046	2	65474	FFC2h	IEEE 1667-2009
2046	3	65475	FFC3h	IEEE 1667-2015
2046	4	65476	FFC4h	IEEE 1667-2018

Table E.18 shows the guidelines used by T10 when selecting a coded value for a standard.

Table E.18 – Standard code value guidelines (part 1 of 6)

Standard Code	Standard or standards family
0	Version Descriptor Not Supported
1 to 8	Architecture Model
1	SAM
2	SAM-2
3	SAM-3
4	SAM-4
5	SAM-5
6	SAM-6
9 to 64	Command Set
9	SPC
10	MMC
11	SCC
12	SBC
13	SMC
14	SES
15	SCC-2
16	SSC
17	RBC

Table E.18 – Standard code value guidelines (part 2 of 6)

Standard Code	Standard or standards family
18	MMC-2
19	SPC-2
20	OCRW
21	MMC-3
22	obsolete
23	SMC-2
24	SPC-3
25	SBC-2
26	OSD
27	SSC-2
28	obsolete
29	MMC-4
30	ADC
31	SES-2
32	SSC-3
33	MMC-5
34	OSD-2
35	SPC-4
36	SMC-3
37	ADC-2
38	SBC-3
39	MMC-6
40	ADC-3
41	SSC-4
43	OSD-3
44	SES-3
45	SSC-5
46	SPC-5
47	SFSC
48	SBC-4
49	ZBC

Table E.18 – Standard code value guidelines (part 3 of 6)

Standard Code	Standard or standards family
50	ADC-4
51	ZBC-2
52	SES-4
53	ZBC-3
54	SBC-5
55	SPC-6
56	SPC-7
57	SBC-6
65 to 84	Physical Mapping Protocol (group 1)
65	SSA-TL2
66	SSA-TL1
67	SSA-S3P
68	SSA-S2P
69	SIP
70	FCP
71	SBP-2
72	FCP-2
73	SST
74	SRP
75	iSCSI
76	SBP-3
77	SRP-2
78	ADP
79	ADT
80	FCP-3
81	ADT-2
82	FCP-4
83	ADT-3
84	FCP-5
	more at 291

Table E.18 – Standard code value guidelines (part 4 of 6)

Standard Code	Standard or standards family
85 to 94	Parallel SCSI Physical
85	SPI and SPI Amendment
86	Fast-20
87	SPI-2
88	SPI-3
89	EPI
90	SPI-4
91	SPI-5
95 to 104	Serial Attached SCSI
95	SAS
96	SAS-1.1
97	SAS-2
98	SAS-2.1
99	SAS-3
100	SAS-4
101	SAS-4.1
105 to 154	Fibre Channel (group 1)
105	FC-PH and FC-PH Amendment
106	FC-AL
107	FC-AL-2
108	FC-PH-3
109	FC-FS
110	FC-PI
111	FC-PI-2
112	FC-FS-2
113	FC-LS
114	FC-SP
115	FC-PI-3
116	FC-PI-4
117	FC 10GFC
118	FC-SP-2

Table E.18 – Standard code value guidelines (part 5 of 6)

Standard Code	Standard or standards family
119	FC-FS-3
120	FC-LS-2
121	FC-PI-5
122	FC-PI-6
123	FC-FS-4
124	FC-LS-3
149	FC-SCM
150	FC-DA-2
151	FC-DA
152	FC-Tape
153	FC-FLA
154	FC-PLDA
	more at 311
155 to 164	SSA
155	SSA-PH2
156	SSA-PH3
165 to 174	IEEE 1394
165	IEEE 1394:1995
166	IEEE 1394a
167	IEEE 1394b
175 to 200	ATAPI & USB
175	ATA/ATAPI-6
176	ATA/ATAPI-7
177	ATA/ATAPI-8
185	USB
186	UAS
187	ACS-x
188	obsolete
189	ZAC-x
190	UAS-3
201 to 224	Networking

Table E.18 – Standard code value guidelines (part 6 of 6)

Standard Code	Standard or standards family
225 to 244	ATM
245 to 260	Translators
245	SAT
246	SAT-2
247	SAT-3
248	SAT-4
249	SAT-5
250	SAT-6
251	SNT
261 to 270	SAS Transport Protocols
261	SPL
262	SPL-2
263	SPL-3
264	SPL-4
265	SPL-5
271 to 290	SCSI over PCI Express Transport Protocols
271	SOP
272	PQI
273	obsolete
274	PQI-2
291 to 310	Physical Mapping Protocol (group 2)
291	ADT-4
311 to 350	Fibre Channel (group 2)
351 to 2045	Reserved for Expansion
2046	IEEE 1667
2047	Reserved

E.10 T10 IEEE binary identifiers

The IEEE binary identifiers assigned to T10 standards are shown in table E.19.

Table E.19 – IEEE binary identifiers assigned by T10

IEEE Binary Identifier	T10 Standard
0060 9E01 03E0h	SBP (obsolete)
0060 9E01 0483h	SBP-2
0060 9E01 04D8h	SPC-2
0060 9E01 05BBh	SBP-3
0060 9E01 0800h	SRP revision 10
0060 9E01 0801h	ANSI SRP

Annex F
(informative)

T10 vendor identification

This annex contains the list of T10 vendor identifications (see table F.1) as of the date of this document. The purpose of this list is to help avoid redundant usage of T10 vendor identifications. Technical Committee T10 of Accredited Standards Committee INCITS maintains an informal list of T10 vendor identifications currently in use. The T10 web site, http://www.t10.org, provides a convenient means to request an identification code. If problems are encountered using the T10 web site, please contact the chairman of T10 prior to using a new T10 vendor identification to avoid conflicts.

The information in this annex was complete and accurate at the time of publication. However, the information is subject to change. Technical Committee T10 of INCITS maintains an electronic copy of this information on its website (http://www.t10.org/). In the event that the T10 website is no longer active, access may be possible via the INCITS website (http://www.incits.org), the ANSI website (http://www.ansi.org), the IEC website (http://www.iec.ch/), the ISO website (http://www.iso.ch/), or the ISO/IEC JTC 1 website (http://www.jtc1.org/).

Table F.1 – T10 vendor identification list (part 1 of 19)

ID	Organization
3nhtech	3NH Technologies
3PARdata	3PARdata, Inc. (now HPE)
A-Max	A-Max Technology Co., Ltd
ABSOLUTE	Absolute Analysis
ABT	Angelbird Technologies GmbH
ACARD	ACARD Technology Corp.
Accusys	Accusys INC.
Acer	Acer, Inc.
ACL	Automated Cartridge Librarys, Inc.
Actifio	Actifio
Acuid	Acuid Corporation Ltd.
AcuLab	AcuLab, Inc. (Tulsa, OK)
ADAPTEC	Adaptec (now part of Microchip Technology Inc.)
ADIC	Advanced Digital Information Corporation
ADSI	Adaptive Data Systems, Inc. (a Western Digital subsidiary)
ADTX	ADTX Co., Ltd.
ADVA	ADVA Optical Networking AG
AEM	AEM Performance Electronics
AERODISK	AERO DISK LLC
AERONICS	Aeronics, Inc.
AGFA	AGFA
AGILACK	Agilack
Agilent	Agilent Technologies
AIC	Advanced Industrial Computer, Inc.
AIPTEK	AIPTEK International Inc.
Aktiv	Aktiv Company
Alcohol	Alcohol Soft
ALCOR	Alcor Micro, Corp.
AMCC	Applied Micro Circuits Corporation

Table F.1 – T10 vendor identification list (part 2 of 19)

ID	Organization
AMCODYNE	Amcodyne
Amgeon	Amgeon LLC
AMI	American Megatrends, Inc.
AMPEX	Ampex Data Systems
Amphenol	Amphenol
Amtl	Tenlon Technology Co.,Ltd
Analogue	Analogue
ANAMATIC	Anamartic Limited (England)
Ancor	Ancor Communications, Inc.
ANCOT	ANCOT Corp.
ANDATACO	Andataco (now nStor)
andiamo	Andiamo Systems, Inc.
ANOBIT	Anobit
ANRITSU	Anritsu Corporation
ANTONIO	Antonio Precise Products Manufactory Ltd.
AoT	Art of Technology AG
APPLE	Apple Computer, Inc.
ARCHIVE	Archive
ARDENCE	Ardence Inc
Areca	Areca Technology Corporation
Arena	MaxTronic International Co., Ltd.
Argent	Argent Data Systems, Inc.
ARIO	Ario Data Networks, Inc.
ARISTOS	Aristos Logic Corp. (now part of Microchip Technology Inc.)
ARK	ARK Research Corporation
ARL:UT@A	Applied Research Laboratories : University of Texas at Austin
ARTECON	Artecon Inc. (Obs. - now Dot Hill)
Artistic	Artistic Licence (UK) Ltd
ARTON	Arton Int.
ASACA	ASACA Corp.
ASC	Advanced Storage Concepts, Inc.
ASPEN	Aspen Peripherals
AST	AST Research
ASTEK	Astek Corporation
ASTK	Alcatel STK A/S
AStor	AccelStor, Inc.
ASTRO	ASTRODESIGN,Inc.
ASTUTE	Astute Networks, Inc.
AT&T	AT&T
ATA	SCSI / ATA Translator Software (Organization Not Specified)
ATARI	Atari Corporation
ATech	ATech electronics
ATG CYG	ATG Cygnet Inc.
ATL	Quantum|ATL Products
ATTO	ATTO Technology Inc.
ATTRATEC	Attratech Ltd liab. Co
ATX	Alphatronix

Table F.1 – T10 vendor identification list (part 3 of 19)

ID	Organization
Audio3	Audio3 Ltd.
AURASEN	Aurasen Limited
Avago	Avago Technologies (now Broadcom, Inc.)
AVC	AVC Technology Ltd
AVIDVIDR	AVID Technologies, Inc.
AVR	Advanced Vision Research
Axcient	Axcient
AXSTOR	AXSTOR
Axxana	Axxana Ltd.
B*BRIDGE	Blockbridge Networks LLC
BALLARD	Ballard Synergy Corp.
Barco	Barco
BAROMTEC	Barom Technologies Co., Ltd.
Bassett	Bassett Electronic Systems Ltd
BAYHUB	BayHub Technology Ltd.
BC Hydro	BC Hydro
BDT	BDT AG
BECEEM	Beceem Communications, Inc
BENQ	BENQ Corporation.
BERGSWD	Berg Software Design
BEZIER	Bezier Systems, Inc.
BHTi	Breece Hill Technologies
biodata	Biodata Devices SL
BIOS	BIOS Corporation
BIR	Bio-Imaging Research, Inc.
BiT	BiT Microsystems (obsolete, new ID: BITMICRO)
BITMICRO	BiT Microsystems, Inc.
Blendlgy	Blendology Limited
BLKGUARD	BlockGuard Ltd
BLOOMBAS	Bloombase
BlueArc	BlueArc Corporation
bluecog	bluecog
BME-HVT	Broadband Infocommunicatons and Electromagnetic Theory Department
BNCHMARK	Benchmark Tape Systems Corporation
Bosch	Robert Bosch GmbH
Botman	Botmanfamily Electronics
BoxHill	Box Hill Systems Corporation (Obs. - now Dot Hill)
BRDGWRKS	Bridgeworks Ltd.
BREA	BREA Technologies, Inc.
BREECE	Breece Hill LLC
BreqLabs	BreqLabs Inc.
Broadcom	Broadcom Inc.
BROCADE	Brocade Communications Systems, Incorporated (now Broadcom, Inc.)
BUFFALO	BUFFALO INC.
BULL	Bull Peripherals Corp.
BUSLOGIC	BusLogic Inc.
BVIRTUAL	B-Virtual N.V.

Table F.1 – T10 vendor identification list (part 4 of 19)

ID	Organization
CACHEIO	CacheIO LLC
CalComp	CalComp, A Lockheed Company
CALCULEX	CALCULEX, Inc.
CALIPER	Caliper (California Peripheral Corp.)
CAMBEX	Cambex Corporation
CAMEOSYS	Cameo Systems Inc.
CANDERA	Candera Inc.
CAPTION	CAPTION BANK
CAST	Advanced Storage Tech
CATALYST	Catalyst Enterprises
CCDISK	iSCSI Cake
CDC	Control Data or MPI
CDP	Columbia Data Products
CDS	Cirrus Data Solutions, Inc.
ceacent	Shenzhen Jiahua Zhongli Technology Co.
Celsia	A M Bromley Limited
CenData	Central Data Corporation
Cereva	Cereva Networks Inc.
CERTANCE	Certance
Chantil	Chantil Technology
CHEROKEE	Cherokee Data Systems
CHINON	Chinon
CHPSYSTM	Cheapie Systems
CHRISTMA	Christmann Informationstechnik + Medien GmbH & Co KG
CIE&YED	YE Data, C.Itoh Electric Corp.
CIPHER	Cipher Data Products
Ciprico	Ciprico, Inc.
CIRRUSL	Cirrus Logic Inc.
CISCO	Cisco Systems, Inc.
CLEARSKY	ClearSky Data, Inc.
CLOVERLF	Cloverleaf Communications, Inc
CLS	Celestica
CMD	CMD Technology Inc.
CMTechno	CMTech
CNGR SFW	Congruent Software, Inc.
CNSi	Chaparral Network Storage, Inc.
CNT	Computer Network Technology (now Broadcom, Inc.)
COBY	Coby Electronics Corporation, USA
COGITO	Cogito
COMAY	Corerise Electronics
COMPAQ	Compaq Computer Corporation (now HPE)
COMPELNT	Compellent Technologies, Inc. (now Dell)
COMPORT	Comport Corp.
COMPSIG	Computer Signal Corporation
COMPTEX	Comptex Pty Limited
CONNER	Conner Peripherals
Control	Controlant ehf.

Table F.1 – T10 vendor identification list (part 5 of 19)

ID	Organization
COPANSYS	COPAN SYSTEMS INC (now HPE)
CORAID	Coraid, Inc
CORE	Core International, Inc.
CORERISE	Corerise Electronics
COVOTE	Covote GmbH & Co KG
COWON	COWON SYSTEMS, Inc.
CPL	Cross Products Ltd
CPU TECH	CPU Technology, Inc.
CREO	Creo Products Inc.
CROSFLD	Crosfield Electronics (now FujiFilm Electonic Imaging Ltd)
CROSSRDS	Crossroads Systems, Inc.
crosswlk	Crosswalk, Inc.
CSCOVRTS	Cisco - Veritas
CSM, INC	Computer SM, Inc.
CULTECH	Cultech Trading Ltd
Cunuqui	CUNUQUI SLU
CYBERNET	Cybernetics
Cygnal	Dekimo
CYPRESS	Cypress Semiconductor Corp.
D Bit	Digby's Bitpile, Inc. DBA D Bit
DALSEMI	Dallas Semiconductor
DANEELEC	Dane-Elec
DANGER	Danger Inc.
DAT-MG	DAT Manufacturers Group
Data Com	Data Com Information Systems Pty. Ltd.
DATABOOK	Databook, Inc.
DATACOPY	Datacopy Corp.
DataCore	DataCore Software Corporation
DataG	DataGravity
DATAPT	Datapoint Corp.
DATARAM	Dataram Corporation
DATC	Datum Champion Technology Co., Ltd
DAVIS	Daviscomms (S) Pte Ltd
DCS	ShenZhen DCS Group Co.,Ltd
DDN	DataDirect Networks, Inc.
DDRDRIVE	DDRdrive LLC
DE	Dimension Engineering LLC
DEC	Digital Equipment Corporation (now HPE)
DEI	Digital Engineering, Inc.
DELL	Dell, Inc.
Dell(tm)	Dell, Inc
DellEMC	Dell EMC
DELPHI	Delphi Data Div. of Sparks Industries, Inc.
DENON	Denon/Nippon Columbia
DenOptix	DenOptix, Inc.
DEST	DEST Corp.
DFC	DavioFranke.com

Table F.1 – T10 vendor identification list (part 6 of 19)

ID	Organization
DFT	Data Fault Tolerance System CO.,LTD.
DGC	Data General Corp.
DIGIDATA	Digi-Data Corporation
DigiIntl	Digi International
Digital	Digital Equipment Corporation (now HPE)
DILOG	Distributed Logic Corp.
DISC	Document Imaging Systems Corp.
DiscSoft	Disc Soft Ltd
DLNET	Driveline
DNS	Data and Network Security
DNUK	Digital Networks Uk Ltd
DOSTMANN	Dostmann Electronic GmbH
DotHill	Dot Hill Systems Corp.
DP	Dell, Inc.
DPT	Distributed Processing Technology
Drewtech	Drew Technologies, Inc.
DROBO	Data Robotics, Inc.
DSC	DigitalStream Corporation
DSI	Data Spectrum, Inc.
DSM	Deterner Steuerungs- und Maschinenbau GmbH & Co.
DSNET	Cleversafe, Inc.
DT	Double-Take Software, INC.
DTC QUME	Data Technology Qume
DXIMAGIN	DX Imaging
E-Motion	E-Motion LLC
EARTHLAB	EarthLabs
EarthLCD	Earth Computer Technologies, Inc.
ECCS	ECCS, Inc.
ECMA	European Computer Manufacturers Association
EDS	Embedded Data Systems
EHUALU	Beijing E-Hualu Information Technology Co.
EIM	InfoCore
ELE Intl	ELE International
ELEGANT	Elegant Invention, LLC
Elektron	Elektron Music Machines MAV AB
elipsan	Elipsan UK Ltd.
Elms	Elms Systems Corporation
ELSE	ELSE Ltd.
ELSEC	Littlemore Scientific
EMASS	EMASS, Inc.
EMC	EMC Corp.
EMiT	EMiT Conception Eletronique
EMTEC	EMTEC Magnetics
EMULEX	Emulex (now Broadcom, Inc.)
ENERGY-B	Energybeam Corporation
ENGENIO	Engenio Information Technologies, Inc.
ENMOTUS	Enmotus Inc

Table F.1 – T10 vendor identification list (part 7 of 19)

ID	Organization
Entacore	Entacore
EPOS	EPOS Technologies Ltd.
EPSON	Epson
EQLOGIC	EqualLogic
Eris/RSI	RSI Systems, Inc.
ETERNE	EterneData Technology Co.,Ltd.(China PRC.)
EuroLogc	Eurologic Systems Limited (now part of Microchip Technology Inc.)
evolve	Evolution Technologies, Inc
EXABYTE	Exabyte Corp. (now part of Tandberg)
EXATEL	Exatelecom Co., Ltd.
EXAVIO	Exavio, Inc.
Exsequi	Exsequi Ltd
Exxotest	Annecy Electronique
FAIRHAVN	Fairhaven Health, LLC
FALCON	FalconStor, Inc.
FDS	Formation Data Systems
FENSTER	Fenster Software
FFEILTD	FujiFilm Electonic Imaging Ltd
Fibxn	Fiberxon, Inc.
FID	First International Digital, Inc.
FILENET	FileNet Corp.
FirmFact	Firmware Factory Ltd
FLYFISH	Flyfish Technologies
FOXCONN	Foxconn Technology Group
FRAMDRV	FRAMEDRIVE Corp.
FREECION	Nable Communications, Inc.
FRESHDTK	FreshDetect GmbH
FSC	Fujitsu Siemens Computers
FTPL	Frontline Technologies Pte Ltd
FUJI	Fuji Electric Co., Ltd. (Japan)
FUJIFILM	Fuji Photo Film, Co., Ltd.
FUJITSU	Fujitsu
FUNAI	Funai Electric Co., Ltd.
FUSIONIO	Fusion-io Inc.
FUTURED	Future Domain Corp. (now part of Microchip Technology Inc.)
G&D	Giesecke & Devrient GmbH
G.TRONIC	Globaltronic - Electronica e Telecomunicacoes, S.A.
Gadzoox	Gadzoox Networks, Inc. (now Broadcom, Inc.)
Gammaflx	Gammaflux L.P.
GDI	Generic Distribution International
GEMALTO	gemalto
Gen_Dyn	General Dynamics
Generic	Generic Technology Co., Ltd.
GENSIG	General Signal Networks
GEO	Green Energy Options Ltd
GIGATAPE	GIGATAPE GmbH
GIGATRND	GigaTrend Incorporated

Table F.1 – T10 vendor identification list (part 8 of 19)

ID	Organization
Global	Global Memory Test Consortium
Gnutek	Gnutek Ltd.
Goidelic	Goidelic Precision, Inc.
GoldKey	GoldKey Security Corporation
GoldStar	LG Electronics Inc.
GOOGLE	Google, Inc.
GORDIUS	Gordius
Gossen	Gossen Foto- und Lichtmesstechnik GmbH
GOULD	Gould
HAGIWARA	Hagiwara Sys-Com Co., Ltd.
HAPP3	Inventec Multimedia and Telecom co., ltd
HCD	HoneycombData Inc
HDS	Horizon Data Systems, Inc.
Helldyne	Helldyne, Inc
Heydays	Mazo Technology Co., Ltd.
HGST	HGST a Western Digital Company
HI-TECH	HI-TECH Software Pty. Ltd. (now part of Microchip Technology Inc.)
HITACHI	Hitachi America Ltd or Nissei Sangyo America Ltd
HL-DT-ST	Hitachi-LG Data Storage, Inc.
HONEYWEL	Honeywell Inc.
Hoptroff	HexWax Ltd
HORIZONT	Horizontigo Software
HP	Hewlett Packard
HPE	Hewlett Packard Enterprise
HPI	HP Inc.
HPQ	Hewlett Packard
HUALU	CHINA HUALU GROUP CO., LTD
HUASY	Huawei Symantec Technologies Co., Ltd.
HUAWEI	Huawei Technologies Co. Ltd.
HYLINX	Hylinx Ltd.
HypStone	Hyperstone GmbH
HYUNWON	HYUNWON inc
i-cubed	i-cubed ltd.
I-O DATA	I-O DATA DEVICE
IBM	International Business Machines Corporation
Icefield	Icefield Tools Corporation
Iceweb	Iceweb Storage Corp
ICL	ICL
ICP	ICP vortex Computersysteme GmbH
IDE	International Data Engineering, Inc.
IDG	Interface Design Group
IET	ISCSI ENTERPRISE TARGET
IFT	Infortrend Technology, Inc.
IGR	Intergraph Corp.
IMAGINE	Imagine Communications Corp.
IMAGO	IMAGO SOFTWARE SL
IMATION	Imation

Table F.1 – T10 vendor identification list (part 9 of 19)

ID	Organization
IMPLTD	Integrated Micro Products Ltd.
IMPRIMIS	Imprimis Technology Inc.
INCIPNT	Incipient Technologies Inc.
INCITS	InterNational Committee for Information Technology
INDCOMP	Industrial Computing Limited
Indigita	Indigita Corporation
INFOCORE	InfoCore
INITIO	Initio Corporation
INNES	INNES
INNO	InnoCon Medical ApS
INRANGE	INRANGE Technologies Corporation (now Broadcom, Inc.)
Insight	L-3 Insight Technology Inc
INSITE	Insite Peripherals
INSPUR	Inspur Electronic Information Industry Co.,Ltd.
integrix	Integrix, Inc.
INTEL	Intel Corporation
Intransa	Intransa, Inc.
INTRMODL	InterModal Data, Inc
IOC	I/O Concepts, Inc.
ioFABRIC	ioFABRIC Inc.
iofy	iofy Corporation
IOMEGA	Iomega
IOT	IO Turbine, Inc.
iPaper	intelliPaper, LLC
iqstor	iQstor Networks, Inc.
iQue	iQue
ISi	Information Storage inc.
Isilon	Isilon Systems, Inc.
ISO	International Standards Organization
iStor	iStor Networks, Inc.
ITC	International Tapetronics Corporation
iTwin	iTwin Pte Ltd
IVIVITY	iVivity, Inc.
IVMMLTD	InnoVISION Multimedia Ltd.
JABIL001	Jabil Circuit
JETWAY	Jetway Information Co., Ltd
JMR	JMR Electronics Inc.
JOFEMAR	Jofemar
JOLLYLOG	Jolly Logic
JPC Inc.	JPC Inc.
JSCSI	jSCSI Project
Juniper	Juniper Networks
JVC	JVC Information Products Co.
KASHYA	Kashya, Inc.
KENNEDY	Kennedy Company
KENWOOD	KENWOOD Corporation
KEWL	Shanghai KEWL Imp&Exp Co., Ltd.

Table F.1 – T10 vendor identification list (part 10 of 19)

ID	Organization
Key Tech	Key Technologies, Inc
KIOXIA	Kioxia Corporation
KMNRIO	Kaminario Technologies Ltd.
KODAK	Eastman Kodak
KONAN	Konan
koncepts	koncepts International Ltd.
KONICA	Konica Japan
KOVE	KOVE
KSCOM	KSCOM Co. Ltd.,
KUDELSKI	Nagravision SA - Kudelski Group
Kyocera	Kyocera Corporation
Lapida	Gonmalo Electronics
LAPINE	Lapine Technology
LASERDRV	LaserDrive Limited
LASERGR	Lasergraphics, Inc.
LeapFrog	LeapFrog Enterprises, Inc.
LeapIO	LeapIO
LEFTHAND	LeftHand Networks (now HPE)
Leica	Leica Camera AG
LENOVO	Lenovo
Lexar	Lexar Media, Inc.
LEYIO	LEYIO
LG	LG Electronics Inc.
LGE	LG Electronics Inc.
LIBNOVA	LIBNOVA, SL Digital Preservation Systems
LION	Lion Optics Corporation
LMS	Laser Magnetic Storage International Company
LNKDSTR	Guangzhou LinkedStor Technology Co., LTD.
LoupTech	Loup Technologies, Inc.
LSI	LSI Corp. (now Broadcom, Inc.)
LSILOGIC	LSI Logic Storage Systems, Inc.
LTO-CVE	Linear Tape - Open, Compliance Verification Entity
LUXPRO	Luxpro Corporation
MacroSAN	MacroSAN Technologies Co., Ltd.
Malakite	Malachite Technologies (New VID is: Sandial)
MarcBoon	marcboon.com
Marner	Marner Storage Technologies, Inc.
MARVELL	Marvell Semiconductor, Inc.
Matrix	Matrix Orbital Corp.
MATSHITA	Matsushita
MAXELL	Hitachi Maxell, Ltd.
MAXIM-IC	Maxim Integrated Products
MaxOptix	Maxoptix Corp.
MAXSTRAT	Maximum Strategy, Inc.
MAXTOR	Maxtor Corp.
MaXXan	MaXXan Systems, Inc.
MAYCOM	maycom Co., Ltd.

Table F.1 – T10 vendor identification list (part 11 of 19)

ID	Organization
MBEAT	K-WON C&C Co.,Ltd
MCC	Measurement Computing Corporation
McDATA	McDATA Corporation (now Broadcom, Inc.)
MCUBE	Mcube Technology Co., Ltd.
MDI	Micro Design International, Inc.
MEADE	Meade Instruments Corporation
mediamat	mediamatic
MegaElec	Mega Electronics Ltd
MEII	Mountain Engineering II, Inc.
MELA	Mitsubishi Electronics America
MELCO	Mitsubishi Electric (Japan)
mellanox	Mellanox Technologies Ltd.
MEMOREX	Memorex Telex Japan Ltd.
MEMREL	Memrel Corporation
MEMTECH	MemTech Technology
MendoCno	Mendocino Software
MERIDATA	Oy Meridata Finland Ltd
METHODEI	Methode Electronics India pvt ltd
METRUM	Metrum, Inc.
MHTL	Matsunichi Hi-Tech Limited
MICROBTX	Microbotics Inc.
Microchp	Microchip Technology, Inc.
MICROLIT	Microlite Corporation
MICRON	Micron Technology, Inc.
MICROP	Micropolis
MICROTEK	Microtek Storage Corp
Minitech	Minitech (UK) Limited
Minolta	Minolta Corporation
MINSCRIB	Miniscribe
MiraLink	MiraLink Corporation
Mirifica	Mirifica s.r.l.
MITSUMI	Mitsumi Electric Co., Ltd.
MKM	Mitsubishi Kagaku Media Co., LTD.
Mobii	Mobii Systems (Pty.) Ltd.
MOL	Petrosoft Sdn. Bhd.
MOSAID	Mosaid Technologies Inc.
MOTOROLA	Motorola
MP-400	Daiwa Manufacturing Limited
MPC	MPC Corporation
MPCCORP	MPC Computers
MPEYE	Touchstone Technology Co., Ltd
MPIO	DKT Co.,Ltd
MPM	Mitsubishi Paper Mills, Ltd.
MPMan	MPMan.com, Inc.
MSFT	Microsoft Corporation
MSI	Micro-Star International Corp.
MST	Morning Star Technologies, Inc.

Table F.1 – T10 vendor identification list (part 12 of 19)

ID	Organization
MSystems	M-Systems Flash Disk Pioneers
MTI	MTI Technology Corporation
MTNGATE	MountainGate Data Systems
MXI	Memory Experts International
nac	nac Image Technology Inc.
NAGRA	Nagravision SA - Kudelski Group
NAI	North Atlantic Industries
NAKAMICH	Nakamichi Corporation
NatInst	National Instruments
NatSemi	National Semiconductor Corp.
NCITS	InterNational Committee for Information Technology Standards (INCITS)
NCL	NCL America
NCR	NCR Corporation
NDBTECH	NDB Technologie Inc.
Neartek	Neartek, Inc.
NEC	NEC
nemon	NorthEast Monitoring
NETAPP	NetApp, Inc. (was Network Appliance)
NetBSD	The NetBSD Foundation
Netcom	Netcom Storage
NETENGIN	NetEngine, Inc.
NEWISYS	Newisys Data Storage
Newtech	Newtech Co., Ltd.
NEXSAN	Nexsan Technologies, Ltd.
Nexus	Nexustorage Limited
NFINIDAT	Infinidat Ltd.
NHR	NH Research, Inc.
Nike	Nike, Inc.
Nimble	Nimble Storage (now HPE)
NISCA	NISCA Inc.
NISHAN	Nishan Systems Inc.
Nitz	Nitz Associates, Inc.
NKK	NKK Corp.
NOC	National Oceanography Centre
Novation	Novation
NRC	Nakamichi Research Corporation
NSD	Nippon Systems Development Co.,Ltd.
NSM	NSM Jukebox GmbH
nStor	nStor Technologies, Inc.
NT	Northern Telecom
NUCONNEX	NuConnex
NUSPEED	NuSpeed, Inc.
NVIDIA	NVIDIA Corporation
NVMe	NVM Express Working Group
OAI	Optical Access International
OCE	Oce Graphics
ODS	ShenZhen DCS Group Co.,Ltd

Table F.1 – T10 vendor identification list (part 13 of 19)

ID	Organization
OHDEN	Ohden Co., Ltd.
OKI	OKI Electric Industry Co.,Ltd (Japan)
Olidata	Olidata S.p.A.
OMI	Optical Media International
OMNIFI	Rockford Corporation - Omnifi Media
OMNIS	OMNIS Company (FRANCE)
Ophidian	Ophidian Designs
opslag	Tyrone Systems
Optelec	Optelec BV
Optiarc	Sony Optiarc Inc.
OPTIMEM	Cipher/Optimem
OPTOTECH	Optotech
ORACLE	Oracle Corporation
ORANGE	Orange Micro, Inc.
ORCA	Orca Technology
Origin	Origin Energy
OSI	Optical Storage International
OSNEXUS	OS NEXUS, Inc.
OTHERWLD	Othe World Computing
OTL	OTL Engineering
OVERLAND	Overland Storage Inc.
pacdigit	Pacific Digital Corp
Packard	Parkard Bell
Panasas	Panasas, Inc.
PARALAN	Paralan Corporation
PASCOsci	Pasco Scientific
PATHLGHT	Pathlight Technology, Inc.
Pavilion	Pavilion Data Systems
PCS	Pro Charging Systems, LLC
PEAK_SYS	PEAK-System Technik GmbH
PerStor	Perstor
PERTEC	Pertec Peripherals Corporation
PFTI	Performance Technology Inc.
PFU	PFU Limited
Phigment	Phigment Technologies
PHILIPS	Philips Electronics
PICO	Packard Instrument Company
PIK	TECHNILIENT & MCS
Pillar	Pillar Data Systems
PIONEER	Pioneer Electronic Corp.
Pirus	Pirus Networks
PIVOT3	Pivot3, Inc.
PLASMON	Plasmon Data
Pliant	Pliant Technology, Inc.
PMCSIERA	PMC-Sierra (now part of Microchip Technology Inc.)
PME	Precision Measurement Engineering
PNNMed	PNN Medical SA

Table F.1 – T10 vendor identification list (part 14 of 19)

ID	Organization
POKEN	Poken SA
POLYTRON	PT. HARTONO ISTANA TEKNOLOGI
PRAIRIE	PrairieTek
PREPRESS	PrePRESS Solutions
PRESOFT	PreSoft Architects
PRESTON	Preston Scientific
PRIAM	Priam
PRIMAGFX	Primagraphics Ltd
PRIMOS	Primos
PRNXDATA	PernixData Inc.
PROCOM	Procom Technology
PROLIFIC	Prolific Technology Inc.
ProMAX	ProMAX Systems
PROMISE	PROMISE TECHNOLOGY, Inc
PROSTOR	ProStor Systems, Inc.
PROSUM	PROSUM
PROWARE	Proware Technology Corp.
PTI	Peripheral Technology Inc.
PTICO	Pacific Technology International
PULAX	PULAX Corporation
PURE	PURE Storage
Qi-Hardw	Qi Hardware
QIC	Quarter-Inch Cartridge Drive Standards, Inc.
QLogic	QLogic Corporation
QLS	QLS Consulting
QNAP	QNAP Systems
Qsan	QSAN Technology, Inc.
QStar	QStar Technologies, Inc
QUADSTOR	QUADStor Systems
QUALSTAR	Qualstar
QUANTEL	Quantel Ltd.
QUANTUM	Quantum Corp.
QUEST	Quest Software Inc.
QUIX	Quix Computerware AG
R-BYTE	R-Byte, Inc.
RACALREC	Racal Recorders
RADITEC	Radikal Technologies Deutschland GmbH
RADSTONE	Radstone Technology
RAIDINC	RAID Inc.
RAMAXEL	Ramaxel Technology (Shenzhen) Ltd.
RASSYS	Rasilient Systems Inc.
RASVIA	Rasvia Systems, Inc.
rave-mp	Go Video
RDKMSTG	MMS Dipl. Ing. Rolf-Dieter Klein
RDStor	Rorke China
Readboy	Readboy Ltd Co.
Realm	Realm Systems

Table F.1 – T10 vendor identification list (part 15 of 19)

ID	Organization
realtek	Realtek Semiconductor Corp.
REDUXIO	Reduxio Systems Ltd.
rehanltd	Rehan Electronics Ltd
REKA	REKA HEALTH PTE LTD
RELDATA	RELDATA Inc
RENAGmbH	RENA GmbH
ReThinkM	RETHINK MEDICAL, INC
Revivio	Revivio, Inc.
RGBLaser	RGB Lasersysteme GmbH
RGI	Raster Graphics, Inc.
RHAPSODY	Rhapsody Networks, Inc.
RHS	Racal-Heim Systems GmbH
RICOH	Ricoh
RODE	RODE
RODIME	Rodime
Rorke	RD DATA Technology (ShenZhen) Limited
Royaltek	RoyalTek company Ltd.
RPS	RPS
RTI	Reference Technology
S-D	Sauer-Danfoss
S-flex	Storageflex Inc
S-SYSTEM	S-SYSTEM
S1	storONE
SAMSUNG	Samsung Electronics Co., Ltd.
SAN	Storage Area Networks, Ltd.
Sandial	Sandial Systems, Inc.
SanDisk	SanDisk Corporation
SANKYO	Sankyo Seiki
SANRAD	SANRAD Inc.
SANSSTOR	SANS Technology, Inc.
SANYO	SANYO Electric Co., Ltd.
SC.Net	StorageConnections.Net
SCALE	Scale Computing, Inc.
SCIENTEK	SCIENTEK CORP
SCInc.	Storage Concepts, Inc.
SCREEN	Dainippon Screen Mfg. Co., Ltd.
SDI	Storage Dimensions, Inc.
SDS	Solid Data Systems
SEAC	SeaChange International, Inc.
SEAGATE	Seagate
SEAGRAND	SEAGRAND In Japan
Seanodes	Seanodes
Sec. Key	SecureKey Technologies Inc.
SEQUOIA	Sequoia Advanced Technologies, Inc.
SGI	Silicon Graphics International (now HPE)
SGL	Software Generation Ltd
Shannon	Shannon Systems Co., Ltd.

Table F.1 – T10 vendor identification list (part 16 of 19)

ID	Organization
Shinko	Shinko Electric Co., Ltd.
Shrine-0	Shrine Maiden Heavy Industries
SIEMENS	Siemens
SigmaTel	SigmaTel, Inc.
SII	Seiko Instruments Inc.
Silk	Silk
SIMPLE	SimpleTech, Inc. (Obs - now STEC, Inc.)
SIVMSD	IMAGO SOFTWARE SL
SKhynix	SK hynix Inc.
SKT	SK Telecom Co., Ltd.
SLCNSTOR	SiliconStor, Inc. (now Broadcom, Inc.)
SLI	Sierra Logic, Inc. (now Broadcom, Inc.)
SMCI	Super Micro Computer, Inc.
SmrtStor	Smart Storage Systems
SMS	Scientific Micro Systems/OMTI
SMSC	SMSC Storage, Inc. (now part of Microchip Technology Inc.)
SMX	Smartronix, Inc.
SNYSIDE	Sunnyside Computing Inc.
SoftLock	Softlock Digital Security Provider
SolidFir	SolidFire, Inc.
SONIC	Sonic Solutions
SoniqCas	SoniqCast
SONY	Sony Corporation Japan
SOUL	Soul Storage Technology (Wuxi) Co., Ltd
SPD	Storage Products Distribution, Inc.
SPECIAL	Special Computing Co.
SPECTRA	Spectra Logic, a Division of Western Automation Labs, Inc.
SPERRY	Sperry (now Unisys Corp.)
Spintso	Spintso International AB
STARBORD	Starboard Storage Systems, Inc.
STARWIND	StarWind Software, Inc.
STEC	STEC, Inc.
Sterling	Sterling Diagnostic Imaging, Inc.
STK	Storage Technology Corporation
STNWOOD	Stonewood Group
STONEFLY	StoneFly Networks, Inc.
STOR	StorageNetworks, Inc.
STORAPP	StorageApps, Inc. (now HPE)
STORCIUM	Intelligent Systems Services Inc.
STORCOMP	Storage Computer Corporation
STORM	Storm Technology, Inc.
StorMagc	StorMagic
Stratus	Stratus Technologies
StrmLgc	StreamLogic Corp.
SUMITOMO	Sumitomo Electric Industries, Ltd.
SUN	Sun Microsystems, Inc.
SUNCORP	SunCorporation

Table F.1 – T10 vendor identification list (part 17 of 19)

ID	Organization
suntx	Suntx System Co., Ltd
SUSE	SUSE Linux
Swinxs	Swinxs BV
SWISSLUN	Cleondris GmbH
SYMANTEC	Symantec Corporation
SYMBIOS	Symbios Logic Inc. (now Broadcom, Inc.)
SYMPLY	Symply, Inc.
SYMWAVE	Symwave, Inc.
SYNCSORT	Syncsort Incorporated
SYNERWAY	Synerway
SYNOLOGY	Synology, Inc.
SyQuest	SyQuest Technology, Inc.
SYSGEN	Sysgen
T-MITTON	Transmitton England
T-MOBILE	T-Mobile USA, Inc.
T11	INCITS Technical Committee T11
TALARIS	Talaris Systems, Inc.
TALLGRAS	Tallgrass Technologies
TANDBERG	Tandberg Data A/S
TANDEM	Tandem (now HPE)
TANDON	Tandon
Tarabios	Tarabios Technologies
TCL	TCL Shenzhen ASIC MIcro-electronics Ltd
TDK	TDK Corporation
TEAC	TEAC Japan
TECOLOTE	Tecolote Designs
TEGRA	Tegra Varityper
Teilch	Teilch
Tek	Tektronix
TELLERT	Tellert Elektronik GmbH
TengLing	Beijing TengLing Technology Co.
TENTIME	Laura Technologies, Inc.
TFDATACO	TimeForge
TGEGROUP	TGE Group Co.,LTD.
Thecus	Thecus Technology Corp.
TI-DSG	Texas Instruments
TiGi	TiGi Corporation
TILDESGN	Tildesign bv
TINTRI	Tintri
Tite	Tite Technology Limited
TKS Inc.	TimeKeeping Systems, Inc.
TLMKS	Telemakus LLC
TMS	Texas Memory Systems, Inc.
TMS100	TechnoVas
TOLISGRP	The TOLIS Group
TOSHIBA	Toshiba Japan
TOYOU	TOYOU FEIJI ELECTRONICS CO.,LTD.

Table F.1 – T10 vendor identification list (part 18 of 19)

ID	Organization
Tracker	Tracker, LLC
TRIOFLEX	Trioflex Oy
TRIPACE	Tripace
TRLogger	TrueLogger Ltd.
TROIKA	Troika Networks, Inc.
TRULY	TRULY Electronics MFG. LTD.
TRUSTED	Trusted Data Corporation
TSSTcorp	Toshiba Samsung Storage Technology Corporation
TZM	TZ Medical
UD-DVR	Bigstone Project.
UDIGITAL	United Digital Limited
UIT	United Infomation Technology
ULTRA	UltraStor Corporation
UNISTOR	Unistor Networks, Inc.
UNISYS	Unisys
USCORE	Underscore, Inc.
USDC	US Design Corp.
VARCem	The VARCem Team
VASCO	Vasco Data Security
VDS	Victor Data Systems Co., Ltd.
VELDANA	VELDANA MEDICAL SA
VENTANA	Ventana Medical Systems
Verari	Verari Systems, Inc.
VERBATIM	Verbatim Corporation
Vercet	Vercet LLC
VERITAS	VERITAS Software Corporation
Vexata	Vexata Inc
VEXCEL	VEXCEL IMAGING GmbH
VicomSys	Vicom Systems, Inc.
VIDEXINC	Videx, Inc.
VikingES	Viking Enterprise Solutions
VIOLIN	Violin Memory, Inc.
VIRIDENT	Virident Systems, Inc.
VITESSE	Vitesse Semiconductor Corporation (now part of Microchip Technology Inc.)
VIXEL	Vixel Corporation (now Broadcom, Inc.)
VLS	Van Lent Systems BV
VMAX	VMAX Technologies Corp.
VMware	VMware Inc.
Vobis	Vobis Microcomputer AG
VOLTAIRE	Voltaire Ltd.
VRC	Vermont Research Corp.
VRugged	Vanguard Rugged Storage
VTGadget	Vermont Gadget Company
Waitec	Waitec NV
WangDAT	WangDAT
WANGTEK	Wangtek

Table F.1 – T10 vendor identification list (part 19 of 19)

ID	Organization
Wasabi	Wasabi Systems
WAVECOM	Wavecom
WD	Western Digital Corporation
WDC	Western Digital Corporation
WDIGTL	Western Digital
WDTI	Western Digital Technologies, Inc.
WEARNES	Wearnes Technology Corporation
WeeraRes	Weera Research Pte Ltd
Wildflwr	Wildflower Technologies, Inc.
WSC0001	Wisecom, Inc.
X3	InterNational Committee for Information Technology Standards (INCITS)
XEBEC	Xebec Corporation
XENSRC	XenSource, Inc.
Xerox	Xerox Corporation
Xield	Xield Technologies Limited
XIOtech	XIOtech Corporation
XIRANET	Xiranet Communications GmbH
XIV	XIV (now IBM)
XtremIO	XtremIO
XYRATEX	Xyratex
YADRO	YADRO
YINHE	NUDT Computer Co.
YIXUN	Yixun Electronic Co.,Ltd.
YOTTA	YottaYotta, Inc.
zadara	Zadara Inc.
Zarva	Zarva Digital Technology Co., Ltd.
ZBS	SMARTX Corporation
ZETTA	Zetta Systems, Inc.
ZTE	ZTE Corporation
ZVAULT	Zetavault
Zvezda	Zvezda LLC

Annex G
(informative)

Bibliography

ISO/IEC 14776-321, *Information Technology - Small Computer Systems Interface (SCSI) - Part 321: SCSI Block Commands (SBC)*

> NOTE 40 - SBC is the only published standard that defines write once devices and optical memory devices.

INCITS 497-2012, *Information Technology - Automation/Drive Interface - Commands - 3 (ADC-3)*

INCITS 551-2019, *Information Technology - SCSI RDMA Protocol - 2 (SRP-2)*

ISO/IEC 14776-115, *Information Technology - Small Computer Systems Interface (SCSI) - Part 115: SCSI Parallel Interface - 5 (SPI-5)*

ANSI/IEEE 1667:2015, *Standard Protocol for Authentication in Host Attachments of Transient Storage* Devices

ANSI/IEEE 1667:2018, *Standard Protocol for Authentication in Host Attachments of Transient Storage Devices* (under consideration)

INCITS 309-1998, *Information Technology - Serial Storage Architecture SCSI-3 Protocol (SSA-S3P)*

INCITS 441-2008, *Information Technology - Automation/Drive Interface - Transport Protocol - 2 (ADT-2)*

INCITS 466-2011, *Information Technology - Single-Byte Command Code Sets-4 Mapping Protocol (FC-SB-4)*

ISO/IEC 24739 (all parts), *Information Technology - (all parts) AT Attachment with Packet Interface - 7 (AT/ATAPI-7)*

ISO 80000-1:2009, *Quantities and units – Part 1: General*

ISO 80000-2:2009, *Quantities and units – Part 2: Mathematical signs and symbols to be used in the natural sciences and technology*

IEC 80000-13:2008, *Quantities and units – Part 13: Information science and technology*

RFC 793, *Transmission Control Protocol - DARPA Internet Program - Protocol Specification* [6]

RFC 1034, *Domain Names - Concepts and Facilities* [6]

RFC 1035, *Domain Names - Implementation and Specification* [6]

RFC 3986, *Uniform Resource Identifier (URI): Generic Syntax* [6]

RFC 7144, *Internet Small Computer Systems Interface (iSCSI) SCSI Features Update* [6]

---

[6] For more information on the RFCs and standards published by the Internet Engineering Task Force (IETF), see http://www.ietf.org/.

JEDEC JESD220A, *Universal Flash Storage (UFS 1.1) standard* [7]

PCI Express Base Specification 3.0, November 10, 2010 [8]

NVM Express Base Specification 2.0 [9]

DMTF DSP0274, *Security Protocol and Data Model (SPDM 1.0) specification revision 1.0* [10]

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[7] For more information on the documents published by JEDEC® see http://www.jedec.org/. JEDEC® is a registered trademark of the JEDEC Solid State Technology Association. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO.

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