3.   Definitions, abbreviations and acronym

3.1.19   **DDCD (Double Density Compact Disc)** - A family of related optical storage media that capacity has double than CD.

3.1.20   **DDCD-ROM (Double Density Compact Disc - Read Only Memory)** - A standard for storing digital data.

3.1.25   **DDCD-RW (DDCD ReWritable)** - A DDCD that can be re-written.

3.1.27   **DDCD-R (DDCD Recordable)** - A DDCD that can be written only once.

3.1.29   **DDCD R/RW** - either a DDCD-R, or a DDCD-RW, or both.

3.1.71   **HMSF address (Hour/Minute/Second/Frame)** - The physical address, expressed as a sector count relative to either the beginning of the medium (absolute) or to the beginning of the current track (relative). As defined by the CD standards, each F field unit is one sector; each S field unit is 75 F field units; each M field unit is 60 S field units. Valid contents of F fields are binary values from 0 through 74. Valid contents of S fields are binary values from 0 through 59. Valid contents of M fields are binary values from 0 through 60. Valid contents of H fields are binary values from 0 through 2.

## 4.3	DDCD Model

The Double Density CD (DDCD) Media Format is an extension of CD family whose capacity is more than double. This capacity is achieved by using a conventional 780 nm laser and using a NA of 0.50 or 0.55, and
- reduction of the track pitch (x 1.45)
- reduced minimum pit size (x 1.33)

Table 21 - Realization of higher density

Parameter	Red Book CD	DDCD	Factor
Track pitch (um)	1.60	1.10	1.45
Length of optical Marks (3* n *11)	n*0.278	n*0.208	1.33
Program area radius (mm)	25-58 (120 mm disc) 25-37.5 (80 mm disc)	24-58 (120 mm disc) 24-37.5 (80 mm disc)	1.06
Total user bit rate/ Channel bit rate:	0.284 (CD-ROM *Mode 1*)	0.284 (CD-ROM *Mode 2*)	1.00

A DDCD medium is an 80 mm or a 120 mm disc with a continuously recorded physical track beginning from a radius of 24 mm and spiraling outward to a radius 37.5 mm or 58 mm.

Like a conventional CD Drive/Media there are three types of DDCD Drive/Media:
Read Only (DDCD-ROM), Write Once (DDCD-R), and Rewritable (DDCD-RW). The capacities of these media are the same.   The DDCD Media Format is not backward compatible with existing CD devices

4.3.1   DDCD Specifications:

Comparing the new DDCD specifications with those of the conventional CD, some major specifications are the same, such as the size of the disc. Other specifications indicate that some adaptations have to be made to the media production process of the DDCD's.
Error correction and physical addressing require some changes to the decoding/encoding equipments.

Table 23 shows some DDCD parameters.

Table 23 – Main Parameters of DDCD

	DDCD-ROM	DDCD-R	DDCD-RW
Capacity (120 mm disc) [Mbytes]	1300	1300	1300
Capacity (80 mm disc) [Mbytes]	400	400	400
Wavelength of laser diode [nm]	780	780	780
Reference NA [for read] [for write]	> 0.50	> 0.50 0.55	> 0.50 0.55
Data Bit length [um]	0.442	0.442	0.442
Channel Bit length [um]	0.208	0.208	0.208
Minimum Pit/Mark length [um]	0.62	0.62	0.62
Maximum Pit/Mark length [um]	2.29	2.29	2.29
Track pitch [um]	1.10	1.10	1.10
Sense of disc rotation seen from reading side	Counter clockwise	Counter clockwise	Counter clockwise
Thickness of the disc [mm]	1.2	1.2	1.2
User data per sector [bytes]	2048	2048	2048
Error Correction Code	CIRC*	CIRC*	CIRC*
Layered ECC Constraint Length	1sector	1sector	1sector
Correctable burst error length [mm]	3.16	3.16	3.16
Scanning velocity at 1X speed [m/s]	0.90	0.90	0.90
Channel bit rate [Mbps]	4.3218	4.3218	4.3218
User data bit rate at 1X speed [Kbytes/s]	150	150	150

Note:

CIRC* is different from the conventional CD. In the DDCD system, the delay parameter "D" of CIRC is extended from 4 to 7 to improve burst error correction ability in case of higher recording density. The maximum burst error correction ability of CIRC* is extended to 837 symbols.

4.3.1   Disc Structure

There are three address expressions used in the DDCD system; the Block address contained in the sector header (Physical Sector Number), Subcode-Q channel (Subcode frame time number), and the address referred to the blocks of the Host system (LBA: Logical Block Address).
The address used by the Host system starts from 0 to the end of the recorded information on the disc.
LBA 0 shall correspond with the sector header address of D300h and the Subcode-Q address of 0:12:00:16 (0 hour, 12 minutes, 00 second, 16 frame). Only the Data Area is generally addressable by using LBA.
Subcode-Qs are addressed in time based address. The representation for a time based address is H:MM:SS:FF, where H = hours, MM = minutes, SS = seconds, and FF = frames. Hour field is 1 digit. MM,SS,FF are 2 digits respectively.
One Hour is subdivided into 60 Minutes. One Minute is 60 seconds. One Second is 75 frames.
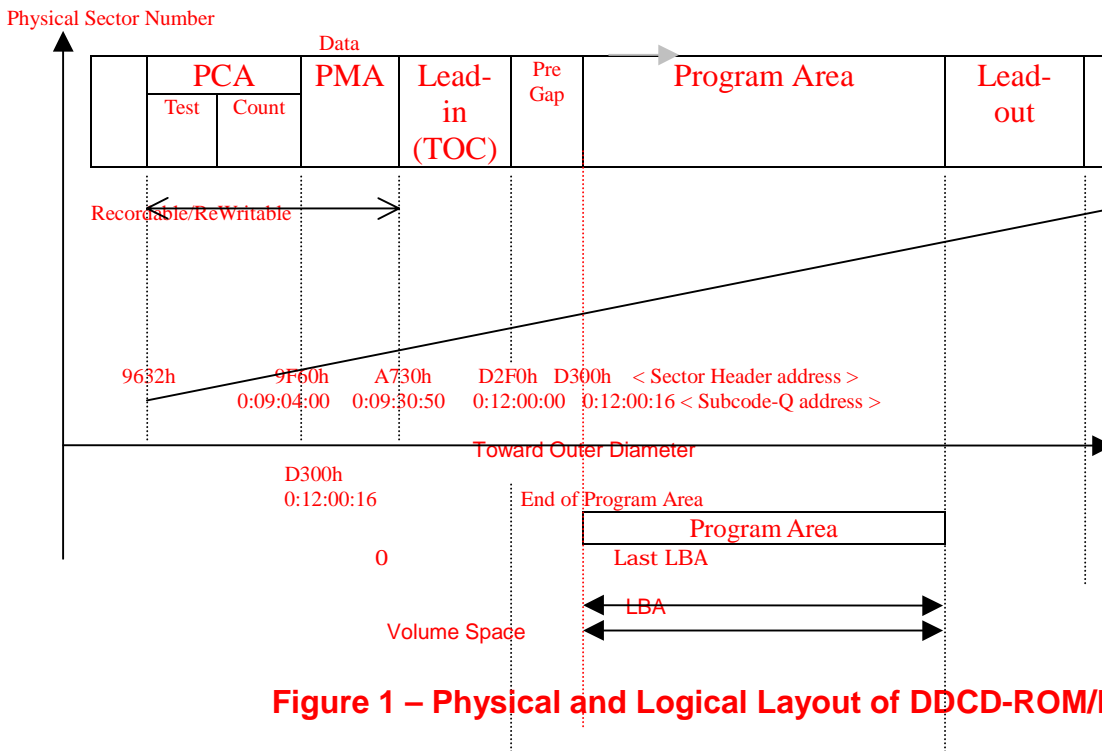
Physical Sector Number

	PCA		PMA	Lead-in (TOC)	Pre Gap	Program Area	Lead-out	
	Test	Count						

Data

Recordable/ReWritable

9632h   9F60h   A730h   D2F0h   D300h   < Sector Header address >
            0:09:04:00   0:09:30:50   0:12:00:00 0:12:00:16 < Subcode-Q address >

Toward Outer Diameter

D300h
0:12:00:16   End of Program Area

Program Area

0   Last LBA

LBA

Volume Space

Figure 1 – Physical and Logical Layout of DDCD-ROM/R/RW

4.3.1.2   Single Session Disc

A Session is the recorded sequence: The Lead-in Area, The Program Area, The Lead-out Area. The Lead-in / Lead-out Area is a guard area at inner / outer part of the disc. The Lead-in Area also contains the table of contents (TOC) for Program Area. The Program Area is also known as the user area of the disc.

4.3.1.2.1   Multi-Session Disc

The multi-session allows a single disc to have several concatenated sessions. On a recorded disc, session may appear as shown in Figure 2.
DDCD read only drives are not typically capable of reading through unrecorded areas on the medium. The DDCD read only drive needs EFM data in order to find and stay in the physical track. This is to ensure that a DDCD read only drive is capable of accessing all areas of a Program Area.

Session1 Lead-in	Session1 Program Area	Session1 Lead-out	Session2 Lead-in	Session2 Program Area	Session2 Lead-out	......	Last Session Lead-in	Last Session Program Area	Last Session Lead-out

Figure 2 – Multi-Session Recorded Disc

In order to assure readability with DDCD read only drives, the recording system shall always close the session before attempting interchange.
Additional information is needed in order to locate all of the program areas.
This is accomplished by using Subcode-Q Mode 5 in the Lead-in areas.

4.3.1.3   Physical Sector

The physical format defined by the DDCD media standard provides 2,352 bytes per sector. For computer data applications, 2,048 bytes is used for user data, 12 bytes for a synchronization field, 4 bytes for a sector address, 8 bytes for an additional information and 276 bytes – the auxiliary field – for Layered ECC.

4.3.1.3.1   Sector Structure

A Sector called Mode2 Sector shall consist of 2,352 bytes arranged with 12 Sync. bytes, 4 Header bytes, 8 Subheader bytes, 2,048 User Data bytes, and 4 Error Detection Code (EDC) bytes, 172 P-Parity bytes, 104 Q-Parity bytes. The User Data bytes are identified from 24th to 2071st. The Header shall consist of 3 bytes of Sector Address and 1 Mode byte. The Mode byte shall be 02h that indicates Mode 2 Disc Type.
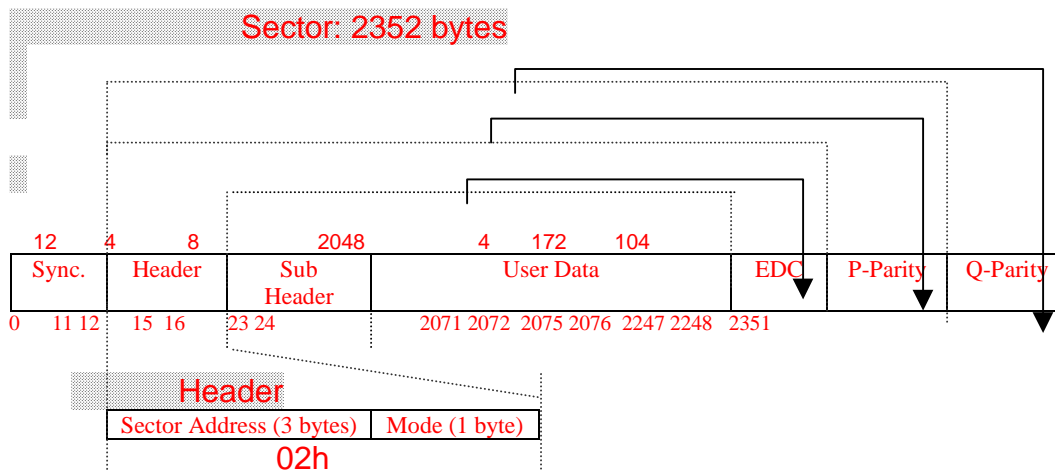

Figure 3 - Sector format Mode 2

The physical format of DDCD media uses smaller unit of synchronization than the other magnetic or optical recording systems.

The basic unit of the data stream synchronization is a small frame. This is different from large frame (sector) as referred to in the HMSF unit. Each small frame consists of 588 bits. A sector on DDCD media consists of 98 small frames.

A DDCD small frame consists of:
1. 1 synchronization pattern (24+3 bits)
2. 1 byte of sub-channel data (14+3 bits)
3. 24 bytes of data (24 x (14+3) bits)
4. 8 bytes of CIRC code (8 x (14+3) bits) Total:588 bits.

Data, sub-channel and CIRC bytes are encoded to 14-bit codes according to the EFM table; then three merging bits are added. The merging bits are chosen to minimize DSV (Digital Sum Value) and provide DC free characteristics.

The data bytes of 98 small frames comprise the physical unit of data referred to as a sector. 98 small frames times 24 bytes per small frame equals 2,352 bytes of data per sector.

4.3.1.3.2   Sub-Channel Information Formats

The sub-channel 1 byte of each frame is assigned one bit for each of the 8 sub-channels, designated P, Q, R, S, T, U, V, W. Sub-channel P and R to W are all reserved and set to zero. All the sub-channel Q bits of a sector define the sub-channel Q information block. The sub-channel Q block consists of 98 bits, one bit from each small frame in a sector.

The format provides the information of the location and is defined as follows:
1. 2-bits sub-channel synchronization field

2. 4-bits ADR field (defines the format)
3. 4-bits control field (defines the type of information in this sector)
4. 8-bits Track number
5. 8-bits index number
6. 28-bits reserved
7. 28-bits Absolute HMSF address (4-bits Hour, 8-bits Minutes, 8-bits Seconds, 8-bits Frames)
8. 16-bits CRC error detection code

ADR	TNO	INDEX	Reserved for future	AHOUR	AMIN	ASEC	AFRAME	CRC

Figure 4 – Subcode-Q Mode1 format recorded in Program Area

TNO   = 01 to 99 is the track number
INDEX = 00.
AHOUR, AMIN, ASEC, AFRAME
= the absolute time address expressed in 7 BCD digits.

4.3.2   DDCD Ready Condition/Not Ready Condition

The Ready Condition occurs after the disc is inserted and the Logical Unit has performed its initialization tasks. These tasks may include reading the lead-in information from the media. This "Ready" is different from and should not be confused with the ATA Ready Status. A CHECK CONDITION Status *shall* be returned for the Not Ready Condition only for Commands that require or imply disc access.

A Not Ready Condition may occur for the following reasons:
1. There is no disc.
2. The Logical Unit is unable to load or unload the disc.
3. The Logical Unit is performing an extended operation as the result of an Immediate
   mode Command such as FORMAT UNIT, BLANK, or CLOSE TRACK/SESSION commands
The Logical Unit *shall* spin up and make the disc ready for media accesses when a disc is detected.

After the Logical Unit becomes ready, the Logical Unit may enter the power state in which the Logical Unit was when the previous medium was removed.

Any media access that occurs when the Logical Unit is not spinning *shall* spin the media up and not generate an error. Any media access that is requested while a deferred operation is in progress (i.e. writing from a write cache) *shall not* generate an error.
Note: Accesses to the media can be satisfied from the Logical Unit's cache and may not require the media to be spun up.
Some Commands are allowed to generate a "NOT READY" check condition, and others are not.

4.3.3   DDCD Address Reporting Format (HMSF bit)

Several (conventional) CD specific Commands can return addresses either in logical block address or in HMSF format. The READ HEADER, READ SUBCHANNEL, and READ TOC/PMA/ATIP Commands have this feature.

Table 23 – HMSF Address Format

Bit Byte	7	6	5	4	3	2	1	0
0	H Field							
1	M Field							
2	S Field							
3	F Field							

The format is specified by an HMSF bit in the CDB. The HMSF bit of zero requests that the logical block address format be used for the absolute address field or for the offset from the beginning of the current Track.

An HMSF bit of one requests that the HMSF format be used for these fields. The H, M, S, and F Fields are expressed as binary numbers.

4.3.4 Error Reporting

If any of the following conditions occur during the execution of a Command, the DDCD Logical Unit *shall* return CHECK CONDITION status. The appropriate sense key and additional sense code *shall* be set. The following list illustrates some error conditions and the applicable sense keys. The list does not provide an exhaustive enumeration of all conditions that may cause the CHECK CONDITION status.

Table 24 – Error Conditions and Sense Key

Condition	Sense Key
Invalid logical block address	ILLEGAL REQUEST
Unsupported option requested	ILLEGAL REQUEST
Attempt to read a blank block	ILLEGAL REQUEST
Attempt to play a data block as audio	ILLEGAL REQUEST
Device reset or medium change Since last Command	UNIT ATTENTION
Self diagnostic failed	HARDWARE ERROR
Unrecovered read error	MEDIUM ERROR / HARDWARE ERROR
Recovered read error	RECOVERED ERROR
Overrun or other error that might be resolved by repeating the Command	ABORTED COMMAND

In case of an invalid logical block address, the sense data information field *shall* be set to the logical block address of the first invalid address.

In case of an attempt to read a blank or previously unwritten block, the sense data information field *shall* be set to the logical block address of the first blank block encountered. The data read up to the error block *shall* be transferred.

There are other special error situations for DDCD Logical Units. The following cases *shall* cause CHECK CONDITION Status, 5/63/00 END OF USER AREA ENCOUNTERED ON THIS TRACK:

4.3.5 Recording for DDCD Media

There are several kinds of writing method of recording data in DDCD media. Session At Once, Track At Once, and Packet Writing are all used as methods of recording DDCD media. There is a special

case of Session At Once recording known as Disc At Once. Packet Writing can be further classified into Variable Packet Writing and Fixed Packet Writing.

4.3.5.1 DDCD Recordable and DDCD ReWritable Structure

An unrecorded DDCD-R or DDCD-RW disc does not have an EFM to find the physical track in the traditional way of DDCD read only drives. A blank DDCD-R or DDCD-RW has pre-groove and it has the built in wobble for the purpose of defining and finding the physical track.
The wobble is a 22.05KHz signal modulated with digital information. The position within the pre-groove is contained in each pre-groove frame of 42 bits. This is known as an Absolute Time In Pre-groove (ATIP).
The ATIP frame shall consist of 42 bits.
The format of the ATIP frame is defined in Table 25:

Table 25 – ATIP format

Number of bits	4	3	21	14
Bit position	1234	567	0011 11111111 222222222 8901 23456789012345678	23333333333444 90123456789012
Data	Sync	Discriminator	Physical frame address	CRC remainder

In the area that is expected to be the disc's Lead-in Area, the additional information is interleaved between positional ATIP frames.
The additional information provided are:
● First possible start address for disc Lead-in (TOC)
● Last possible start address for disc Lead-out
● Special information about recording permissions
● Power and speed requirements for recording the medium
● DDCD-R vs. DDCD-RW medium

DDCD-R/RW discs have two additional areas prior to the first Lead-in; the Power Calibration Area (PCA), and the Program Memory Area (PMA).

The Power Calibration Area (PCA) is present only in DDCD-R and DDCD-RW media for the purpose of write power calibration. The PCA is divided into two areas: the test area and the count area. The test area is divided into 1000 calibration partitions. The count area is a counting area for use of the test recording.

The Program Memory Area (PMA) is present only for DDCD-R and DDCD-RW media for the purpose of counting for the use of user data area on the medium. This information is contained only within the Subcode-Q channel of the PMA frames.

4.3.5.2   Packet Layout for DDCD

The layout of a Packet on DDCD media is shown in Figure 5. Each packet starts with Link block followed by three Run-in blocks. The User data blocks are placed directly after the Run-in blocks. Finally, three Run-out blocks are located following the User data blocks. In the case of Fixed packet writing, the size of each Packet in a Track is constant in length.
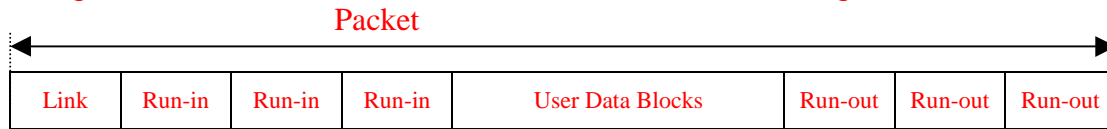
Figure 5 – Packet Layout

Blocks are uniquely identified by bit 5, 6, and 7 of the block's mode byte.

Table 26 – Block Identifier bits

Mode Byte Bit7, 6, 5	Block
000	User Data block
001	Third Run-in block
010	Second Run-in block
011	First Run-in block
100	Link block
101	Third Run-out block
110	Second Run-out block
111	First Run-out block

Figure 6 shows an example of the layout of packet written Track.
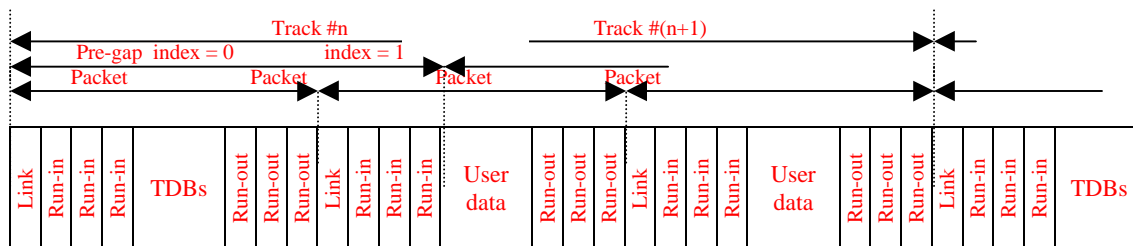
Figure 6 – Example of Packet written Track layout

5.3.1 Profile List Feature (0000h)

This Feature identifies Profiles supported by the Logical Unit. The Profile List descriptor returned is defined in Table 1. Profiles are defined as collections of Features and provide a method to quickly determine the Logical Unit's type. This Feature is always current, even if none of the Profiles listed are current.

Table 1 - Profile List Descriptor Format

| Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			Feature Code = 0000h				
1								(LSB)
2	Reserved			Version			Persistent	Current
3	Additional Length							
4 - n	Profile Descriptor(s)							

The Feature Code field shall be set to 0000h.
The Version field is reserved and shall be set to zero. Future versions of a Feature will be backward compatible; incompatible changes will be included in a different Feature.
The Persistent bit shall be set to one to indicate that the reporting of the Profile list is always supported.
The Current bit shall be set to one.
The Additional Length field shall be set to ((number of Profile Descriptors) * 4).
The Profile Descriptors are shown in Table 2. All Profiles supported by the Logical Unit shall always be reported. Profile descriptors are returned in the order of preferred operation - most desirable to least desirable. E.g. a DVD-ROM that could also read CD-ROM would list the DVD-ROM Profile first and the CD-ROM Profile second.

Table 2 - Profile Descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			Profile Number				
1								(LSB)
2	Reserved							CurrentP
3	Reserved							

The Profile Number identifies a Profile the Logical Unit conforms to, see Table 3.
The CurrentP bit, when set to one, shall indicate that this Profile is currently active. If no medium is present, no Profile should be active. Multifunction devices shall select the most appropriate Profile(s), if any, to set as current. The most appropriate current Profile is also reported in the Feature Header

Table 3 - Profile List

Profile Number	Profile Name	Description	Sub-Clause
0000h	Reserved		
0001h	Non-removable disk	Re-writable disk, capable of changing behavior	
0002h	Removable disk	Re-writable; with removable media	
0003h	MO Erasable	Magneto-Optical disk with sector erase capability	
0004h	MO Write Once	Magneto-Optical write once	
0005h	AS-MO	Advance Storage – Magneto-Optical	
0006h – 0007h	Reserved		
0008h	CD-ROM	Read only Compact Disc capable	
0009h	CD-R	Write once Compact Disc capable	
000Ah	CD-RW	Re-writable Compact Disc capable	
000Bh - 000Fh	Reserved		
0010h	DVD-ROM	Read only DVD	
0011h	DVD-R	Write once DVD	
0012h	DVD-RAM or DVD+RW	Re-writable DVD	
0013h – 001Fh	Reserved		
0020h	DDCD-ROM	Read only DDCD	
0021h	DDCD-R	Write only DDCD	
0022h	DDCD-RW	Re-Write only DDCD	
0023h-002Fh	Reserved		
0030h-FFFEh	Reserved		
FFFFh	Logical Units Not Conforming to a Standard Profile	The Logical Unit does not conform to any Profile.	

5.3.20 Double Density CD Read Feature (0030h)

This Feature identifies a Logical Unit that can read DDCD specific information from the media and can read user data from DDCD blocks.

Table 112: DDCD Read Descriptor Format

Bit Byte	7	6	5	4	3	2	1	0
0	Feature Code = 0030h							
1								
2	Reserved			Feature Version = 0000b			Persistent	Current
3	Additional Length = 00h							

Since DDCD-ROM medium is removable, Persistent is cleared to zero.
Current bit shall be set to zero if DDCD-ROM media is not present.
A Logical Unit that read DDCD-ROM media shall support the commands specified in Table 113.

Table 113 : DDCD Read Commands

Op Code	Command Description
BEh	READ CD
43h	READ TOC/PMA/ATIP

5.3.21 Double Density CD-R Write Feature (0031h)

This Feature identifies a Logical Unit that can write data to DDCD-R. A Logical Unit that write and read DDCD-R media shall support the commands specified in Table 114.

Table 114 : DDCD-R Write Commands

Op Code	Command Description
51h	READ DISC INFORMATION
52h	READ TRACK INFORMATION
53h	RESERVE TRACK
2Ah	WRITE(10)
AAh	WRITE(12)

Table 115: DDCD-R Write Feature Descriptor Format

Bit / Byte	7	6	5	4	3	2	1	0
0	Feature Code = 0031h							
1								
2	Reserved		Feature Version = 0000b				Persistent	Current
3	Additional Length = 4							
4	Reserved					TestWR	Reserved	
5	Reserved							
6	Reserved							
7	Reserved							

The Feature Code field shall be set to 0031h
Since DDCD-R medium is removable, Persistent is cleared to zero.
The Current bit, when set to zero, shall indicate DDCD-R media is not present.
The Additional Length field shall be set to 04h.
The TestWR bit, when set to zero, shall indicate that the Logical Unit is not capable of performing test writes. When set to one, the Logical Unit shall be capable of performing test writes.

5.3.22 Double Density CD-RW Write Feature (0032h)

This Feature identifies a Logical Unit that can write data to DDCD-RW. Logical Unit that write and read DDCD-RW media shall support the commands specified in Table 116.

Table 116 : DDCD-RW Write Commands

Op Code	Command Description
51h	READ DISC INFORMATION
52h	READ TRACK INFORMATION
53h	RESERVE TRACK
2Ah	WRITE(10)
AAh	WRITE(12)

Table 117: DDCD-RW Write Feature Descriptor Format

Bit / Byte	7	6	5	4	3	2	1	0
0	Feature Code = 0032h							
1								
2	Reserved			Feature Version = 0000b			Persistent	Current
3	Additional Length = 4							
4	Reserved						Intermediate	Blank
5	Reserved							
6	Reserved							
7	Reserved							

The Feature Code field shall be set to 0032h
Since DDCD-RW medium is removable, Persistent is cleared to zero.
The Current bit, when set to zero, shall indicate DDCD-RW media is not present.
The Additional Length field shall be set to 04h.

The Intermediate bit, if set to 1, shall indicate that the Logical Unit suppots quick formatting (Format Type of xxh - Quick Format). If set to 0, shall indicate that the Logical Unit does not support and quick formatting.
The Blank bit, if set to 1, shall indicate that the Logical Unit supports BLANK Command, Blanking Type 00h and 01h. If set to 0, shall indicate that the Logical Unit does not support BLANK Command.

5.4.11   Profile 20h: DDCD-ROM

Logical Units identifying Profile 20h as current shall support the Features listed in

Table 23: Mandatory Feature List for the DDCD-ROM Drive

Feature Number	Feature Name	Description
0000h	Profile List	A list of all profiles supported by the device
0001h	Core	Basic Functionality
0002h	Morphing	Ability to notify the host about operational changes and accept host requests to prevent operational changes
0003h	Removable Medium	The medium may be removed from the device
0010h	Random Readable, PP = 1	Read ability for storage with random addressing
0030h	DDCD Read	The ability to read DDCD specific structure
0100h	Power Management	Host and device directed power management.
0105h	Time-out	Ability to response to all commands within a specific time

5.4.12 Profile 21h: DDCD-R

Logical Units identifying Profile 21h as current shall support the Features listed in

Table 24: Mandatory Feature List for the DDCD-R/RW Drive

Feature Number	Feature Name	Description
0000h	Profile List	A list of all profiles supported by the device
0001h	Core	Basic Functionality
0002h	Morphing	Ability to notify the host about operational changes and accept host requests to prevent operational changes
0003h	Removable Medium	The medium may be removed from the device
0010h	Random Readable, PP = 1	Read ability for storage with random addressing
0021h	Incremental Streaming Writable	Write support of sequential recording
0030h	DDCD Read	The ability to read DDCD specific structure
0031h	DDCD-R Write	The ability to write DDCD-R specific structure
0100h	Power Management	Host and drive power management.
0105h	Time-out	Ability to response to all commands within a specific time
0107h	Real-Time Streaming	Ability to read and write using Host requested performance parameters

5.4.13 Profile 22h: DDCD-RW

Logical Units identifying Profile 22h as current shall support the Features listed in

Table 25: Mandatory Feature List for the DDCD-R/RW Drive

Feature Number	Feature Name	Description
0000h	Profile List	A list of all profiles supported by the device
0001h	Core	Basic Functionality
0002h	Morphing	Ability to notify the host about operational changes and accept host requests to prevent operational changes
0003h	Removable Medium	The medium may be removed from the device
0010h	Random Readable, PP = 1	Read ability for storage with random addressing
0020h	Random Writable	Write support for randomly addressed writes
0021h	Incremental Streaming Writable	Write support of sequential recording
0023h	Formattable	Support for formatting of media
0026h	Restricted Overwrite	Write support for media that shall be written in multiples of logical blocks
0030h	DDCD Read	The ability to read DDCD specific structure
0031h	DDCD-R Write	The ability to write DDCD-R specific structure
0032h	DDCD-RW Write	The ability to write DDCD-RW specific structure
0100h	Power Management	Host and drive power management.
0105h	Time-out	Ability to response to all commands within a specific time
0107h	Real-Time Streaming	Ability to read and write using Host requested performance parameters

5.5.4 Write Parameters Mode page (Page Code 05h)

Write Parameters Mode Page (Page Code 05h)
The Write Parameters Mode Page (see Table 4) contains parameters needed for the correct execution of WRITE(XX) commands when writing, using certain writing models.
The values in this page do not necessarily reflect the status on a given medium. They will be used as applicable when a write operation occurs. If any parameters have values incompatible with the current medium, the Logical Unit shall generate a CHECK CONDITION status, a sense code of ILLEGAL REQUEST and an ASC of ILLEGAL MODE FOR THIS TRACK shall occur when a write is attempted. Fields that are ignored for the current medium may contain 0 for the default mode parameter value.
Fields and bits within the Write Parameters Mode Page not utilized by the installed medium may be ignored.

Table 4 - Write Parameters Mode Page

Bit Byte	7	6	5	4	3	2	1	0
0	PS	Reserved	Page Code (05h)					
1	Page Length (32h)							
2	Reserved	BUFE	LS_V	Test Write	Write Type			
3	Multi-session		FP	Copy	Track Mode			
4	Reserved				Data Block Type			
5	Link Size							
6	Reserved							
7	Reserved		Host Application Code					
8	Session Format							
9	Reserved							
10	(MSB)							
11	Packet Size							
12								
13								(LSB)
14	(MSB)	Audio Pause Length						
15								(LSB)
16	(MSB)							
17	...							
...	Media Catalog Number							
30	...							
31								(LSB)
32	(MSB)							
33	...							
...	International Standard Recording Code							
46	...							
47								(LSB)
48	Sub-header Byte 0							
49	Sub-header Byte 1							
50	Sub-header Byte 2							
51	Sub-header Byte 3							
52 - 55	Vendor Specific							

The Parameter Savable bit is defined in sub-clause

The BUFE bit, when set to one, indicates that Buffer Under-run Free recording is enabled for sequential recording. The Logical Unit *shall* perform silent linking and continue the writing when the buffer becomes empty. When set to zero, it *shall* indicate that Logical Unit *shall* terminate writing and perform linking. The following WRITE (10) Command is terminated with CHECK CONDITION Status, ILLEGAL REQUEST, INVALID ADDRESS FOR WRITE. This bit is valid when the DVD-R Write Feature is current.

The LS_V (Link Size Valid) bit, when set to one indicates that the value in the Link Size field is valid. When set to zero, indicates compatibility with legacy Logical Units that did not implement the Link Size field; such Logical Units assume a Link Size of 7.

The Link Size field specifies the Linking Loss area size in sectors. The Link Size field is valid only for Write Type "Packet/Incremental." When another Write Type is specified, device shall ignore LS_V bit and Link Size field. The Logical Unit shall accept values that are valid for the Logical Unit but not valid for the current medium. If writing is attempted when an invalid Link Size is set, the Logical Unit shall generate CHECK CONDITION status, ILLEGAL REQUEST, ILLEGAL MODE FOR THIS TRACK/RZONE.

On CD-R/RW media the Test Write bit is valid only for Write Type 1 or 2 (Track at Once or Session at Once). On DDCD-R/RW media the Test Write bit is valid only for Write Type 1 (Track at Once). On DVD-R media, the Test Write bit is valid only for Write Type 0 or 2 (Incremental or Disc-at-once). When the Test Write bit is set to one, it indicates that the device performs the write process, but does not write data to the media. When the bit is set to zero the Write laser power is set such that user data is transferred to the media. In addition, all track and disc information collected, during test write mode, shall be cleared. It should be noted that the number of tracks reserved or written may be limited in test write mode.

Write Type Field (Table 5) specifies the stream type to be used during writing. Write Type values are shown in Table 5.

Table 5 - Write Type Field

Value	Definition
00h	Packet/Incremental
01h	Track-at-once
02h	Session-at-once
03h	Raw
04h - 0Fh	Reserved

Packet/Incremental - the device shall perform packet/Incremental writing when WRITE commands are issued.

Track At Once - the device shall perform Track At Once recording when write commands are issued.

Session At Once - the device shall perform Session At Once recording. For CD, this mode requires that a cue sheet be sent prior to sending write commands.

Raw - the device shall write data as received from the Initiator. In this mode, the Initiator sends the Lead-in. The Initiator shall provide Q Sub-channel in this mode, the only valid Data Block Types are 1, 2, and 3. The Next Writable Address starts at the beginning of the Lead-in (this shall be a negative LBA on a blank disc).

> NOTE: In RAW record mode the Logical Unitshall not generate run-in and run-out blocks (main and Sub-channel 1 data) but shall generate and record the link block. Write Type of Track-at-once and Raw are invalid when DVD-R media is present.

The Multi-session field defines how session closure affects the opening of the next session. See Table 6.

Table 6 - Multi-session Field Definition

Multi-session Field	Action Upon Session Closure
00b	No B0 pointer. Next Session not allowed
01b	For the CD media, B0 pointer = FF:FF:FF. Next session not allowed. For the DDCD media, B0 pointer = F:FF:FF:FF. Field reserved for non-CD media
10b	Reserved
11b	Next session allowed. B0 pointer = next possible program area.

The FP bit, when set to one indicates that the packet type is fixed. Otherwise, the packet type is variable. This bit is ignored unless the write type is set to 0 (Packet). For DVD-R, this bit shall default to one.

A Copy bit with value one indicates that this is the first or higher generation copy of a copyright protected track. When set to one, the copyright bit in the control nibble of each mode 1 Q Sub-channel shall alternate between 1 and 0 at 9.375 Hz. The duty cycle is 50%, changing every 4 blocks. The initial value on the medium is zero. For DDCD, this bit shall be set to zero.

Track Mode is the Control nibble in all Mode 1 Q Sub-channel in the track. The default value of this field for DVD-R Logical Units shall be 5. The default value of this field for DDCD-R/RW logical Units shall be 5.

Data Block Type defines both the specific data fields in a user data block and its size. The Data Block Type is defined in Table 7. This size is used for writing instead of the block size set in the mode select header. The default value of this field for DVD-R Logical Units shall be 8. The default value of this field for DDCD-R/WR Logical Units shall be 8.

Table 7 - Data Block Type Codes

Value	Block Size	Definition	Requirement
0	2352	Raw data 2352 bytes of raw data (not valid for write type = packet)	Optional
1	2368	Raw data with P and Q Sub-channel 2352 bytes of raw data, 16 bytes for P & Q Sub-channel (see **Error! Reference source not found.**): Bytes 0..9 are Q Sub-channel data Bytes 10..11 are Q Sub-channel EDC Bytes 12..14 are zero Byte 15, most significant bit has state of P Sub-channel bit (not valid for write type = packet)	Optional
2	2448	Raw data with P-W Sub-channel appended: 2352 bytes of raw data. 96 bytes of pack form R-W Sub-channel in the low order 6 bits of each byte. Bit 7 of each byte contains the P Sub-channel state and bit 6 of each byte contains the Q Sub-channel bit. (not valid for write type = packet)	Optional
3	2448	Raw data with raw P-W Sub-channel appended: 2352 bytes of raw data. 96 bytes of raw P-W Sub-channel. (not valid for write type = packet or DDCD Media)	Optional
4 - 6		Reserved values	
7	NA	Vendor Specific	Optional
8	2048	Mode 1 (ISO/IEC 10149): 2048 bytes of user data	Mandatory
9	2336	Mode 2 (ISO/IEC 10149): 2336 bytes of user data. Invalid for DDCD media	Optional
10	2048	Mode 2 (CD-ROM XA, form 1): 2048 bytes of user data, sub-header from write parameters. Requirment for DDCD	Mandatory
11	2056	Mode 2 (CD-ROM XA, form 1): 8 bytes of sub-header, 2048 bytes of user data	Optional
12	2324	Mode 2 (CD-ROM XA, form 2): 2324 bytes of user data, sub-header from write parameters. Invalid for DDCD media	Optional
13	2332	Mode 2 (CD-ROM XA, form 1, form 2, or mixed form): 8 bytes of sub-header 2324 bytes of user data Invalid for DDCD media	Mandatory
14	-	Reserved values	
15	NA	Vendor Specific	Optional

NOTES:

1. When a track has been designated for packet writing, the device shall ensure that the TDB is written upon receipt of the write command.

2. With the exceptions of data block types 1, 2, and 3, the device shall generate all P Sub-channel and all mode 1, mode 2, and mode 3 Q Sub-channel.

3. For data block types 8 through 13, the device shall generate all sync fields and all headers.
4. For data blocks of mode 1 or of mode 2, form 1, the device shall generate EDC and L-EC parity.
5. For data block types 0, 1, 2, and 3, the device shall perform no data scrambling per ISO/IEC 10149.
6. For data block types 8 through 13, the device shall perform data scrambling per ISO/IEC 10149.

The Host Application Code field is typically zero. When the unrestricted Use Disc bit in Disc Information Block (see Table 10) is one, the Host Application Code field shall be ignored by the device. If the Unrestricted Use Disc bit is zero, then the Host Application Code shall be set to the appropriate value for the medium in order that writing be allowed. An Host Application Code of zero is used for a Restricted Use - General Purpose Disc.

The Session Format code is to be written in the TOC of the session containing this track. The Session Format code is the PSEC byte of the mode 1, point A0 TOC entry. The DDCD is always set to 20h See Table 27 - READ TOC/PMA/ATIP response data (Format = 0000b).

Table 28 - Session Format Codes

Session Format Codes	Session Format
00h	CD-DA, or CD-ROM or other data discs
10h	CD-I Disc
20h	CD-ROM XA Disc, DDCD Disc
All Other Values	Reserved

The Packet Size field, if FP bit is set to one, specifies the number of User Data Blocks per fixed packet. The Packet Size field, if FP bit is set to 0, shall be ignored. For DVD-R media, the default Packet Size shall be 16. Audio Pause Length is the number of blocks from the beginning of the track that the mode 1 Q Sub-channel INDEX shall be zero. If this number is zero, then there is no period where the Mode 1 Q Sub-channel INDEX shall be zero. The default value shall be 150. This field is valid only for audio tracks, otherwise it is ignored.

The Media Catalog Number (MCN) will be written in the mode 2 Q Sub-channel in at least one out of every 100 blocks in the program area. The Initiator may include bytes 14 & 15, however, the Logical Unit will ignore these bytes and insert the appropriate Zero and AFRAME values. When the MCN is returned to the Initiator the Media Catalog Number (MCN) is formatted as in.

The International Standard Recording Code (ISRC) is formatted as in.

For the DDCD, This field is ignored.

6.1.3   Format Unit Command

The FORMAT UNIT Command (Table 9) formats a medium into Initiator addressable logical blocks per the Initiator defined options.
The medium may be certified and control structures created for the management of the medium and defects. There is no guarantee that the medium has not been altered.

Table 9 - Format Unit Command

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (04h)							
1	Reserved			FmtData	CmpList	Format Code		
2	Reserved							
3	(MSB)		Interleave Value					
4								(LSB)
5	Control Byte							

A FmtData bit of zero indicates that there is no parameter list. A FmtData bit of one indicates that a parameter list is available from the Initiator. For CD-RW, DVD-RAM, DDCD-R/RW and DVD-R FmtData shall be set to one.
The CmpList bit is used in conjunction with the DCRT (**Error! Reference source not found.**) bit to determine usage of the existing G_1-list, G_2-list and SDL to construct new G_1-list and G_2-list (**Error! Reference source not found.**) on DVD-RAM media. A CmpList bit of zero indicates that the parameter list provided is in addition to those already available to the Logical Unit. A CmpList bit of one indicates that the parameter list is complete and the Logical Unit is to ignore any existing parameters. On DDCD/CD /DVD-RW media, CmpList bit shall be set to zero.
A formatted DDCD-RW / CD-RW session shall consist of a single, fixed packet track. The packet size specified in the WRITE PARAMETERS mode page defines the packet size for the format operation.
If the WRITE TYPE field in the WRITE PARAMETERS mode page is not packet (00b), the FORMAT UNIT command shall terminate with a CHECK CONDITION and set sense to ILLEGAL REQUEST, COMMAND SEQUENCE ERROR. If the FP bit in the WRITE PARAMETERS mode page is not set to one (Fixed Packet), the FORMAT UNIT command shall terminate with a CHECK CONDITION and set sense to ILLEGAL REQUEST, COMMAND SEQUENCE ERROR.
The Format Code identifies the parameter list format. For DDCD-RW / CD-RW, the Format Code shall be set to seven (111b), for DVD-RAM the Format Code shall be set to one (001b).
The Interleave Value field identifies the value to be used when formatting. The values are specified below:

>   For DDCD / CD-RW, Interleave Value shall be zero.
>   For DVD-RAM, the value shall be set to zero

During the operation of the FORMAT command, the Logical Unit *shall* respond to other commands as follows:

a. In response to all commands except GET CONFIGURATION, GET EVENT/STATUS NOTIFICATION, REQUEST SENSE and INQUIRY, the Logical Unit *shall* return CHECK CONDITION status.
b. In response to the GET CONFIGURATION, GET EVENT/STATUS NOTIFICATION, and INQUIRY command, the Logical Unit *shall* respond as commanded.
c. In response to the REQUEST SENSE command, unless an error has occurred, the Logical Unit *shall* return a sense key of NOT READY and an additional sense code of LOGICAL UNIT NOT READY, FORMAT IN PROGRESS, with the sense key specific bytes set for progress indication. See the REQUEST SENSE Command description in ANSI NCITS 301 SPC-2 Standard. Refer to sub-clause **Error! Reference source not found.**, for the description of handling deferred errors that may occur during the format operation.

During the execution of the FORMAT UNIT command, the Logical Unit *shall* perform a medium defect management algorithm if the Defect Management Feature is current. The FORMAT UNIT command for DVD-RAM media may not provide a method to receive defect location information from the Initiator.

A format data (FmtData) bit of one indicates that the FORMAT UNIT parameter list (see **Error! Reference source not found.**) *shall* be transferred to the Logical Unit. The data sent to the Logical Unit consists of a Format List Header, followed by an initialization pattern descriptor (that may have zero length), followed by zero or one Format descriptors. The Format descriptor *shall* be one of Formattable Capacity Descriptors returned by the READ FORMAT CAPACITIES command.

6.1.19 Read Disc Information Command

The READ DISC INFORMATION Command (Table 10) provides information about all discs. The parameters returned by the Logical Unit are specific to the media that is currently installed in the Logical Unit. In the case of a DVD-ROM Logical Unit, the disc information returned may be for the last closed Session. In the case of media that does not have logical Tracks, the number of Tracks and Sessions is considered one. If this command is required by an implemented Feature, the command shall always function, even if that Feature's Current bit becomes zero.If a Logical Unit does not implement this command it shall respond with a CHECK CONDITION status.

Table 10 - READ DISC INFORMATION Command Descriptor Block

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (51h)							
1	Reserved							
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	(MSB)			Allocation Length				
8								(LSB)
9	Control Byte							

The Disc Information Block has two parts; a static disc information area, as shown in Table 10, and an OPC response shown in Table 14.
The number of Disc Information bytes returned (Table 10) is limited by the Allocation Length parameter of the command packet. An Allocation Length of zero shall not be considered an error. If the Allocation Length is greater than the amount of available Disc Information Data, only the available data will be transferred.

If a field or bit is not applicable to the installed medium, the defaut parameters in the Write Parameters Mode Page shall be returned in the corresponding field.

Table 10 - Disc Information Block

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			Disc Information Length				
1								(LSB)
2	Reserved			Erasable	State of last Session		Disc Status	
3	Number of First Track on Disc							
4	Number of Sessions (LSB)							
5	First Track Number in Last Session (LSB)							
6	Last Track Number in Last Session (LSB)							
7	DID_V	DBC_V	URU	Reserved				
8	Disc Type							
9	Number of Sessions (MSB)							
10	First Track Number in Last Session (MSB)							
11	Last Track Number in Last Session (MSB)							
12	(MSB)							
13				Disc				
14				Identification				
15								(LSB)
16	(MSB)							
17				Last Session Lead-in Start Time				
18				HMSF				
19								(LSB)
20	(MSB)							
21				Last Possible Start Time for Start of Lead-out				
22				HMSF				
23								(LSB)
24	(MSB)							
...				Disc Bar Code				
31								(LSB)
32	Reserved							
33	Number of OPC Table Entries							
34 - n	OPC Table Entries							

The Disc Information Length is the number of bytes available in both the recording information area and the appended OPC table. Disc Information Length excludes itself.

Disc Status field indicates the status of the disc and is shown in Table 11. A device that does not have the ability to write the inserted medium (ex. C/DD/DVD-ROM) will return COMPLETE (10b) status.

Table 11 - Disc Status

Status	Definition
00b	Empty disc
01b	Incomplete disc (Appendable)
10b	Complete Disc (eg. Not Appendable. C/DD/DVD-ROM, complete CD-R, CD-RW, DDCD-R/RW, DVD-R, or write protected Random Writable media)
11b	Others (non-write protected Random Writable media)

The State of Last Session field is defined in Table 12. For media that does not use Sessions this field shall be 11h.

Table 12 - State of Last Session

Session State	Definition
00b	Empty Session
01b	Incomplete Session
10b	Reserved
11b	Complete Session (only possible when Disc Status is Complete)

The Erasable bit, when set to one, indicates that CD-RW /DDCD-RW medium is present. Otherwise, CD-RW /DDCD-RW medium is not present.

The Number of First Track identifies the first track number:

For non-CD media, this field shall be set to 1. For CD/DD media,

1) If Disc Status is set to 00 (Empty Disc), the Number of First Track field shall be 1.
2) If there are no entries in the PMA and the first track is an Incomplete Track, the Number of First Track field shall be equal to 1.
3) If the only session on the disc is an Incomplete Session, the Number of First Track field is from the PMA.
4) Otherwise, the Number of First Track field contains the track number for the first TOC entry in the first Session.The Number of Sessions (bytes 4 & 9) on the disc refers to all complete sessions plus any incomplete or empty sessions. A Blank Disc will always have a session count equal to one.

First Track Number in Last Session (bytes 5 & 10) is the track number of the first track in the last session. In order for Tracks in the last Session, that may be open, to be scanned by the READ TRACK INFORMATION Command, the First Track Number in Last Session is identified. This is inclusive of the invisible track.

Last Track Number in Last Session (bytes 6 & 11) is the track number of the last track in the last session. In order for Tracks in the last Session, that may be open, to be scanned by READ TRACK INFORMATION Command, the Last Track Number in Last Session is identified.This is inclusive of the invisible track.

The DID_V (Disc ID Valid) bit, when set to one, indicates that the Disc Identification field is valid.

The DBC_V (Disc Bar Code Valid bit, when set to one, indicates that the Disc Bar Code field (bytes 24 through 31) is valid.

The URU (Unrestricted Use Disc) bit, when set to one, indicates that the mounted DVD-R, CD-R/RW disc is defined for unrestricted use. For DDCD, the Unrestricted Use Disc bit shall be set to one.

When the Unrestricted Use Disc bit is set to zero, the mounted DVD-R, CD-R/RW disc is defined for

restricted use. To record data to the mounted disc the appropriate Initiator Application code shall be set through the Write Parameters Page. For DDCD, Initiator Application code is not treated. Initiator Application code of the Write Parameters Page is ignored by the DDCD logical unit.

An Initiator Application Code of zero may be used to indicate a restricted use disc - general purpose. Logical Units that do not read a URU bit from the medium shall set this bit to one.

For CD/DD, the Disc Type field specifies the type of data on the whole disc. A disc has only one disc type. The Disc Type shall be obtained from the PMA or from the A0/PSEC field in the TOC of the first session in that there is at least one data track, or is recorded together with disc ID in PMA.

In the case of a session that contains no data track (only audio), A0/PSEC field in the TOC of the session is always 00h regardless of actual Disc Type. For DDCD, the Disc Type shall be set to 20h.

For CD discs, the Disc Type shall be determined from the following sequences:

> 1) Disc ID (Disc Type) as written in PMA;
>
> 2) From the first Complete Session that includes at least one data track;
>
> 3) From the first Session of a Complete Disc;
>
> 4) The Disc type is NOT decided, the Disc Type field of Disc Information shall contain FF. (undefined).

Table 13 - Disc Type Field - PMA

Disc Type Code	Disc Type
00h	CD-DA or CD-ROM Disc
10h	CD-I Disc
20h	CD-ROM XA Disc DDCD
FFh	Undefined
All Other Values	Reserved

For CD/DD, the Disc Identification number recorded in the PMA is returned. The Disc Identification Number is recorded in the PMA as a six-digit BCD number. It is returned in the Disc Information Block as a 32 bit binary integer.

The Last Session Lead-in Start Time field is valid only for CD medium. Otherwise, this field shall be set to 0. This field is an address given in MSF format as defined in sub-clause **Error! Reference source not found.** This field shall specify the location of the next Lead-in to be recorded. If the disc is Empty as specified in the Disc Status field or has no Complete Session, then the Lead-in Start Time is returned as specified by ATIP. If the last Session, is second or greater, Empty or Incomplete, this field shall specify the Lead-in Start Time of the Last Session. If the Disc Status is Complete, the Lead-in Start Time shall be FF/FF/FF/FF HMSF.

The Last Possible Start Time for Start of Lead-out field is valid only for CD media. Otherwise this field shall be set to 0. This field is returned as the address, encoded in the ATIP and is returned in HMSF format as specified in sub-clause **Error! Reference source not found.** If the disc is a Complete Disc, the Last Possible Start Time of Lead-out shall be FF/FF/FF/FF HMSF.

The Disc Bar Code field contains the hexadecimal value of the bar code if the Logical Unit has the ability to read Disc Bar Code and a bar code is present. See **Error! Reference source not found.**. For DDCD, the Disc Bar Code does not exist. The Disc Bar Code field shall be set to 0.

An OPC (Optimum Power Calibration) Table is attached only if the values are known for the disc. Since OPC values are likely to be different for different recording speeds, each table entry is associated with a recording speed. The Number of OPC Table Entries indicates that [8 x (Number of OPC Table Entries)] bytes follow the first part of the Disc Information. This number shall be the same for all values of Allocation Length. The Number of OPC Table Entries shall always be zero for discs that OPC has not yet been determined. For DVD-R, the use of OPC table entries is vendor- specific.

Table 14 - OPC Table Entry

Bit Byte	7	6	5	4	3	2	1	0
0	Speed (kBytes per second)							
1								
2	OPC Values							
3								
4								
5								
6								
7								

Speed is in kBytes per second. See SEND OPC Command sub-clause **Error! Reference source not found.**

The OPC Value field is associated with the speed specified in the speed field, and its content is vendor specific.

Recommended error reporting is defined in Table 15.

Table 15 - Recommended errors for READ DISC INFORMATION Command

Error	Reference
Deferred Errors	Sub-clause **Error! Reference source not found.**
General Errors	**Error! Reference source not found.**
Media Access Errors	**Error! Reference source not found.**

6.1.20 Read Format CAPACITIES

The READ FORMAT CAPACITIES command (Table 16) allows the Initiator to request a list of the possible format capacities for an installed random-Writable media. This command also has the capability to report the capacity for a media when it is installed. If the command is required, by an implemented Feature it shall function independently of the state of that Feature's Current bit.
The Allocation Length field specifies the maximum number of bytes that an Initiator has allocated for returned data. An Allocation Length of zero indicates that no data shall be transferred. This condition shall not be considered as an error. The Logical Unit shall terminate the data transfer when Allocation Length bytes have been transferred or when all available data have been transferred to the Initiator, whatever is less.

Table 16 – READ FORMAT CAPACITIES Command Descriptor Block

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (23h)							
1	Reserved			Reserved				
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	(MSB)	Allocation Length						
8								(LSB)
9	Control							

Table 17 – READ FORMAT CAPACITIES Data Format

Bit Byte	7	6	5	4	3	2	1	0
0 - 3	Capacity List Header							
4 – 11	Current/Maximum Capacity Descriptor							

Formattable Capacity Descriptor(s)

0	
..	Formattable Capacity Descriptor 0
7	
….	
0	
..	Formattable Capacity Descriptor n
7	

Table 18 – Capacity List Header

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved							
1	Reserved							
2	Reserved							
3	Capacity List Length							

The Capacity List Length specifies the length in bytes of the Capacity Descriptors that follow. Each Capacity Descriptor is eight bytes in length, making the Capacity List Length equal to eight times the number of descriptors. Values of n * 8 are valid, where 0 < n < 32.

Table 19 – Current/Maximum Capacity Descriptor

Bit Byte	7	6	5	4	3	2	1	0
4	(MSB)							
5				Number of Blocks				
6								
7								(LSB)
8	Reserved						Descriptor Type	
9	(MSB)							
10				Block Length				
11								(LSB)

The Number of Blocks indicates the number of addressable blocks for the capacity defined by each Descriptor Type.

The Descriptor Type field (Table 20) indicates the type of information the descriptor contains.

Table 20 – Descriptor Types

Descriptor Type	Description
00b	Reserved
01b	Unformatted Media. The reported value is for the maximum formatted capacity for this media. For DDCD/CD-RW medium, the value reported is the maximum possible when using Format Type 10h.
10b	Formatted Media. The reported value is the current media's capacity. In the case of sequential writable media, the number of blocks field indicates the number of blocks between the first Lead-in and the Lead-out or Border-out. When the media doen not have a complete session it shall be reported as "No Media Present" with Descriptor Type = 11b.
11b	No Media Present. The reported value is for the maximum capacity of a media that the Logical Unit is capable of reading.

The Block Length specifies the length in bytes of each logical block.

6.1.24.2 Sub-Channel Data Format (01h) CD current position

Table 21 defines the response data format for the CD current position data format.

Table 21 - CD current position data format

Bit / Byte	7	6	5	4	3	2	1	0
0	Sub-channel Data Format Code (01h)							
1	ADR				CONTROL			
2	TRACK NUMBER							
3	INDEX NUMBER							
4	(MSB)							
	Absolute CD Address							
7								(LSB)
8	(MSB)							
	Track Relative CD Address							
11								(LSB)

The ADR field gives the type of information encoded in the Q Sub-channel of this block, as shown in Table 22.

Table 22 - ADR Q Sub-channel field

ADR Code	Description
0h	Q Sub-channel mode information not supplied
1h	Q Sub-channel encodes current position data (i.e., track, index, absolute address, relative address)
2h	Q Sub-channel encodes media catalog number
3h	Q Sub-channel encodes ISRC
4h – Fh	Reserved

The control field is defined in Table 23.

The bits of the control field (except for the copy bit) can change during an actual pause (X=00) of at least 2 seconds and during the Lead-in area only.

Table 23 - Q Sub-channel control field

Field	Definitions
00x0b	2 audio channels without pre-emphasis
00x1b	2 audio channels with pre-emphasis of 50/15 µs
10x0b	audio channels without pre-emphasis (reserved in CD-R/RW)
10x1b	audio channels with pre-emphasis of 50/15 µs (reserved in CD-R/RW)
01x0b	Data track, recorded uninterrupted
01x1b	Data track, recorded incremental
11xxb	Reserved
xx0xb	digital copy prohibited
xx1xb	digital copy permitted

Table 324 - Q Sub-channel control field for DDCD

Field	Definitions
0100b	Data track, recorded uninterrupted or recorded incremental

6.1.25   Read TOC/PMA/ATIP Command

The READ TOC/PMA/ATIP Command (Table 24) requests that the Logical Unit transfer data from the Table of Contents, the Program Memory Area (PMA), and the Absolute Time in Pre-Grove (ATIP) from CD media. For media that does not support a TOC, this command will return fabricated information that is similar to that of CD media for some formats. This fabrication is required for some legacy Initiator environments.

Table 24 - READ TOC/PMA/ATIP Command Descriptor Block

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (43h)							
1	Reserved			Reserved			HMSF	Reserved
2	Reserved				Format			
3	Reserved							
4	Reserved							
5	Reserved							
6	Track/Session Number							
7	(MSB) Allocation Length							
8								(LSB)
9	Control							

See sub-clause **Error! Reference source not found.** for a description of the MSF bit.

The Format field is defined in Table 25.

Table 25 - Format Field

Format field	Return Data	Optional/ Mandatory	Description	Track/ Session field Usage
0000b	TOC	M	The Track/Session Number field specifies starting track number for that the data will be returned. For multi-session discs, this command will return the TOC data for all sessions and for Track number AAh only the Lead-out area of the last complete session. See Table 27.	Track Number
0001b	Session Info	M	This format returns the first complete session number, last complete session number and last complete session starting address. In this format, the Track/Session Number field is reserved and should be set to 00h. NOTE: This format provides the Initiator access to the last finalized session starting address quickly. See Table 28.	Reserved
0010b	Full TOC	M	This format returns all Q sub-code data in the Lead-in(TOC) areas starting from a session number as specified in the Track/Session Number field, In this mode, the Logical Unit will support Q Sub-channel POINT field value of A0h, A1h, A2h, Track numbers, B0h, B1h, B2h, B3h, B4h, C0h, and C1h. See Table 29. There is no defined LBA addressing and MSF bit shall be set to one.	Session Number
0011b	PMA	O	This format returns all Q sub-code data in the PMA area. In this format, the Track/Session Number field is reserved and shall be set to 00h. See Table 33. There is no defined LBA addressing and MSF bit shall be set to one.	Reserved
0100b	ATIP	O	This format returns ATIP data. In this format, the Track/Session Number field is reserved and shall be set to 00h. See Table 34. There is no defined LBA addressing and MSF bit shall be set to one.	Reserved
0101b	CD-TEXT	O	This format returns CD-TEXT information that is recorded in the Lead-in area as R-W Sub-channel Data	Reserved
All Other Format Codes			Reserved.	Reserved

The Track/Session Number field specifies the starting track number for that the data shall be returned. The data is returned in contiguous ascending track number order. A value of AAh requests that the starting address of the Lead-out area be returned. If this value is zero, the Table of Contents data shall begin with the first track or session on the medium.
If the Track/Session Number field is not valid for the currently installed medium, the command shall be terminated with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.
When a Read TOC/PMA/ATIP command is presented for a DDCD/CD-R/RW media, where the first TOC has not been recorded (no complete session) and the Format codes 0000b, 0001b, or 0010b are specified, this command shall be rejected with an INVALID FIELD IN CDB. Devices that are not capable of reading an incomplete session on DDCD/CD-R/RW media shall report CANNOT READ MEDIUM – INCOMPATIBLE FORMAT.

6.1.25.1   READ TOC Response parameter list, general definition
The response parameter list (see Table 26) indicates the general description of the response data to the Read TOC/PMA/ATIP command. Each descriptor field is format specific and is defined in the appropriate format sub-clause.

Table 26 - READ TOC/PMA/ATIP parameter list, general definition

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			Data Length				
1								(LSB)
2	First Track/Session/Reserved Field(Hex)							
3	Last Track/Session/Reserved Field(Hex)							
Parameter List Descriptor(s)								
0 : : n	Descriptor data , format specific							

The Data Length indicates the length, in bytes, of the parameter list descriptor data.
The Track/Session/Reserved Field is format specific and indicates the location, if any, of the information in the parameter list descriptors.
Descriptor data fields are format specific. The definitions of the bytes are described in each format sub-clause.

6.1.25.2   TOC/PMA/ATIP Response Data Format 0000b
The response data consist of four header bytes and zero or more track descriptors. The response data is dependent upon the format specified in the format field of the CDB. The response data returned for Format 0000b is specified in Table 27.

Table 27 - READ TOC/PMA/ATIP response data (Format = 0000b)

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			TOC Data Length				
1								(LSB)
2	First Track Number(Hex)							
3	Last Track Number(Hex)							
TOC Track Descriptor(s)								
0	Reserved							
1	ADR				CONTROL			
2	Track Number(Hex)							
3	Reserved							
4	(MSB)							
...	Logical Block Address							
7								(LSB)

The TOC data length indicates the length in bytes of the following TOC data. The TOC data length value does not include the TOC data length field itself. This value is not modified when the allocation length is insufficient to return all of the TOC data available.
The First Track Number field indicates the first track number in the first complete session Table of Contents.
The Last Track Number field indicates the last track number in the last complete session Table of Contents before the Lead-out.
The ADR field gives the type of information encoded in the Q Sub-channel of the block where this TOC entry was found. The possible ADR values are defined in Table 22.
The Control Field indicates the attributes, of the track, see Table 23.

For DDCD, the bits control field is always set to 0100b (see table 324).
The Track Number field indicates the track number for that the data in the TOC track descriptor is valid. A track number of AAh indicates that the track descriptor is for the start of the Lead-out area. The Logical Block Address contains the address of the first block with user information for that track number as read from the Table of Contents. An MSF bit of zero indicates that the Logical Block Address field contains a logical block address. An MSF bit of one indicates the Logical Block Address field contains an MSF address (see sub-clause 4.1.6).

6.1.25.3   TOC/PMA/ATIP Response Data Format 0001b

The response data returned for Format 0001b is specified in Table 28.

Table 28 - READ TOC/PMA/ATIP response data (Format = 0001b)

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			TOC Data Length				
1								(LSB)
2	First Complete Session Number (Hex)							
3	Last Complete Session Number (Hex)							

TOC Track Descriptor

	7	6	5	4	3	2	1	0
0	Reserved							
1	ADR				CONTROL			
2	First Track Number In Last Complete Session (Hex)							
3	Reserved							
4	(MSB)							
…	Logical Block Address of First Track in Last Session							
7								(LSB)

The TOC Data Length specifies the length in bytes of the available session data. The TOC Data Length value does not include the TOC Data Length field itself. This value is not modified when the allocation length is insufficient to return all of the session data available.

The First Complete Session Number is set to one.

The Last Complete Session Number indicates the number of the last complete session on the disc. The Last Complete Session Number shall be set to one for a single session disc or if the Logical Unit does not support multi-session discs.

The ADR field gives the type of information encoded in the Q Sub-channel of the block where this TOC entry was found. The possible ADR values are defined in Table 22.

The Control Field indicates the attributes of the track. The possible control field values are defined in Table 23.

First Track Number In Last Complete Session returns the first track number in the last complete session.

The Logical Block Address contains the address of the first block with user information for the first track of the last session, as read from the Table of Contents. An MSF bit of zero indicates that the Logical Block Address field contains a logical block address. An MSF bit of one indicates the Logical Block Address field contains an MSF address (see sub-clause **Error! Reference source not found.**).

6.1.25.4 TOC/PMA/ATIP Response Data Format 0010b

None of the fields in the response data of Format 0010b are affected by the HMSF bit in the CDB. The response data returned for Format 0010b is specified in Table 29.

Table 29 - READ TOC/PMA/ATIP response data (Format = 0010b)

Bit / Byte	7	6	5	4	3	2	1	0
0	(MSB)			TOC Data Length				
1								(LSB)
2	First Complete Session Number (Hex)							
3	Last Complete Session Number (Hex)							
TOC Track Descriptor(s)								
0	Session Number (Hex)							
1	ADR				CONTROL			
2	TNO							
3	POINT							
4	Min							
5	Sec							
6	Frame							
7	Zero							
	Hour				PHOUR			
8	PMIN							
9	PSEC							
10	PFRAME							

Multiple TOC Track Descriptors may be returned, but only one of each entry is reported.

For Format field of 0010b, the Logical Unit shall return TOC data for Q Sub-channel modes 1 and 5 (except mode 5, point 1 through 40) in the Lead-in area.

The TOC Data Length specifies the length in bytes of the available TOC data. The TOC Data Length value does not include the TOC Data Length field itself. This value is not modified when the allocation length is insufficient to return all TOC data available.

The First Complete Session Number shall be set to one.

The Last Complete Session Number indicates the number of the last complete session on the disc. The Last Complete Session Number is set to one for a single session disc or if the Logical Unit does not support multi-session discs.

The ADR field gives the type of information encoded in the Q Sub-channel of the block where this TOC entry was found. The possible ADR values are defined in Table 22.

The Control Field indicates the attributes of the track. The possible control field values are defined in Table 23.

Entries in bytes 2 through 10 of the descriptors (TNO, POINT, MIN, SEC, FRAME, PMIN, PSEC, PFRAME, Zero, HOUR, PHOUR) shall be converted to hex by the Logical Unit if the media contains a value between 0 and 99bcd. (See **Error! Reference source not found.**)

The returned TOC data of a multi-session disc is arranged in ascending order of the session number with duplicates removed. The TOC data within a session is arranged in the order of Q Sub-channel POINT field value of A0h – AFh, Track Numbers, B0h, BFh. Only recorded Points shall be returned.

The TOC Track Descriptor format in the Lead-in area of the TOC is described in Table 30.

Table 30 - TOC Track Descriptor Format, Q Sub-channel

CTRL	ADR	TNO	POINT	MIN	SEC	FRAME	ZERO	PMIN	PSEC	PFRAME
4 or 6	1	00h	01h-63h	ATIME (Absolute time)			00h	Start position of track		
4 or 6	1	00h	A0h	ATIME (Absolute time)			00h	First Track Number	Disc Type	00h
4 or 6	1	00h	A1h	ATIME (Absolute time)			00h	Last Track Number	00h	00h
4 or 6	1	00h	A2h	ATIME (Absolute time)			00h	Start position of Lead-out		
4 or 6	5	00h	B0h	Start time of next possible program in the Recordable Area of the disc			# of pointers in Mode 5	Maximum start time of outer-most Lead-out area in the Recordable Area of the disc		
4 or 6	5	00h	B1h	00h	00h	00h	00h	# of skip interval Pointers (N<=40)	# of skip Track Pointers (N<=21)	00h
4 or 6	5	00h	B2h-B4h	Skip #	Skip #	Skip #	Skip #	Skip #	Skip #	Skip #
4 or 6	5	00h	01h-40h	Ending time for the interval that should be skipped			Reserved	Start time for interval that should be skipped on playback		
4 or 6	5	00h	C0h	optimum recording power	Reserved	Reserved	Reserved	Start time of the first Lead-in Area of the disc		
4 or 6	5	00h	C1h	Copy of information from A1 point in ATIP.						

The DDCD TOC Track Descriptor format in the Lead-in area of the TOC is described in the Table 328
All of the TOC Track Descriptors, in Table 30, are further define in sub-clause found. The POINT Field (Table 31) defines various types of information within the TOC Lead-in area.

Table 328 – DDCD TOC Track Descriptor Format, Q Sub-channel

CTRL	ADR	TNO	POINT	MIN	SEC	FRAME	HOUR	PHOUR	PMIN	PSEC	PFRAME
4	1	00h	01h-63h	ATIME (Absolute time)				Start position of track			
4	1	00h	A0h	ATIME (Absolute time)				0000b	First Track Number	Disc Type 20h	00h
4	1	00h	A1h	ATIME (Absolute time)				0000b	Last Track Number	00h	00h
4	1	00h	A2h	ATIME (Absolute time)				Start position of Lead-out			
4	1	00h	F0h	ATIME (Absolute time)				0000b	Book type / Book ver.	Material type	Moment of inertia
4	5	00h	B0h	Start time of next possible program in the Recordable / ReWritable Area of the disc				Maximum start time of outer-most Lead-out area in the Recordable / ReWritable Area of the disc			
4	5	00h	C0h	Copy of Special Information1 in ATIP (ROM: reserved and set to zero)			# of pointers in Mode 5	Start time of the first Lead-in Area of the disc			
4	5	00h	C1h	Copy of Additional Information1 in ATIP.				0000b	Set to zero		
4	5	00h	CFh	Stop position of Inner part Lead-out Area				Start position of outer part Lead-in Area			

Table 31 - POINT Field

ADR	POINT Field	Description
1	01-63h	Track number references
1	A0h	First Track number in the program area
1	A1h	Last Track number in the program area
1	A2h	Start location of the Lead-out area
5	01-40h	Skip Interval Pointers
5	B0h	Used to Identify a Multi-session Disc (Photo CD) Contains start time of next possible program area
5	B1h	Number of skip interval pointers & Skip track assignments
5	01-40h	Skip Interval Pointers
5	B2-B4h	Skip Track Assignment Pointers
5	C0h	Start time of first Lead-in area of disc (This only exists in the first Lead-in area)
5	C1h	Copy of information from additional area 1 in ATIP.

The Disc Type field (see Table 32) indicates the type of disc inserted.

Table 32 - Disc Type Byte Format

Value	Description
00h	CD-DA or CD Data with first track in Mode 1
10h	CD-I disc
20h	CD data XA disc with first track in Mode 2 or DDCD disc

The definition for the Control Field in the Q Sub-channel is in Table 23.

6.1.25.5   TOC/PMA/ATIP Response Data Format 0011b

None of the fields in the response data of Format 0011b are affected by the MSF bit in the CDB.The response data returned for Format 0011b is specified in Table 33.

Table 33 - READ TOC/PMA/ATIP response data (Format = 0011b)

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			PMA Data Length				
1								(LSB)
2	Reserved							
3	Reserved							

PMA Descriptor(s)

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved							
1	ADR				CONTROL			
2	TNO							
3	POINT							
4	Min							
5	Sec							
6	Frame							
7	Zero							
	Hour				Phour			
8	PMIN							
9	PSEC							
10	PFRAME							

Multiple PMA Descriptors may be returned.

The returned PMA descriptors are arranged in the order found in the PMA, with duplicates removed.
The PMA Data Length indicates the length in bytes of the available PMA data. The PMA Data Length value does not include the PMA Data Length field itself. This value is not modified when the allocation length is insufficient to return all PMA data available. This value is set to 2 plus eleven times the number of descriptors read.
Entries in bytes 2 through 10 of the descriptors (TNO, POINT, MIN, SEC, FRAME, Zero, HOUR, PHOUR) shall be converted to binary by the Logical Unit if the media contains a value between 0 and 99bcd. (See **Error! Reference source not found.**)

6.1.26 TOC/PMA/ATIP Response Data Format 0100b

None of the fields in the response data of Format 0100b are affected by the MSF bit in the CDB. The response data returned for Format 0100b is specified in Table 34.

Table 34 - READ TOC/PMA/ATIP response data (Format = 0100b)

Bit / Byte	7	6	5	4	3	2	1	0
0	(MSB)			ATIP Data Length				
1								(LSB)
2	Reserved							
3	Reserved							

ATIP Descriptor

Bit / Byte	7	6	5	4	3	2	1	0
0	1	Indicative Target Writing Power			Revered / DDCD	Reference Speed		
1	0	URU	Reserved					
2	1	Disc Type	Disc Sub-Type			A1	A2	A3
3	Reserved							
4	ATIP Start Time of Lead-in (Min)							
5	ATIP Start Time of Lead-in (Sec)							
6	ATIP Start Time of Lead-in (Frame)							
7	Reserved							
8	ATIP Last Possible Start Time of Lead-out (Min)							
9	ATIP Last Possible Start Time of Lead-out (Sec)							
10	ATIP Last Possible Start Time of Lead-out (Frame)							
11	Reserved							
12	0	Lowest Usable CLV Recording Speed			Highest Usable CLV Recording Speed			
13	0	Power Multiplication Factor p			Target y value of the Modulation/Power function			Reserved
14	1	Recommended Erase/Write Power Ratio (P_{eo}/W_{eo})			Reserved			
15	Reserved							
16-18	A2 Values							
19	Reserved							
20-22	A3 Values							
23	RESERVED							
24-26	S4 Values							
27	Reserved							

ATIP Data Length specifies the number of bytes to be transferred in response to the command. The ATIP Data Length value does not include the data length field itself. This value is not modified when the allocation length is insufficient to return all of the ATIP data available.

The DDCD bit, when set to one, indicates that DDCD-R/RW disc is mounted. When the DDCD bit is set to zero, indicates that CD-R/RW disc is mounted.

The fields in the response data of Format 0100b are affected by the DDCD bit.

Indicative Target Writing Power Field - encoded information indicating the media's recommended initial laser power setting. When the DDCD bit is set to zero, Indicative Target Writing Power Field is 3

bits space. When the DDCD bit is set to one, Indicative Target Writing Power Field is 4 bits space. The meaning of these bits varies between DDCD/CD-R and DDCD/CD-RW media.

Reference Speed Field - encoded information indicating the recommended write speed for the media. 00h = reserved. 01h - 2X recording, 02h-07h are reserved. Only valid for CD-RW/DDCD-R/RW media.

For DDCD-RW media, 000b-001b = reserved. 010b = 4x recording. 011b = 8x recording, 100b-111b are reserved.

The URU (Unrestricted Use Disc) bit, when set to one, indicates that the mounted CD-R/RW or DDCD-R/RW disc is defined for unrestricted use. When the Unrestricted Use Disc bit is set to zero, the mounted CD-R/RW disc is defined for restricted use. To record data to the mounted disc the appropriate Initiator Application code shall be set through the Write Parameters Page. An Initiator Application Code of zero may be used to indicate a restricted use disc - general purpose.

Disc Type - zero indicates CD-R or DDCD-R media; one indicates CD-RW or DDCD-RW media. When the Disc Type bit is set to zero and the DDCD bit is set to zero, the Disc Type indicates CD-R media. When the Disc Type bit is set to zero and the DDCD bit is set to one, the Disc Type indicates DDCD-R media. When the Disc Type bit is set to one and the DDCD bit is set to zero, the Disc Type indicates CD-RW media. When the Disc Type bit is set to one and the DDCD bit set to one, the Disc Type indicates DDCD-RW media.

Disc Sub-Type - shall be set to zero.

A1 - when set to one, indicates that bytes 16-18 are valid.

A2 - when set to one, indicates that bytes 20-22 are valid.

A3 - when set to one, indicates that bytes 24-26 are valid.

When DDCD bit is set, byte 24-27 are valid.

The special information 4(S4) field are available for both DDCD-R and DDCD-RW

ATIP Start Time of Lead-in (min, sec, frame) - the start time of the Lead-in. The value is read from ATIP and returned in hex format. Legal values for the M field are 50h through 63h.

When the DDCD bit is set to one, ATIP Start Time of Lead-in field contains not HMSF address but binary address.

ATIP Last Possible Start Time of Lead-out (min, sec, frame) - the last possible start time of Lead-out. The value is read from ATIP and returned in hex format. Valid values for the M field is 0 through 4Fh.

When the DDCD bit is set to one, ATIP Start Time of Lead-out field contains binary address.

Lowest Usable CLV Recording Speed (see Table 35) - valid only when A1 = 1.

Table 35 - Lowest CLV Recording Speeds

Value	Recording Speed
000b	Reserved
001b	2X
010b - 111b	Reserved

Highest Usable CLV Recording Speed (see Table 36)- valid only when A1 = 1.

Table 36 - Highest CLV Recording Speeds

Value	Recording Speed
000b	Reserved
001b	2X
010b	4X
011b	6X
100b	8X
101b - 111b	Reserved

The following fields reported as recorded in ATIP, contain information that is beyond the scope of this standard.

> Power Multiplication Factor p field.
> Target y value of the Modulation/Power function field.
> Recommended Erase/Write Power Ratio (P_{eo}/W_{eo}) field.
> A2 Values - Reserved
> A3 Values - Reserved

6.1.26.1   TOC/PMA/ATIP Response Data Format 0101b

None of the fields in the response data of Format 0101b are affected by the MSF bit in the CDB. The response data returned for Format 0101b is specified in **Error! Reference source not found.**.

When a Read TOC/PMA/ATIP command with the Format code 0101b is presented for a DDCD-R/RW media, this command shall be rejected with an INVALID FIELD IN CDB.

6.1.26 Read Track Information Command

The READ TRACK INFORMATION Command (Table 37) provides information about a track, regardless of its status. In case of media that does not support logical tracks, the number of tracks and sessions is considered one. If this command is required, by an implemented Feature, the command shall function if any media is present.

For CD/DD, if the PMA/TOC is unreadable, the command shall be terminated with CHECK CONDITION Status, sense code of UNABLE TO RECOVER TABLE-OF-CONTENTS. For DVD, if the RMA/RMD in Border-out is unreadable, the command shall be terminated with CHECK CONDITION Status, sense code L-EC UNCORRECTABLE ERROR.

Table 37 - READ TRACK INFORMATION Command Descriptor Block

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (52h)							
1	Reserved						Address/Number Type	
2	(MSB)							
3	Logical Block Address/							
4	Track/Session Number							
5								(LSB)
6	Reserved							
7	(MSB) Allocation Length							
8								(LSB)
9	Control Byte							

The Address/Number Type field in byte 1 is used to specify the contents of bytes 2 through 5 of the CDB.

The Logical Block Address/Track/Session Number field, Bytes 2 through 5 are defined in Table 38.

Table 38 – LBA/Track/Session Number Field definition

Address/ Number Type field	Logical Block Address/Track/ Session Number	Description
00b	Logical Block Address	T_{LBA}, where T_{LBA} is the number of the track that contains the block associated with Logical Block Address.
01b	00h	T_{toc}, where T_{toc} is the Lead-in area of the disc
01b	T_{CDB}, a valid track number	T_{CDB}
01b	FFh	T_{INV}, where T_{INV} is the Track number of the invisible or incomplete Track
10b	Session Number	$T_{session}$, where $T_{session}$ is the number of the first Track that is in the Session Number.
11b	Reserved	

The number of Track Information Block bytes returned is limited by the Allocation Length parameter of the CDB. An Allocation Length of zero is not an error. Fields not used with the installed media shall return 0.

The format and content of the Track Information Block is shown in Table 39.

Table 39 - Track Information Block

Bit / Byte	7	6	5	4	3	2	1	0
0	(MSB)			Data Length				
1								(LSB)
2	Track Number (LSB)							
3	Session Number (LSB)							
4	Reserved							
5	Reserved		Damage	Copy	Track Mode			
6	RT	Blank	Packet/Inc	FP	Data Mode			
7	Reserved						LRA_V	NWA_V
8	(MSB)							
9				Track Start				
10				Address				
11								(LSB)
12	(MSB)							
13				Next Writable				
14				Address				
15								(LSB)
16	(MSB)							
17				Free				
18				Blocks				
19								(LSB)
20	(MSB)							
21				Fixed Packet Size/				
22				Blocking Factor				
23								(LSB)
24	(MSB)							
25				Track Size				
26								
27								(LSB)
28	(MSB)							
29				Last Recorded Address				
30								
31								(LSB)
32	Track Number (MSB)							
33	Session Number (MSB)							
34	Reserved							
35	Reserved							

Data length field specifies the length, in bytes, of the requested data to be transferred in response to the command. The data length value does not include the data length field itself. If the Allocation length specified is less than the data length, the response shall be truncated at the allocation length specified. This truncation shall not cause a CHECK CONDITION status to be presented. The Data Length is not modified when the allocation length is insufficient to return all of the response data available.

Track Number is the track number for all of the information in this structure or a value of 1 for media not containing logical tracks. If the Track number is set to zero, and the P through W bit is set (see Table 7),the contents of Track Information Block shall be returned for the Lead-In area. In this case, the Track Start Address field is the start address of the Lead-In area.

Session Number is the number of the session containing this track, or a value of 1 for media not containing sessions that contain this track.

The Copy bit indicates that this track is a second or higher generation copy. For media that does not support CGMS, this bit shall beset to zero.

The Damage bit, when set to one, and the NWA_V is set to zero, the track shall be considered "not closed due to an incomplete write". An automatic repair may be attempted by the Logical Unit when the CLOSE TRACK/SESSION command is issued. Further incremental writing in this track is not possible. The Damage bit, when set to one, and the NWA_V is set to one, indicates a Track that may be recorded further in an incremental manner. An automatic repair shall be attempted by the Logical Unit when the next command that requires writing to the Track is issued. If the repair is successful, the Damage bit shall be set to zero. Prior to the start of the repair, the NWA field shall contain the address of the Next Writable Sector assuming a successful repair.

Track Mode is the control nibble as defined for mode 1 Q Sub-channel for this track. For non-CD media, this field shall be set to 4. (For DDCD, this field shall be set to 4). See Table 4 and Table 23

For CD/DD, if the RT bit is zero, then the track is not reserved, otherwise the track is reserved. The RT bit indicates that a PMA entry indicating the track's start and end addresses exists. For DVD, the RT bit of zero indicates that the Track is Complete, Invisible, or Incomplete status. An RT bit of one indicates that the Track is Empty Reserved or Partially Recorded Reserved status.

If the Logical Unit is not capable of reading the PMA or RMA, this field shall be set to zero.

The Blank bit, when set to one, indicates that the track contains no written data and Last Recorded Address field is invalid. For CD/DD, Tracks with the Track Descriptor Block recorded shall not be considered blank. For other media, this bit shall be set to zero.

For CD/DD, the Packet/Inc bit is valid only when the RT bit is set to one or the track indicated is the incomplete track. The Packet/Inc bit, when set to one, indicates that this track is to be written only with packets (CD) or incremental recording (DVD).

For CD/DD media, the FP (Fixed Packet) bit is valid only when the Packet/Inc bit is set to one. When the Packet/Inc bit is set to one and the FP bit is also set to one, then the track is to be written only with fixed packets. When the Packet/Inc bit is set to one and the FP bit is set to zero, then the track is to be written only with variable packets. Except for C/DVD-R/RW, this field should be set to zero

When writing, certain parameters may be set via the Write Parameters Page. The state of the track determines what parameters shall be set and that parameters in the mode page shall match. Required Write Parameters are defined in Table 40.

Table 40 - Write Parameter Restrictions due to Track State

RT	Blank	Packet	CD Write Parameter Restrictions	DVD Write Parameter Restrictions
0	0	0	Can't write to stamped disc, or during track at once on invisible track, or writing session at once mode	Can't write to stamped disc, or writing disc-at-once, can not write to complete disc.
0	0	1	Write type is set to packet; all parameters common to READ TRACK INFOMATION and the Write Parameters mode page shall match.	Write type is set to incremental; all parameters common to READ TRACK INFOMATION and the Write Parameters mode page shall match
0	1	0	Write type may be set to packet or TAO. All other parameters shall be changeable. If this track is the first track of a Session, then Session at Once is allowed.	Write type is set to disc-at-once:Invisiable Track of disc-at-once, empty. Can't start disc-at-once recording in this state. A Track shall be reserved prior to start of disc-at-once recording. All parameters common to READ TRACK INFOMATION and the Write Parameters mode page shall match
0	1	1	Invalid State	Write type is set to incremental; Invisiable track for incremental recording, the Track is writable. All parameters common to READ TRACK INFOMATION and the Write Parameters mode page shall match
1	0	0	Can't write to recorded track or during track at once on reserved Track.	Can't write to disc during disc at once on reserved Track.
1	0	1	Write type is set to packet; all parameters common to READ TRACK INFO and the write parameters mode page shall match.	Write type is set to incremental; Partially recorded reserved Track, the Track is writable. All parameters common to READ TRACK INFOMATION and the Write Parameters mode page shall match
1	1	0	Write type is set to TAO. Track mode set to same as READ TRACK INFO. Copy bit may be set only if copyright bit in track mode is clear. All other common parameters shall match.	Write type is set to disc-at-once; Empty reserved Track for disc-at-once. All parameters common to READ TRACK INFOMATION and the Write Parameters mode page shall match
1	1	1	Write type is set to Packet. Track mode set to same as READ TRACK INFO. Copy bit may be set only if copyright bit in track mode is clear. FP and packet size are changeable. All other common parameters shall match.	Write type is set to incremental; Empty reserved Track, the Track is writable. All parameters common to READ TRACK INFOMATION and the Write Parameters mode page shall match

For CD, when the RT, Blank and Packet bits are set to one, FP bit of the READ TRACK INFORMATION response data is set to zero.

Data Mode field defines the track content. Data Mode is defined in Table 42.

Table 41 - Track Status Indications

RT	Blank	Packet	FP	DVD		CD	
				Write Method	Track Status	Write Method	Track Status
0	0	0	-	-	(invalid)	Uninterrupted/ TAO/SAO	Complete/During TAO/SAO
0	0	1	0	Incremental	Incomplete	Variable	Incomplete
0	0	1	1	-	(invalid)	Fixed	Incomplete
0	1	0	-	DAO/ Incremental	Invisible	TAO/Variable/ Fixed(*)	Invisible
0	1	1	0	Incremental	Invisible	-	(invalid)
0	1	1	1	-	(invalid)	-	(invalid)
1	0	0	-	DAO	Complete/ during DAO	TAO	Complete/During TAO
1	0	1	0	Incremental	Complete/ Partially Recorded Reserved	Variable	Complete/ Partially Recorded Reserve
1	0	1	1	-	(invalid)	Fixed	Complete/ Partially Recorded Reserve
1	1	0	-	DAO	Before starting writing	TAO	Empty Reserved
1	1	1	0	Incremental	Empty Reserved	Variable/Fixed	Empty Reserved
1	1	1	1	-	(invalid)	-	(invalid)
* In case last session is empty, SAO is also valid.							

Table 42 - Data Mode

Value	Definition
1	Mode 1 (ISO/IEC 10149)
2	Mode 2 (ISO/IEC 10149 or CD-ROM XA) DDCD
Fh	Data Block Type unknown (no track descriptor block)
0, 3 - Eh	Reserved

If NWA_V is zero, then the next writable address field is not valid. Otherwise the next writable address field is valid. NWA_V shall be set to zero if the Track is not writable for any reason.
If LRA_V is zero, then the Last Recorded Address field is not valid. Otherwise, the Last Recorded Address field is valid. The LRA_V bit shall be set to zero if the Track has damage for any reason and is repaired automatically.
The Track Start Address is the starting address for the specified Track.

The Next Writable Address, if valid, is the LBA of the next writable user block in the Track specified by the LBA/Track Number field in the CDB. For CD media, Next Writable Address shall be associated with the RT, Blank, Packet and FP bits as defined in Table 43. If the write type is Raw, the Next Writable Address may be a negative number as required to point to the start of the first Lead-in. When streaming in any write type, the Next Writable Address shall be the next user data block the Logical Unit expects to receive if no under-run occurs.

Table 43 - Next Writable Address Definition

RT	Blank	Packet	FP	NWA_V	Definition
0	0	0	-	0^4	LBA that shall be specified by next write command *2
0	0	1	0	1^1	LBA that shall be specified by next write command *2
0	0	1	1	1^1	LBA that shall be specified by next write command *2, *3
0	1	0	0	1	LBA of the first data block after pre-gap *5
0	1	1	0	-	-
0	1	1	1	-	-
1	0	0	-	0^4	LBA that shall be specified by next write command *2
1	0	1	0	1^1	LBA that shall be specified by next write command *2
1	0	1	1	1^1	LBA that shall be specified by next write command *2, *3
1	1	0	-	1	LBA of the first data block after pre-gap
1	1	1	0	1	LBA of the first data block after pre-gap
1	1	1	1	-	-

Notes:
1 – When "Free Blocks" is 0 (data full), NWA_V is 0.
2 - NWA shall be taken account of data blocks in buffer that has not yet been written to media. If the Logical Unit can write the data of next write command without interrupting of current data streaming(no underrun condition), NWA shall be contiguous to last address data in buffer. If WCE in Mode Cache Page is zero, NWA shall be taken account of Link Blocks (2 Run-out blocks, 1 Link block and 4 Run-out blocks) in case of Addressing Method-1.
3 - NWA shall follow the Addressing Method-2 if Method-2 bit in Mode CD Capabilities and Mechanical Status Page is set to one.
4 – During TAO (SAO), NWA_V is 1.
5 - In the case of SAO NWA shall be the first block after Lead-in for the first track of session.

The Free Blocks field represents the maximum number of user data blocks available for recording in the track. For CD media, this field shall be computed as follows: First, the Available Track Space (ATS) shall be computed.

For the invisible track; $ATS = (StartTimeofLastPossibleLead\text{-}out) – NWA + 5$.

For a reserved track; $ATS = (PMAStopTime) – NWA + 5$.

For DDCD media, this field shall be computed as follows: First, the Available Track Space (ATS) shall be computed.

For the invisible/incomplete track;

$$ATS = (StartTimeofLastPossibleLead\text{-}out) – NWA + 4.$$

For a reserved track;

$$ATS = (PMAStopTime) – NWA + 4.$$

If the track is reserved for, or written with fixed packets, or is the invisible track and the Write Parameters Mode Page

specifies fixed packets,   Otherwise, $FreeBlocks = ATS – 7$.

> Note: The StartTimeofLastPossibleLead-out is the last possible location of the link block at the start of the Lead-out. If a disc is fully recorded, the PMA entry for the last track will be equal to the StartTimeofLastPossibleLead-out.

Addressing within fixed packet written tracks is translated by the Logical Unit for reading and writing. The NWA shall also reflect this translation:

Method 1 is the physical address.

Method 2 is used on fixed packet written tracks to hide the link areas from the Initiator. The TrackStartAddress is always a physical address, even if prior tracks are recorded with Method 2. IP( ) is the integer part of the value.

For CD, the Fixed Packet Size is valid only when the Packet and the FP bits are both set to one. For DVD-R, if the FP bit is set to zero, the Fixed Packet Size field specifies the number of sectors that are actual disc access unit. In the case of DVD, this field has a value of 16. FP bit set to one is undefined. If the disc is stamped, then DAMAGE = 0, BLANK = 0, RT = 0, and NWA_V = 0.

Track Size is the number of user data blocks in the track. For CD the track size shall be computed as follows:

First, compute the Complete Track Size (CTS).

For an incomplete track: $CTS = (StartTimeofLastPossibleLead\text{-}out) – PMATrackStart + 5$.

For a reserved track: $CTS = (PMAStopTime) – PMAStartTime + 5$.

For DDCD, the track size shall be computed as follows:

For an incomplete DDCD track:

$$CTS = (StartTimeofLastPossibleLead\text{-}out) – PMATrackStart + 4.$$

For a reserved DDCD track:

$$CTS = (PMAStopTime) – PMAStartTime + 4.$$