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MMC-2 Commands specific to CD Media Only

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10.0 Commands specific to CD Media Only

There are specific capabilities that are valid for CD media only. Most of these capabilities are provided by specialized commands and options. This section details these capabilities and commands. The commands in this section are only valid for CD media and will be rejected when any other media type is installed in the Logical Unit. Note that for a Logical Unit that supports the Changer Logical Unit Model, there may be different media types installed in the Logical Unit and as such only when media that is currently selected is CD shall these commands be allowed.

10.1 Command support for CD Media

Table 130 - Commands specific to CD Media Only

Command Description	Opcode	Reference
PLAY AUDIO [10]	45h	section 10.1.2 on page 179
PLAY AUDIO MSF	47h	section 10.1.3 on page 182
PLAY CD	4Ch	section 10.1.4 on page 185
READ C/DVD CAPACITY	25h	section 9.1.12 on page 141
READ CD	BEh	section 10.1.5 on page 189
READ CD MSF	E9h	section 10.1.6 on page 201
READ HEADER	44h	section 10.1.8 on page 209
READ SUB-CHANNEL	42h	section 10.1.9 on page 213
READ TOC/PMA/ATIP	43h	section 10.1.10 on page 221
SCAN	EAh	section 10.1.12 on page 241
STOP PLAY / SCAN	4Eh	section 10.1.13 on page 245

Key: M = command implementation is mandatory.
 O = command implementation is optional.
 * = indicates a PLAY command. If any of the PLAY commands (indicated by an * in the type column) are implemented, all the PLAY commands shall be implemented by the ATAPI CD-ROM Drive.

10.1.1 PAUSE/RESUME Command

The PAUSE/RESUME command requests that the Logical Unit stop or start an audio play operation. This command is used with PLAY AUDIO and PLAY CD commands that are currently executing in immediate mode.

Table 131 - PAUSE/RESUME Command

Byte	Bit	7	6	5	4	3	2	1	0	
0		Operation Code (4Eh)								
1		LUN			Reserved					
2		Reserved								
3		Reserved								
4		Reserved								
5		Reserved								
6		Reserved								
7		Reserved								
8		Reserved								
9		Vendor-Specific			Reserved			NACA	Flag	Link
10		PAD								
11		PAD								

A Resume bit of zero causes the Logical Unit to enter the hold track state with the audio output muted after the current block is played. A Resume bit of one causes the Logical Unit to release the pause/scan and begin play at the block following the last block played/scanned.

If an audio play operation cannot be resumed and the resume bit is one, the command is terminated with CHECK CONDITION status 05/2C Command Sequence Error. If the resume bit is zero and an audio play operation cannot be paused, (no audio play operation has been requested, or the requested audio play operation has been completed), the command is terminated with CHECK CONDITION status. See "Figure 13 - Stop Play/Play Audio/Audio Scan/Pause/Resume Sequencing" on page 246 for additional information.

It shall not be considered an error to request a PAUSE when a pause is already in effect or to request a RESUME when a play operation is in progress.

Table 132 - Recommended Sense Key, ASC and ASCQ for Pause/Resume Command Errors

Sense Key	ASC	ASCQ	Description of Error
02	04	00	LOGICAL UNIT NOT READY - CAUSE NOT REPORTABLE
02	04	01	LOGICAL UNIT NOT READY - IN PROGRESS OF BECOMING READY
02	04	02	LOGICAL UNIT NOT READY - INITIALIZING COMMAND REQUIRED
02	04	03	LOGICAL UNIT NOT READY - MANUAL INTERVENTION REQUIRED
02	3A	00	MEDIUM NOT PRESENT
05	20	00	INVALID COMMAND OPERATION CODE
05	24	00	INVALID FIELD IN COMMAND PACKET
05	2C	00	COMMAND SEQUENCE ERROR
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON, RESET OR BUS DEVICE RESET OCCURRED
06	2E	00	INSUFFICIENT TIME FOR OPERATION
06	3F	00	LOGICAL UNIT OPERATING CONDITIONS HAVE CHANGED
06	3F	01	MICROCODE HAS BEEN CHANGED

10.1.2 PLAY AUDIO Command

The PLAY AUDIO command requests that the C/DVD Logical Unit begin an audio playback operation. The command function and the output of audio signals shall be as specified by the settings of the mode parameters, including the SOTC bit.

Table 133 - PLAY AUDIO Command

Byte	Bit	7	6	5	4	3	2	1	0	
0		Operation Code (4sh)								
1		LUN				Reserved				
2		Starting Logical Block Address								
3										
4										
5										LSB
6		Reserved								
7		Play Length								
8										LSB
9		Vendor-Specific			Reserved			MACA	Flag	Link
10		PAD								
11										

This command responds with immediate status, allowing overlapped commands.

For ATAPI Logical Units this command shall set the DSC bit upon command completion. See also "11.9 Immediate Command Processing Considerations" on page 253.

If any commands related to audio operations are implemented then the PLAY AUDIO (10) command shall be implemented to allow a method for the Host Computer to determine if audio operations are supported. An C/DVD Logical Unit responding to a PLAY AUDIO (10) command that has a transfer length of zero with CHECK CONDITION status and setting the sense key to ILLEGAL REQUEST does not support audio play operations.

The Starting Logical Block Address field specifies the logical block at which the audio playback operation shall begin. PLAY AUDIO commands with a starting logical block address of FFFF FFFFh shall implement audio play from the current location of the optics. PLAY AUDIO commands with a starting LBA address of 0000 0000h shall begin the audio play operation at 00m 02s 00f.

The Play Length Field specifies the number of contiguous logical blocks that shall be played. A Transfer Length Field of zero indicates that no audio operation shall occur. This condition shall not be considered an error.

If the starting address is not found the command shall be terminated with CHECK CONDITION 05/21 LOGICAL BLOCK OUT OF RANGE status. If the address is not within an audio track the command shall be terminated with CHECK CONDITION ILLEGAL MODE FOR THIS TRACK OR INCOMPATIBLE MEDIUM status. If a not ready condition exists, the command shall be terminated with CHECK CONDITION 02/xx status.

If the CD information type (data vs. audio) changes within the transfer length, the command shall be terminated with a CHECK CONDITION and the sense key shall be set to ILLEGAL REQUEST and the additional sense code set to END OF USER AREA ENCOUNTERED ON THIS TRACK.

If the logical block address requested is not within an audio track, 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 ILLEGAL MODE FOR THIS TRACK.

Table 134 - Recommended Sense Key, ASC and ASCQ for Play Audio Command Errors

Sense Key	ASC	ASCQ	Description of Error
02	04	00	LOGICAL UNIT NOT READY - CAUSE NOT REPORTABLE
02	04	01	LOGICAL UNIT NOT READY - IN PROGRESS OF BECOMING READY
02	04	02	LOGICAL UNIT NOT READY - INITIALIZING COMMAND REQUIRED
02	04	03	LOGICAL UNIT NOT READY - MANUAL INTERVENTION REQUIRED
02	3A	00	MEDIUM NOT PRESENT
02	06	00	NO REFERENCE POSITION FOUND (media may be upside down)
04	15	00	RANDOM POSITIONING ERROR
04	15	01	MECHANICAL POSITIONING ERROR
05	20	00	INVALID COMMAND OPERATION CODE
05	21	00	LOGICAL BLOCK ADDRESS OUT OF RANGE
05	24	00	INVALID FIELD IN COMMAND PACKET
05	30	01	CANNOT READ MEDIUM - UNKNOWN FORMAT
05	30	02	CANNOT READ MEDIUM - INCOMPATIBLE FORMAT
05	63	00	END OF USER AREA ENCOUNTERED ON THIS TRACK
05	64	00	ILLEGAL MODE FOR THIS TRACK OR INCOMPATIBLE MEDIUM
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON OR HARD RESET OCCURRED
06	3F	00	LOGICAL UNIT OPERATING CONDITIONS HAVE CHANGED
06	3F	01	MICROCODE HAS BEEN CHANGED

10.1.2.1 Play Audio with Immediate Packet Commands

The PLAY AUDIO and AUDIO SCAN commands will continue to play while other commands are processed by the Logical Unit. Some commands can be accepted without disrupting the audio operations, while others will cause the Play operation to stop. The following section describes the operation of other commands while playing audio.

The C/DVD Logical Unit shall accept and perform the commands as specified in "Table 135 - Play or Scan Overlapped Command Operation". If any other command than described in Table 135 - is received, the Audio playback or Scan shall be terminated.

See "Figure 13 - Stop Play/Play Audio/Audio Scan/Pause/Resume Sequencing" on page 246 for additional information.

For ATAPI Logical Units, the ATA commands other than A2, A0 shall stop any play or scan.

Table 135 - Play or Scan Overlapped Command Operation

Opcode	Command Description	Action Taken
ANY	When it generates an Illegal Field in Command Packet CHECK CONDITION.	Will terminate with the error and not affect the Play operation
BFh	GET C/DVD INFORMATION	The command will execute normally and the information will be returned to the host. The play operation will be unaffected.
4Ah	GET EVENT STATUS NOTIFICATION	Will execute normally.
12h	INQUIRY	The Inquiry data will be returned.
A6h	LOAD/UNLOAD C/DVD	Play operation will be stopped.
BDh	MECHANISM STATUS	Will execute normally.
55h	MODE SELECT	The Mode Select will be accepted and executed as long as no Media or Mode information is changed. If parameters that affect the play are changed, the Mode Select will terminate with a CHECK CONDITION without being executed.
5Ah	MODE SENSE	Will execute normally.
4Eh	PAUSE/RESUME	Play operation will be stop or continue based on command type
1Eh	PREVENT/ALLOW MEDIA REMOVAL	Will execute normally.
45h	PLAY AUDIO (10)	Play will continue from the new address.
47h	PLAY AUDIO MSF	Play will continue from the new address.
ECh	PLAY CD	Play will continue from the new address.
A8h	READ (12)	Play operation will be stopped.
BEh	READ CD	If the read command returns only the Q sub-channel data then the play will continue and the command will return the data from the current location. If any data other than the Q sub-channel is requested the command will be executed and the play operation will be aborted.
44h	READ HEADER	Will execute normally and play operation will continue.
E9h	READ CD MSF	If the read command returns only the Q sub-channel data then the play will continue and the command will return the data from the current location. If any data other than the Q sub-channel is requested the command will be executed and the play operation will be aborted.
25h	READ CD CAPACITY	Will execute normally.
42h	READ SUB-CHANNEL	Only the current position information (Format Code 01h) will be supported while the play is in progress. If any other type of information is requested the READ SUB-CHANNEL will not be executed and a CHECK CONDITION will be generated.
43h	READ C/DVD STRUCTURE	Only Logical Units that cache the TOC will be able to respond to this command while the play is in progress. If the Logical Unit does not support caching the TOC, the command will not be executed and a CHECK CONDITION will be generated.
03h	REQUEST SENSE	Will execute normally.
2Eh	SEEK	Play operation will be stopped.
EAh	SCAN	SCAN command will be executed and the PLAY command will resume at completion of the scan.
1Eh	START/STOP UNIT	Play operation will be stopped.
00h	TEST UNIT READY	Will execute normally.

10.1.3 PLAY AUDIO MSF Command

The PLAY AUDIO MSF command requests that the C/DVD Logical Unit begin an audio playback operation. The command function and the output of audio signals shall be as specified by the settings of the mode parameters including the SOTC bit described on page 120.

Table 136 - PLAY AUDIO MSF Command

Byte	Bit	7	6	5	4	3	2	1	0
0		Operation Code (47h)							
1		LUN			Reserved				
2		Reserved							
3		Starting M Field							
4		Starting S Field							
5		Starting F Field							
6		Ending M Field							
7		Ending S Field							
8		Ending F Field							
9		Vendor-Specific			Reserved		NACA	Flag	Link
10		PAD							
11									

This command responds with immediate status, allowing overlapped commands.

For ATAPI Logical Units this command shall set the DSC bit upon command completion. See also "11.9 Immediate Command Processing Considerations" on page 253.

The Starting M field, the Starting S field, and the Starting F field specify the absolute MSF address at which the audio play operation shall begin. The Ending M field, the Ending S field, and the Ending F field specify the absolute MSF address where the audio play operation shall end. All contiguous audio sectors between the starting and the ending MSF address shall be played.

If the Starting Minutes, Seconds and Frame Fields are set to FFh, the Starting address is taken from the Current Optical Head location. This allows the Audio Ending address to be changed without interrupting the current playback operation.

A Starting MSF address equal to an ending MSF address causes no audio play operation to occur. This shall not be considered an error. If the Starting MSF address is greater than the Ending MSF address, the command shall be terminated with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST.

If the starting address is not found the command shall be terminated with CHECK CONDITION 05/21 LOGICAL BLOCK OUT OF RANGE status. If the address is not within an audio track the command shall be terminated with CHECK CONDITION ILLEGAL MODE FOR THIS TRACK OR INCOMPATIBLE MEDIUM status. If a not ready condition exists, the command shall be terminated with CHECK CONDITION 02/xx status.

See "10.1.2.1 Play Audio with Immediate Packet Commands" on page 180 for information on overlapped commands during an Audio Playback.

Table 137 - Recommended Sense Key, ASC and ASCQ for Play Audio MSF Command Errors

Sense Key	ASC	ASCQ	Description of Error
02	04	00	LOGICAL UNIT NOT READY - CAUSE NOT REPORTABLE
02	04	01	LOGICAL UNIT NOT READY - IN PROGRESS OF BECOMING READY
02	04	02	LOGICAL UNIT NOT READY - INITIALIZING COMMAND REQUIRED
02	04	03	LOGICAL UNIT NOT READY - MANUAL INTERVENTION REQUIRED
02	3A	00	MEDIUM NOT PRESENT
02	06	00	NO REFERENCE POSITION FOUND (media may be upside down)
04	15	00	RANDOM POSITIONING ERROR
04	15	01	MECHANICAL POSITIONING ERROR
05	20	00	INVALID COMMAND OPERATION CODE
05	21	00	LOGICAL BLOCK ADDRESS OUT OF RANGE
05	24	00	INVALID FIELD IN COMMAND PACKET
05	30	01	CANNOT READ MEDIUM - UNKNOWN FORMAT
05	30	02	CANNOT READ MEDIUM - INCOMPATIBLE FORMAT
05	63	00	END OF USER AREA ENCOUNTERED ON THIS TRACK
05	64	00	ILLEGAL MODE FOR THE TRACK OR INCOMPATIBLE MEDIUM
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON OR HARD RESET OCCURRED
06	3F	00	LOGICAL UNIT OPERATING CONDITIONS HAVE CHANGED
06	3F	01	MICROCODE HAS BEEN CHANGED

10.1.4 PLAY CD Command

The PLAY CD command provides one standard, universal way of sending digital CD data to an external Logical Unit (e.g. an IEC958 or EBU port).

Table 138 - PLAY CD Command (LBA Form)

Byte	Bit	7	6	5	4	3	2	1	0																											
0	Operation Code (ECh)																																			
1	LUN			Expected Sector Type			CMSF (0)	Reserved																												
2	Starting Logical Block Address																																			
3										LSB																										
4																			MSE																	
5																												Play Length in Blocks								
6																																				
7	Reserved																																			
8										Port 2																										
9																			Port 1																	
10																												SPEED			Reserved			Composite	Audio	
11																												Vendor-Specific			Reserved			NACA	Flag Link	

Table 139 - PLAY CD Command (MSF Form)

Byte	Bit	7	6	5	4	3	2	1	0
0	Operation code (ECh)								
1	LUN			Expected Sector Type			CMSF (1)	Reserved	
2	Reserved								
3	Starting M Field								
4	Starting S Field								
5	Starting F Field								
6	Ending M Field								
7	Ending S Field								
8	Ending F Field								
9	Reserved								
10	SPEED	Reserved			Port 2	Port 1	Composite	Audio	
11	Vendor-Specific			Reserved			NACA	Flag	Link

The Expected Sector Type field is used to check the sector type only. If the Requested Sector(s) do not match the specified type, the command will be terminated with a CHECK CONDITION. The Sector that does not match will not be transferred to output port. The sense key, ASC/ASCQ shall be set to 05 ILLEGAL REQUEST, 05/64 ILLEGAL MODE FOR THIS TRACK.

Implementer's Note: The Expected Sector Type is used to generate an error and terminate the transfer when the sectors found on the media, do not match the type desired. This field has NO control of the actual number of bytes transferred.

Table 140 - PLAY CD, Expected Sector Type Field Definition

Expected Sector Type	Definition	Description
000b	Any Type (Mandatory)	No checking of the Sector Type will be performed. The Logical Unit <i>shall</i> always terminate a command, at the sector where a transition between CD-Rom and CD-DA occurs.
001b	CD-DA (Mandatory)	Only Red Book (CD-DA) sectors <i>shall</i> be allowed. An attempt to read any other format <i>shall</i> result in the reporting of an error.
010b	Mode 1 (Mandatory)	Only Yellow Book sectors which have a "user" data field of 2048 bytes <i>shall</i> be allowed. An attempt to read any other format <i>shall</i> result in the reporting of an error.
011b	Mode 2 (Mandatory)	Only Yellow Book sectors which have a "user" data field of 2336 bytes <i>shall</i> be allowed. An attempt to read any other format <i>shall</i> result in the reporting of an error.
100b	Mode 2 Form 1 (Mandatory)	Only Green Book sectors which have a "user" data field of 2048 <i>shall</i> be allowed. An attempt to read any other format <i>shall</i> result in the reporting of an error.
101b	Mode 2 Form 2 (Mandatory)	Only Green Book sectors which have a "user" data field of 2324 <i>shall</i> be allowed. An attempt to read any other format <i>shall</i> result in the reporting of an error. Note that the spare data is included in the user data making the size 2324+4= 2328.
110b - 111b		Reserved

See also, CD-ROM Sector Formats on page 60.

Table 141 - PLAY CD, Field Definition

Flag	Value	Description
Audio	0	Analog Audio Channel is Disabled
	1	Analog Audio Channel is Enabled
Composite	0	Composite Video port is Disabled
	1	Composite Video port is Enabled
Port 1	0	Digital Port 1 is Disabled
	1	Digital Port 1 is Enabled
Port 2	0	Digital Port 2 is Disabled
	1	Digital Port 2 is Enabled
SPEED	0	Speed will be set to x1 for the operation
	1	The Speed used will be the best possible

Table 142 - Recommended Sense Key, ASC and ASCQ for PLAY CD Command Errors

Sense Key	ASC	ASCQ	Description of Error
02	04	00	LOGICAL UNIT NOT READY - CAUSE NOT REPORTABLE
02	04	01	LOGICAL UNIT NOT READY - IN PROGRESS OF BECOMING READY
02	04	02	LOGICAL UNIT NOT READY - INITIALIZING COMMAND REQUIRED
02	04	03	LOGICAL UNIT NOT READY - MANUAL INTERVENTION REQUIRED
02	3A	00	MEDIUM NOT PRESENT
02	06	00	NO REFERENCE POSITION FOUND (media may be upside down)
04	15	00	RANDOM POSITIONING ERROR
04	15	01	MECHANICAL POSITIONING ERROR
05	20	00	INVALID COMMAND OPERATION CODE
05	21	00	LOGICAL BLOCK ADDRESS OUT OF RANGE
05	24	00	INVALID FIELD IN COMMAND PACKET
05	30	01	CANNOT READ MEDIUM - UNKNOWN FORMAT
05	30	02	CANNOT READ MEDIUM - INCOMPATIBLE FORMAT
05	63	00	END OF USER AREA ENCOUNTERED ON THIS TRACK
05	64	00	ILLEGAL MODE FOR THIS TRACK OR INCOMPATIBLE MEDIUM
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON OR HARD RESET OCCURRED
06	3F	00	LOGICAL UNIT OPERATING CONDITIONS HAVE CHANGED
06	3F	01	MICROCODE HAS BEEN CHANGED
0E	00	0E	PLAY OPERATION ABORTED
0E	11	11	READ ERROR, LOSS OF STREAMING

10.1.5 READ CD Command

The READ CD command (Family) provides one standard, universal way of accessing CD data. Rather than breaking the types of data into several related commands, this command is generic to all CD data types.

This command returns any of the CD data streams, including the headers, EDC and ECC, ROM data and CD-DA data. Each type of data is enabled via the use of flags. These flags indicate which information from the CD is to be returned in the data stream. If a flag is cleared, then that particular information will not be returned. If all the flags are cleared, no data will be returned to the host and this condition is not treated as an error.

Table 143 - READ CD Command

Byte	Bit	7	6	5	4	3	2	1	0	
0		Operation Code (Bbh)								
1		LUN				Expected Sector Type		Reserved	RelAdr	
2		Starting Logical Block Address								
3										
4										
5										LSB
6										
6		Transfer Length in Blocks								
7		LSB								
8										
9										
Flag Bits										
9		Synch Field	Header(s) Code		User Data	EDC & ECC	Error Flag(s)		Reserved	
10		Reserved				Sub-Channel Data Selection Bits				
11		Vendor-Specific		Reserved			Flag	Link		

The RelAdr bit is only used for SCSI Logical Units. For information on this bit See “Use of the RelAdr bit” on page 257.

The Expected Sector Type field is used to limit the amount of information returned to the Host. If the Requested Sector(s) do not match the specified type, the command will be terminated with a CHECK CONDITION. The Sector that does not match will not be transferred to the Host. The sense key shall be set to ILLEGAL MODE FOR THIS TRACK.

Implementer’s Note: The Expected Sector Type is used to generate an error and terminate the transfer when the sectors found on the media, do not match the type desired. This field has NO control of the actual number of bytes transferred.

Table 144 - READ-CD, Expected Sector Type Field Definition

Expected Sector Type	Definition	Description
000b	Any Type (Mandatory)	No checking of the Sector Type will be performed. The Logical Unit <i>shall</i> always terminate a command, at the sector where a transition between CD-Rom and CD-DA occurs.
001b	CD-DA (Optional)	Only Red Book (CD-DA) sectors <i>shall</i> be returned. An attempt to read any other format <i>shall</i> result in the reporting of an error.
010b	Mode 1 (Mandatory)	Only Yellow Book sectors which have a “user” data field of 2048 bytes <i>shall</i> be returned. An attempt to read any other format <i>shall</i> result in the reporting of an error.
011b	Mode 2 (Mandatory)	Only Yellow Book sectors which have a “user” data field of 2336 bytes <i>shall</i> be returned. An attempt to read any other format <i>shall</i> result in the reporting of an error.
100b	Mode 2 Form 1 (Mandatory)	Only Green Book sectors which have a “user” data field of 2048 <i>shall</i> be returned. An attempt to read any other format <i>shall</i> result in the reporting of an error.
101b	Mode 2 Form 2 (Mandatory)	Only Green Book sectors which have a “user” data field of 2324 <i>shall</i> be returned. An attempt to read any other format <i>shall</i> result in the reporting of an error. Note that the spare data is included in the user data making the size 2324+4= 2328.
110b - 111b		Reserved

See also, CD-ROM Sector Formats on page 60.

The Synch Field Bit, when set to one indicates that the Synch Field from the sector will be included in the data stream. Note that the data fields that are requested to be included in the data stream shall be contiguous. The Synch Field information (if selected) will be the first information in the data stream; all other fields will follow.

The Header(s) Code is an encoded field that indicates the Header / Sub-header information to be placed in the data stream.

Table 145 - READ CD, Header(s) Code Field Definition

Header(s) Code	Definition	Description
00b	None	None of the header data shall be returned.
01b	HD Only	Only the Mode 1 or Form 1 4-byte header will be returned in the data stream.
10b	Subheader Only	Only the Mode 2 Form 1 or 2 Subheader will be placed into the data stream.
11b	All Headers	Both the Header and Subheader will be placed in the data stream.

The User Data Flag, when set to one, indicates that the Data part of a CD Sector shall be returned in the data stream. When set to 1, the whole user data will be returned to the host. Note that the setting of the Mode Select Block size and Density Code does not apply to this command, and the physical user data will be returned. If the current track is an Audio Track then the Audio Data will be returned, else the normal CD data will be returned.

The EDC and ECC Flag, when set to one, indicates that the EDC and ECC (L-EC) field shall be included in the data stream. For Mode 1 CDs this will include the 8 bytes of pad data.

Error Flag(s) is an encoded field that indicates which (if any) of the C2 and/or Block Error data will be included in the data stream. All the field types are mandatory. If the drive does not support the C2 pointers (as reported in the Mode sense Capabilities page) the data returned shall be zero filled.

Table 146 - READ CD, Error Flag(s) Field Definition

Error Flags	Definition	Description
00b	None	No Error information will be included in the data stream.
01b	C2 Error Flag data	The C2 Error Flag (Pointer) bits (2352 bits or 294 bytes) will be included in the data stream. When the C2 Error pointer bits are included in the data stream, there will be one bit for each byte in error in the sector (2352 total). The bit ordering is from the most significant bit to the least significant bit in each byte. The first bytes in the sector will be the first bits/bytes in the data stream.
10b	C2 & Block Error Flags	Both the C2 Error Flags (2352 bits or 294 bytes) and the Block Error Byte will be included in the data stream. The Block Error byte is the OR of all the C2 Error Flag bytes. So that the data stream will always be an even number of bytes, the Block Error byte will be padded with a byte (undefined). The Block Error byte will be first in the data stream followed by the pad byte.
11b	Reserved	Reserved for future enhancement.

The Sub-Channel Data Selection bits indicate which CD Sub-Channel information is to be included in the data stream, the Q information and/or the "Raw" Sub-channel information (All eight channels, one byte from each of the small frames.) If the bit is set, then that Sub-channel data will be included in the data stream to the Host.

Table 147 - READ CD, Sub-channel Data Selection Field Definition

Sub-channel Data Selection	Definition	Description	Type
000b	No Sub-channel Data	No Sub-channel data will be transferred	Mandatory
001b	RAW	Raw Sub-channel data will be transferred	Optional
010b	Q	Q data will be transferred	Optional
011b	Reserved		
100b	R - W	R-W data will be transferred	Optional
101b - 111b	Reserved		

Support of Sub-channel data is optional. In the case of R-W the drive may return the data de-interleaved and error corrected, RAW or padded with zeros depending on the R-W Supported and R-W de-interleaved and error corrected bits in the CD-ROM capabilities and mechanical status page. Changing the DCR bit using Mode Select for page 1 (Read error recovery page) will affect error correction of subcode data. The inclusion of the sub-channel data will only be valid for Audio sectors.

If the Starting Logical Block Address is set to FFFFFFFFh and the only information requested to be placed in the data stream is the Sub-channel data and there is currently a PLAY AUDIO command in process, the actual address used will be from the current location (of the Play). If the drive is not playing audio, the drive will respond with a CHECK CONDITION with a sense key/ASC/ASCQ of 05h/B9h/00h (Play Not in Progress).

Table 148 - Formatted Q-subcode Data (A Total of 16 Bytes)

Byte	Description
0	Control (4 M.S. bits), ADR (4 L.S. bits)
1	Track number
2	Index number
3	Mm
4	Sec
5	Frame
6	Reserved (00h)
7	AMm
8	Asec
9	AFrame
10	CRC* or 00h (hex)
11	CRC* or 00h (hex)
12	00h (pad)
13	00h (pad)
14	00h (pad)
15	Most Significant Bit is P for this sector (Optional) all other bits are zero.

*CRC is optional

Table 149 - Number of Bytes Returned Based on Data Selection Field

Data to be transferred	Flag Bits	CD-DA	Mode 1	Mode 2 nonXA	Mode 2 Form 1	Mode 2 Form 2
User Data	10h	2352	2048	2336	2048	2328
User Data + EDC/ECC	18h	(10h)	2336	(10h)	2328	(10h)
Header Only	20h	(10h)	4	4	4	4
Header Only + EDC/ECC	28h	(10h)	Illegal	Illegal	Illegal	Illegal
Header & User Data	30h	(10h)	2052	2340	Illegal	Illegal
Header & User Data + EDC/ECC	38h	(10h)	2340	(30h)	Illegal	Illegal
Sub Header Only	40h	(10h)	0	0	8	8
Sub Header Only + EDC/ECC	48h	(10h)	Illegal	Illegal	Illegal	Illegal
Sub Header & User Data	50h	(10h)	(10h)	(10h)	2056	2336
Sub Header & User Data + EDC/ECC	58h	(10h)	(18h)	(10h)	2336	(50h)
All Headers Only	60h	(10h)	4	4	12	12
All Headers Only + EDC/ECC	68h	(10h)	Illegal	Illegal	Illegal	Illegal
All Headers & User Data	70h	(10h)	(30h)	(30h)	2060	2340
All Headers & User Data + EDC/ECC	78h	(10h)	(38h)	(30h)	2340	2340
Sync & User Data	90h	(10h)	Illegal	Illegal	Illegal	Illegal
Sync & User Data + EDC/ECC	98h	(10h)	Illegal	Illegal	Illegal	Illegal
Sync & Header Only	A0h	(10h)	16	16	16	16
Sync & Header Only + EDC/ECC	A8h	(10h)	Illegal	Illegal	Illegal	Illegal
Sync & Header & User Data	B0h	(10h)	2064	2352	Illegal	Illegal
Sync & Header & User Data + EDC/ECC	B8h	(10h)	2352	(B0h)	Illegal	Illegal
Sync & Sub Header Only	C0h	(10h)	Illegal	Illegal	Illegal	Illegal
Sync & Sub Header Only + EDC/ECC	C8h	(10h)	Illegal	Illegal	Illegal	Illegal
Sync & Sub Header & User Data	D0h	(10h)	Illegal	Illegal	Illegal	Illegal
Sync & Sub Header & User Data + EDC/ECC	D8h	(10h)	Illegal	Illegal	Illegal	Illegal
Sync & All Headers Only	E0h	(10h)	16	16	24	24
Sync & All Headers Only + EDC/ECC	E8h	(10h)	Illegal	Illegal	Illegal	Illegal
Sync & All Headers & User Data	F0h	(10h)	2064	2352	2072	2352
Sync & All Headers & User Data + EDC/ECC	F8h	(10h)	2352	(F0h)	2352	(F0h)
Repeat All Above and Add Error Flags	02h	+294	+294	+294	+294	+294
Repeat All Above and Add Block & Error Flags	04h	+296	+296	+296	+296	+296

The lengths of the data returned from the READ CD command vary based on the type of sector that is being read and the requested fields to be returned to the Host. Many combinations are possible, but most are not very useful. Table 149, "Number of Bytes Returned Based on Data Selection Field," on page 193 specifies how the drive responds to many of the requests possible. Requests for transfers not specified by this table shall not be supported and treated as Illegal. Illegal values will cause the command to be aborted with a CHECK Condition, Sense Key 05, ASC 24 (INVALID FIELD IN COMMAND PACKET).

The Values in () indicate that the amount of data is the same as the Flag byte setting specified by the contents of the parenthesis.

Values that are shaded are most useful to the host and shall return the number of bytes specified if supported.

See "Figure 5 - CD-ROM Sector Formats" on page 60 for a description of the data available for each sector type.

Table 150 - Recommended Sense Key, ASC and ASCQ for Read CD Command Errors

Sense Key	ASC	ASCQ	Description of Error
01	18	01	RECOVERED DATA WITH ERROR CORRECTION & RETRIES APPLIED
01	18	04	RECOVERED DATA WITH ECC
01	5D	01	FAILURE PREDICTION THRESHOLD EXCEEDED - Predicted Media Failure
02	04	00	LOGICAL UNIT NOT READY - CAUSE NOT REPORTABLE
02	04	01	LOGICAL UNIT NOT READY - IN PROGRESS OF BECOMING READY
02	04	02	LOGICAL UNIT NOT READY - INITIALIZING COMMAND REQUIRED
02	04	03	LOGICAL UNIT NOT READY - MANUAL INTERVENTION REQUIRED
02	06	00	NO REFERENCE POSITION FOUND (media may be upside down)
02	30	01	CANNOT READ MEDIUM - UNKNOWN FORMAT
02	30	02	CANNOT READ MEDIUM - INCOMPATIBLE FORMAT
02	3A	00	MEDIUM NOT PRESENT
03	02	00	NO SEEK COMPLETE
03	11	05	ECC UNCORRECTABLE ERROR
03	11	06	CIRC UNRECOVERED ERROR (CD Media only)
04	15	00	RANDOM POSITIONING ERROR
04	15	01	MECHANICAL POSITIONING ERROR
05	00	11	PLAY OPERATION IN PROGRESS
05	20	00	INVALID COMMAND OPERATION CODE
05	21	00	LOGICAL BLOCK ADDRESS OUT OF RANGE
05	24	00	INVALID FIELD IN COMMAND PACKET
05	30	01	CANNOT READ MEDIUM - UNKNOWN FORMAT
05	30	02	CANNOT READ MEDIUM - INCOMPATIBLE FORMAT
06	28	00	NOT READY TO READY TRANSITION
06	64	00	ILLEGAL MODE FOR THIS TRACK OR INCOMPATIBLE MEDIUM
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON OR HARD RESET OCCURRED
06	2E	00	INSUFFICIENT TIME FOR OPERATION
06	3F	00	DEVICE OPERATING CONDITIONS HAVE CHANGED
06	3F	01	MICROCODE HAS BEEN CHANGED
0B	11	11	READ ERROR, LOSS OF STREAMING

The CD-DA audio data includes 16 bits of information for each channel, and will be formatted as follows when an audio track is read.

Table 151 - CD-DA (Digital Audio) Data Block Format

Bit Byte	7	6	5	4	3	2	1	0
Cell 1 (1st of 588)								
0	Left Channel (Lower Byte)							
	b7	b6	b5	b4	b3	b2	b1	b0
1	Left Channel (Upper Byte)							
	b15	b14	b13	b12	b11	b10	b9	b8
2	Right Channel (Lower Byte)							
	b7	b6	b5	b4	b3	b2	b1	b0
3	Right Channel (Upper Byte)							
	b15	b14	b13	b12	b11	b10	b9	b8
⋮								
⋮								
⋮								
2348	Left Channel (Lower Byte)							
	b7	b6	b5	b4	b3	b2	b1	b0
2349	Left Channel (Upper Byte)							
	b15	b14	b13	b12	b11	b10	b9	b8
2350	Right Channel (Lower Byte)							
	b7	b6	b5	b4	b3	b2	b1	b0
2351	Right Channel (Upper Byte)							
	b15	b14	b13	b12	b11	b10	b9	b8

If the CD-ROM Drive does not support the CD-DA Stream-Is-Accurate capability (See "9.1.8.7 C/DVD Capabilities and Mechanical Status Page" on page 126) then the Digital Audio data must be read as a continuous stream. If while streaming the drive must stop, there will be a non-recoverable error generated (Sense Key 0Bh ABORTED Command, Sense Code BFh LOSS OF STREAMING). This is due to the 1 second uncertainty of the address (There is no header in CD-DA Data). Reissuing the command may not return exactly the same data as the previous try. When the drive supports the Stream Accurate capability, there will be no error, only some time delay for rotational latency.

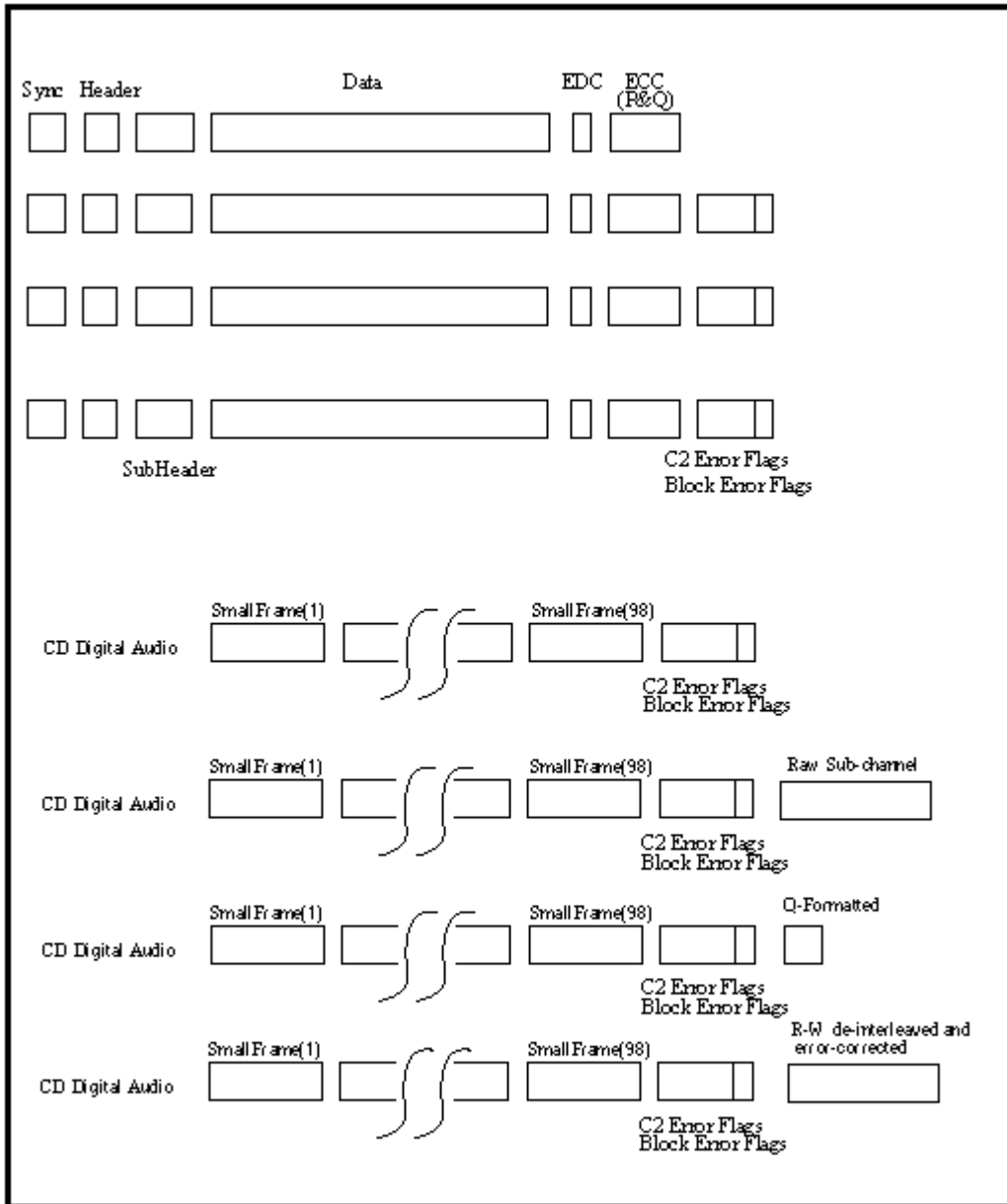


Figure 11 - Read CD Data Stream Order

10.1.5.1 Description of Sub-channels R-W

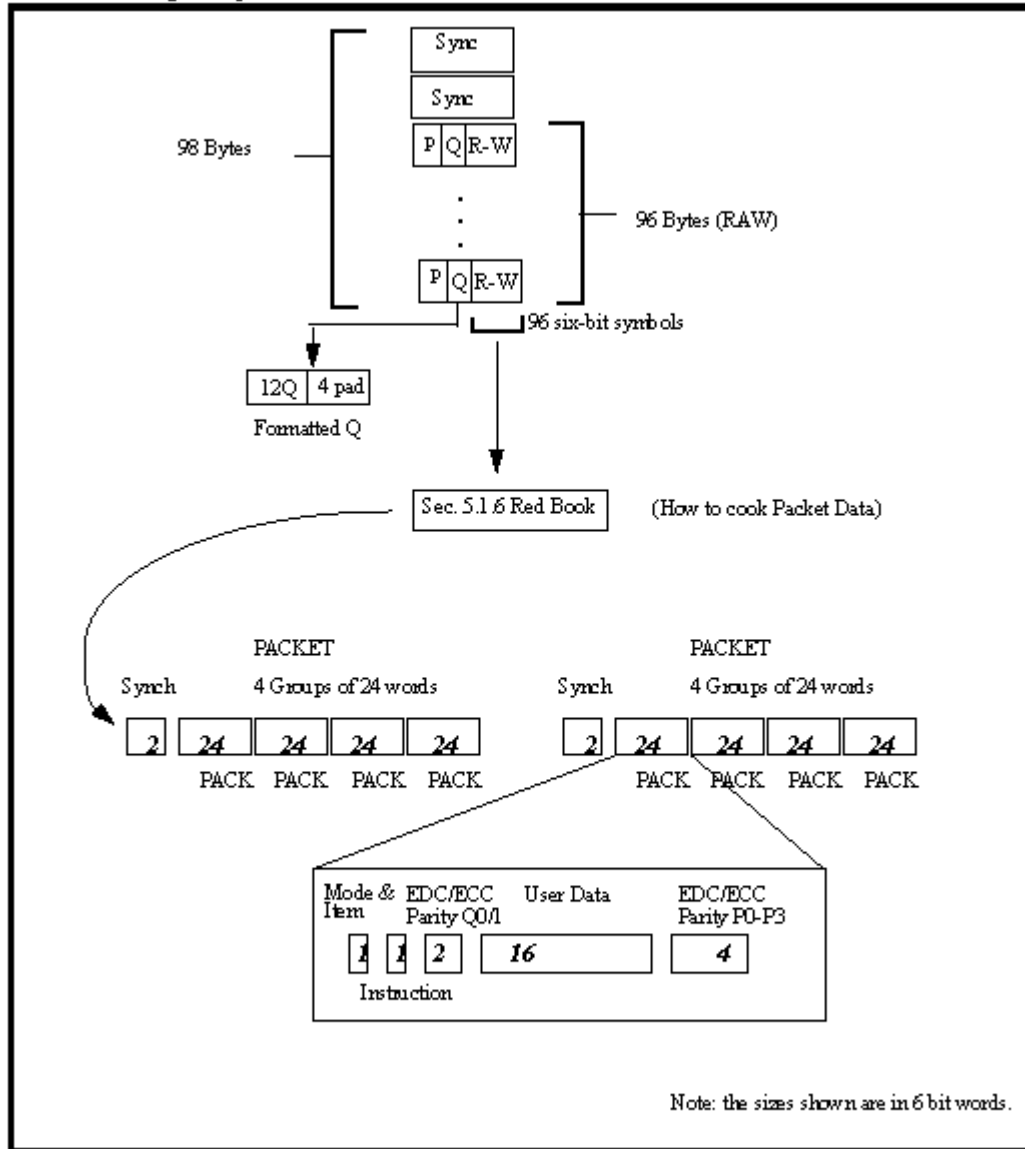


Figure 12 - Read CD Sub-channel, R-W (100b)

Table 152 - R-W Raw

Bit Byte	7	6	5	4	3	2	1	0
0	P-W (0)							
1	P-W (1)							
...	...							
95	P-W (95)							

R-W Raw is returned in the format and order found on the media. It is the responsibility of the device driver to de-interleave and perform error detection and correction on the RAW data to make it usable to higher level applications.

Table 153 - R-W De-Interleaved & Error Corrected

Bit Byte	7	6	5	4	3	2	1	0
0	P	Q	PACK1(0)					
1	P	Q	PACK1(1)					
...	...							
23	P	Q	PACK1(23)					
24	P	Q	PACK2(0)					
25	P	Q	PACK2(1)					
...	...							
47	P	Q	PACK2(23)					
48	P	Q	PACK3(0)					
49	P	Q	PACK3(1)					
...	...							
71	P	Q	PACK3(23)					
72	P	Q	PACK4(0)					
73	P	Q	PACK4(1)					
...	...							
95	P	Q	PACK4(23)					

Drives that can not return P or Q code with PACK data will return 0 in the unsupported P or Q bits. Each PACK is generated after 2 contiguous Sub Channel data frames consisting of 24 bytes with 6 bits of PACK data per byte. Each 96 byte Packet consists of 4 Packs of 24 bytes each.

The basic RAW format is shown in "Figure 12 - Read CD Sub-channel, R-W (100b)" on page 197. The data is synchronized with the subcode synch patterns S0 and S1. Each group of 6 bits (R-W) is called a "symbol". The symbol following the synchs S0 and S1 is the first symbol of the first pack in a packet. The packs following the sync bytes in R-W data must be from the same block and in chronological order.

To guard the data in the sub-coding channels R-W, a (24,20) Reed-Solomon Error Correction Code is used. To improve the burst error correction capability, eight-way interleaving is added to this error correction system.

The first two symbols in a pack have additional protection with a (4,2) Read Solomon Error Correction Code. The first symbol of a pack contains a mode switch of 3 bits and a 3 bit subdivision of mode, called "item". The defined mode item combinations are defined in the following table.

Table 154 - Sub-channel R-W, Allowed Mode/Item Combinations

Mode	Item	Description
000b (0d)	000b (0d)	The ZERO mode
001b (1d)	000b (0d)	The LINE GRAPHICS mode
	001b (1d)	The TV GRAPHICS mode
111b (7d)	000b (0d)	The USER mode
All Others		Reserved for future use

The R-W information is returned as part of the "raw" sub-channel data. The lower 6 bits of each of the bytes contain the R-W data. This data follows the format shown in "Figure 12 - Read CD Sub-channel, R-W (100b)" on page 197. If the Q information needs to be taken from the raw data, then it shall be de-interleaved according the Red book formats.

10.1.6 READ CD MSF Command

The READ CD command (Family) provides one standard, universal way of accessing CD data. Rather than breaking the types of data into several related commands, this command is generic to all CD data types.

This command returns any of the CD data streams, including the headers, EDC and ECC, ROM data and CD-DA data. Each type of data is enabled via the use of flags. These flags indicate which information from the CD is to be returned in

the data stream. If a flag is cleared, then that particular information will not be returned. If all the flags are cleared, no data will be returned to the host and this condition is not treated as an error.

Table 155 - READ CD MSF Command

Byte	Bit	7	6	5	4	3	2	1	0
0	Operation code (E9h)								
1	LUN			Expected Sector Type			Reserved		
2	Reserved								
3	Starting M Field								
4	Starting S Field								
5	Starting F Field								
6	Ending M Field								
7	Ending S Field								
8	Ending F Field								
9	Flag Bits								
	Synch Field	Header(s) Code			User Data	ECC & ECC	Error Flag(s)		Reserved
10	Reserved						Sub-Channel Data Selection Bits		
11	Vendor-Specific			Reserved			NACA	Flag	Link

The Starting M field, the Starting S field, and the Starting F field specify the absolute MSF address at which the Read operation shall begin. The Ending M field, the Ending S field, and the Ending F field specify the absolute MSF address where the Read operation shall end. All contiguous sectors between the starting and the ending MSF address shall be read.

A starting MSF address equal to an ending MSF address prevents a read operation. This shall not be considered an error. If the starting MSF address is greater than the ending MSF address, the command shall be terminated with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST.

If the starting address is not found, or if a not ready condition exists, the command shall be terminated with CHECK CONDITION status.

See "10.1.5 READ CD Command" on page 189 for a description of Expected User Data Type, Flag Bits and Sub-channel Data Selection Bits.

Table 156 - Recommended Sense Key, ASC and ASCQ for Read CD MSF Command Errors

Sense Key	ASC	ASCQ	Description of Error
01	18	01	RECOVERED DATA WITH ERROR CORRECTION & RETRIES APPLIED
01	18	04	RECOVERED DATA WITH ECC
01	5D	01	FAILURE PREDICTION THRESHOLD EXCEEDED - Predicted Media Failure
02	04	00	LOGICAL UNIT NOT READY - CAUSE NOT REPORTABLE
02	04	01	LOGICAL UNIT NOT READY - IN PROGRESS OF BECOMING READY
02	04	02	LOGICAL UNIT NOT READY - INITIALIZING COMMAND REQUIRED
02	04	03	LOGICAL UNIT NOT READY - MANUAL INTERVENTION REQUIRED
02	06	00	NO REFERENCE POSITION FOUND (media may be upside down)
02	30	01	CANNOT READ MEDIUM - UNKNOWN FORMAT
02	30	02	CANNOT READ MEDIUM - INCOMPATIBLE FORMAT
02	3A	00	MEDIUM NOT PRESENT
03	02	00	NO SEEK COMPLETE
03	11	05	ECC UNCORRECTABLE ERROR
03	11	06	CIRC UNRECOVERED ERROR (CD Media only)
04	15	00	RANDOM POSITIONING ERROR
04	15	01	MECHANICAL POSITIONING ERROR
05	00	11	PLAY OPERATION IN PROGRESS
05	20	00	INVALID COMMAND OPERATION CODE
05	21	00	LOGICAL BLOCK ADDRESS OUT OF RANGE
05	24	00	INVALID FIELD IN COMMAND PACKET
05	30	01	CANNOT READ MEDIUM - UNKNOWN FORMAT
05	30	02	CANNOT READ MEDIUM - INCOMPATIBLE FORMAT
06	28	00	NOT READY TO READY TRANSITION
05	64	00	ILLEGAL MODE FOR THIS TRACK OR INCOMPATIBLE MEDIUM
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON OR HARD RESET OCCURRED
06	2E	00	INSUFFICIENT TIME FOR OPERATION
06	3F	00	DEVICE OPERATING CONDITIONS HAVE CHANGED
06	3F	01	MICROCODE HAS BEEN CHANGED
0B	11	11	READ ERROR, LOSS OF STREAMING

10.1.7 READ DISC INFORMATION Command

The READ DISC INFORMATION command requests that the C/DVD Logical Unit transfer general information about the CD medium that is mounted to the Host.

Table 157 - READ DISC INFORMATION Command

Byte	Bit	7	6	5	4	3	2	1	0	
0		Operation Code (5th)								
1		LUN				Reserved				
2		Reserved								
3		Reserved								
4		Reserved								
5		Reserved								
6		Reserved								
7	MSB	Allocation Length								
8		LSB								
9		Vendor-Specific			Reserved			NACA	Flag	Link
10		PAD								
11		PAD								

It is not possible to completely characterize some incomplete CD-R/E discs with the information from the Read C/DVD Structure command. The Read Disc Information Command provides information about all discs, including all incomplete CD-R/E discs.

The number of Disc Information bytes returned 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.

Table 158 - Disc Information Returned

Bit Byte	7	6	5	4	3	2	1	0	
0	MSE Disc Information length								
1	LSB								
Information Block									
2	Reserved			Er asable	Status of Last Session	Disc Status			
3	Number of First track on Disc								
4	Number of Sessions								
5	First track Number in Last Session								
6	Last track Number in Last Session								
7	DID_V	DBC_V	GEN	Reserved					
8	Disc Type								
9	Reserved								
10	Reserved								
11	Reserved								
12	(MSB) Disc Identification								
13									
14									
15									(LSB)
16	(MSB) Lead-in Start Time for Last Session								
17									
18									MSF
19									(LSB)
20	(MSB) Last Possible Start Time for StartTime of Lead-out								
21									
22									MSF
23									(LSB)
24	(MSB) Disc Bar Code								
25									
26									
27									
28									
29									
30									
31	(LSB)								
32	Reserved								
33	Number of OPC Table Entries								
34	OPC Table(s)								
.	(See "OPC Table Entries" on page 207.)								
.									

The Disc Information has two parts: a recorded information area and an OPC table.

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

Table 159 - Disc Status

Disc Status	Description
00	Empty Disc
01	Incomplete Disc (Appendable)
10	Complete Disc (CD-ROM or last session is closed and has no next session pointer)
11	Reserved

Status of Last Session is valid only for discs with either empty or incomplete status and given by the following table.

Table 160 - Status of Last Session

Status of Last Session	Description
00	Empty Session
01	Incomplete Session
10	Reserved
11	Complete Session (Only possible when Disc Status is Complete)

The Erasable flag, when set to one indicates that CD-E medium is present. Otherwise, CD-E medium is not present.

The Number of First track on the disc is: 1) If Disc Status is set to 00 (Empty Disc), the Number of First track field shall be one. 2) If there is no PMA for track information and the first track is incomplete track, the track Number of First track shall be equal to one. 3) If there are PMA for track information and there is no Complete Session, the track Number of First track is from PMA. 4) Otherwise, this is the track number for the first TOC entry for track.

The Number of Sessions 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 and Last track Number in Last Session. In order that tracks in a last session which is open may be scanned for Read track Information Command, both the First track Number in Last Session and the Last track Number in Last Session are identified. This is inclusive of the invisible track.

The DID_V (Disc Identification Valid) flag specifies the validity of the Disc Identification field. If it is set to 1, then the Disc Identification field is valid. Otherwise, it is invalid.

The DBC_V (Disc Bar Code Valid) flag specifies the validity of the Disc Bar Code field. If it is set to 1, then the Disc Bar Code field is valid. Otherwise, it is invalid.

The GEN (General Purpose Disc) flag, when set to zero, indicates that the mounted CD-R/E disc is not defined for general purpose use. When the GEN flag is set to one, the mounted CD-R/E disc is defined for general purpose use.

The GEN Flag is returned according to the encoded value in ATIP, as following table:

Table 161 - GEN Flag

GEN Flag	Description
0	Not defined for general purpose disc
1	Defined for general purpose disc

The Disc Type specifies the type of the data on whole disc. A disc has only one disc type. The disc type is recorded in the A0/PSEC field in the TOC of the session in which 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 tracks (only audio), A0/PSEC field in the TOC of the session is always 00h regardless of actual disc type. For all disc, the type shall be determined from the following sequence.

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 (not appendable).
4. The Disc type is NOT decided, the Disc Type field of Disc Information data shall contain FFh.

Table 162 - Disc Type Code

Disc Type Code	Disc Type
00	CD-DA or CD-ROM Disc
10	CD-IDisc
20	CD-ROM XA Disc
FF	Undefined
All other value	Reserved

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.

Lead-in Start Time for Last Session. If the disc is Empty as specified in Disc Status field or has no Complete Session, then the Lead-in Start Time is returned as encoded address in the ATIP. If the last session, which is the second or greater, is Empty or Incomplete Session on disc, it shall return Lead-in Start Time of Last Session. If the Disc Status is Complete, the Lead-in Start Time field is filled with FFh. The Lead-in Start Time is given in the MSF format.

Last Possible Start Time of Lead-out. If the disc is a Complete disc, the Last Possible Start Time of Lead-out field is filled with FFh. The Last Possible Start Time of Lead-out is returned as encoded address in the ATIP and it is given in MSF format.

Disc Bar Code. If the Logical Unit has the ability to read Disc Bar Code and a bar code is present, then the Disc Bar Code field contains the 12 hex digits of the bar code.

Number of OPC Table Entries. An OPC (Optimum Power Control) Table is attached only if the values are known for the mounted 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 is used to compute the number of bytes that will follow will be the number of entries times 8. This number shall be the same for all values of Allocation Length. The Number of OPC Table Entries will always be zero for CD-ROM discs and for CD-R/E discs for which OPC have not yet been determined.

Table 163 - OPC Table Entries

Bit Byte	7	6	5	4	3	2	1	0
0	(MSE) Speed in Kilobytes/Second (LSB)							
1								
2	(MSE) OPC Value (LSB)							
3								
4								
5								
6								
7								

The Speed field indicates the speed for which this OPC value is valid. This value is the number of kilobytes per/second (Speed/1000) that the data is read from the Logical Unit.

Table 164 - Example Data Rates

Speed	CD-ROM/R/E Data Rate
X1	176 KBytes/second
X2	353 KBytes/second
X4	706 KBytes/second
X8	1.4 MBytes/second
X16	2.8 MBytes/second

The OFC_Value field is associated with given speed

Table 165 - Recommended Sense Key, ASC and ASCQ for READ DISC INFORMATION Command Errors

Sense Key	ASC	ASCQ	Description of Error
02	04	00	LOGICAL UNIT NOT READY - CAUSE NOT REPORTABLE
02	04	01	LOGICAL UNIT NOT READY - IN PROGRESS OF BECOMING READY
02	04	02	LOGICAL UNIT NOT READY - INITIALIZING COMMAND REQUIRED
02	04	03	LOGICAL UNIT NOT READY - MANUAL INTERVENTION REQUIRED
02	06	00	NO REFERENCE POSITION FOUND (media may be upside down)
02	3A	00	MEDIUM NOT PRESENT
04	15	00	RANDOM POSITIONING ERROR
04	15	01	MECHANICAL POSITIONING ERROR
05	20	00	INVALID COMMAND OPERATION CODE
05	24	00	INVALID FIELD IN COMMAND PACKET
05	30	01	CANNOT READ MEDIUM - UNKNOWN FORMAT
05	30	02	CANNOT READ MEDIUM - INCOMPATIBLE FORMAT
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON OR HARD RESET OCCURRED
06	2E	00	INSUFFICIENT TIME FOR OPERATION
06	3F	00	LOGICAL UNIT OPERATING CONDITIONS HAVE CHANGED
06	3F	01	MICROCODE HAS BEEN CHANGED

10.1.8 READ HEADER Command

The READ HEADER command requests that the Logical Unit return the CD-ROM Data Block Address Header of the requested logical block.

Table 166 - READ HEADER Command

Byte	Bit	7	6	5	4	3	2	1	0	
0		Operation code (44h)								
1		LUN				Reserved			MSF	Reserved
2		MSB Logical Block Address								
3										
4										
5		LSB								
6		Reserved								
7		MSB Allocation Length								
8		LSB								
9		Vendor-Specific			Reserved			NACA	Flag	Link
10		PAD								
11										

See "5.5 CD Address Reporting Formats (MSF bit)" on page 64 for a description of the MSF bit.

The Logical Block Address field specifies the logical block at which the read header operation shall begin.

See the READ (10) command for exception handling.

The READ HEADER data format below defines the format for the returned CD-ROM data block address header of the requested logical block.

Table 167 - READ HEADER LBA Data Format

Bit Byte	7	6	5	4	3	2	1	0	
0	CD-ROM Data Mode								
1	Reserved								
2	Reserved								
3	Reserved								
4	MSB	Logical Block Address						LSB	
5									
6									
7									

Table 168 - READ HEADER MSF Data Format

Bit Byte	7	6	5	4	3	2	1	0
0	CD-ROM Data Mode							
1	Reserved							
2	Reserved							
3	Reserved							
4	Reserved							
5	M							
6	S							
7	F							

The CD-ROM Data Mode field specifies the CD-ROM data mode of the logical blocks in this sector of data. The values in this field are defined in "Table 169 - CD Data, Mode Codes" on page 210.

Table 169 - CD Data, Mode Codes

CD-ROM Data Mode	User Data Field Contents (2048 Bytes)
00h	Mode 0 or Audio
01h	Mode 1
02h	Mode 2
03h - FFh	Reserved

If the MSF bit is zero, the Absolute Address field gives the logical block address of the first logical block in the physical sector where the data for the requested logical block address is found. If the MSF bit is one, the Absolute Address field gives the MSF address of the sector where the data for the requested logical block address is found.

Table 170 - Recommended Sense Key, ASC and ASCQ for Read Header Command Errors

Sense Key	ASC	ASCQ	Description of Error
01	17	01	RECOVERED DATA WITH RETRIES
01	18	01	RECOVERED DATA WITH ERROR CORRECTION & RETRIES APPLIED
01	18	04	RECOVERED DATA WITH ECC
01	5D	01	FAILURE PREDICTION THRESHOLD EXCEEDED - Predicted Media Failure
02	04	00	LOGICAL UNIT NOT READY - CAUSE NOT REPORTABLE
02	04	01	LOGICAL UNIT NOT READY - IN PROGRESS OF BECOMING READY
02	04	02	LOGICAL UNIT NOT READY - INITIALIZING COMMAND REQUIRED
02	04	03	LOGICAL UNIT NOT READY - MANUAL INTERVENTION REQUIRED
02	06	00	NO REFERENCE POSITION FOUND (media may be upside down)
02	3A	00	MEDIUM NOT PRESENT
03	02	00	NO SEEK COMPLETE
03	11	05	ECC UNCORRECTABLE ERROR
03	11	06	CIRC UNRECOVERED ERROR (CD Media only)
04	15	00	RANDOM POSITIONING ERROR
04	15	01	MECHANICAL POSITIONING ERROR
05	20	00	INVALID COMMAND OPERATION CODE
05	21	00	LOGICAL BLOCK ADDRESS OUT OF RANGE
05	24	00	INVALID FIELD IN COMMAND PACKET
05	30	01	CANNOT READ MEDIUM - UNKNOWN FORMAT
05	30	02	CANNOT READ MEDIUM - INCOMPATIBLE FORMAT
05	6F	03	READ OF SCRAMBLED SECTOR WITHOUT AUTHENTICATION
06	28	00	NOT READY TO READY TRANSITION
05	64	00	ILLEGAL MODE FOR THIS TRACK OR INCOMPATIBLE MEDIUM
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON OR HARD RESET OCCURRED
06	2E	00	INSUFFICIENT TIME FOR OPERATION
06	3F	00	DEVICE OPERATING CONDITIONS HAVE CHANGED
06	3F	01	MICROCODE HAS BEEN CHANGED

10.1.9 READ SUB-CHANNEL Command

The READ SUB-CHANNEL command requests that the C/DVD Logical Unit return the requested sub-channel data plus the state of play operations.

Table 171 - READ SUB-CHANNEL Command

Byte	Bit	7	6	5	4	3	2	1	0
0	Operation code (42h)								
1	LUN				Reserved			MSF (Mandatory)	Reserved
2	Reserved	SubQ (Mandatory)		Reserved					
3	Sub-channel Data Format								
4	Reserved								
5	Reserved								
6	Track Number								
7	MSB			Allocation Length					
8									LSB
9	Vendor-Specific			Reserved			NACA	Flag	Link
10	PAD								
11	PAD								

Sub-channel data returned by this command may be from the last appropriate sector encountered by a current or previous media accessing operation. When there is no current play operation, the C/DVD Logical Unit may access the media to read the sub-channel data. The C/DVD Logical Unit is responsible for ensuring that the data returned are current and consistent.

See "5.5 CD Address Reporting Formats (MSF bit)" on page 64 for a description of the MSF bit. Support for the MSF bit is mandatory.

The sub Q bit set to one requests that the C/DVD Logical Unit return the Q sub-channel data. The sub Q bit set to zero requests that no sub-channel data be returned. This shall not be considered an error. Support for the SubQ bit is mandatory. When the sub Q bit is Zero, only the Sub-Channel data header is returned.

Table 172 - Sub-channel Data Header Format

Bit Byte	7	6	5	4	3	2	1	0
Sub-Channel Data Header								
0	Reserved							
1	Audio Status							
2	Sub-channel Data Length							
3	(LSB)							

The sub-channel data format field specifies the returned sub channel data. If this field is 01h, 02h or 03h, the requested sub-Q data item is returned.

Table 173 - Sub-channel Data Format Codes

Format Code	Returned data	Support Requirement
00h	Reserved	Reserved
01h	CD current position	Mandatory
02h	Media catalogue number (UPC/bar code)	Mandatory
03h	Track international standard recording code (ISRC)	Mandatory
04h - EFh	Reserved	
F0h - FFh	Vendor-specific	Optional

The track number field specifies the track number from which the ISRC code is transferred. This field shall have a value from 01h to 63h (99d), and is valid only when the sub-channel data format is 03h. If this field is nonzero for all sub-channel data formats other than 03h the drive will terminate the command with a check condition (INVALID REQUEST / INVALID FIELD IN COMMAND PACKET).

10.1.9.1 CD Current Position Data Format

Table 174 - CD Current Position Data Format (Format Code 01h)

Bit Byte	7	6	5	4	3	2	1	0
Sub Channel Data Header								
0	Reserved							
1	Audio Status							
2	MSB		Sub-channel Data Length				LSB	
3								
CD Current Position Data Block								
4	Sub Channel Data Format Code (01h)							
5	ADR				Control			
6	Track Number							
7	Index Number							
8	MSB		Absolute CD Address				LSB	
9								
10	See 'Table 11 - MSF Address Format' on page 64							
11								
12	MSB		Track Relative CD Address				LSB	
13								
14	See 'Table 11 - MSF Address Format' on page 64							
15								

The Audio Status field indicates the status of play operations. The audio status values are defined in "Table 175 - Audio Status Codes" on page 215. Audio status values 13h and 14h return information on previous audio operations; they are returned only once after the condition has occurred. If another play operation is not requested, the audio status returned for subsequent READ SUB-CHANNEL commands is 15h.

Table 175 - Audio Status Codes

Status	Description
00h	Audio status byte not supported or not valid
11h	Play operation in progress
12h	Play operation paused
13h	Play operation successfully completed
14h	Play operation stopped due to error
15h	No current audio status to return

The Sub-channel Data Length specifies the length in bytes of the following sub-channel data block. A sub-channel data length of zero indicates that no sub-channel data block is included in the returned data. Sub-channel data length does not include the sub channel header.

The Sub-Q Channel Data Block consists of control data (bytes 4 - 5), current position data (bytes 6 - 15) and identification data (bytes 16 - 47). The control data and current position data is obtained from the Q sub-channel information of the current block. Identification data may be reported that was obtained from a previous block. If identification data is reported, the data shall be valid for the sector addressed by the current position data.

1. If an play operation is proceeding in the background, position data for the last sector played shall be reported.
2. In other cases, for instance after a READ command, the C/DVD Logical Unit may either report position data for the last sector processed for that operation or may report position data from the sector at the current read head position.

The ADR field gives the type of information encoded in the Q sub-channel of this block, as shown in the following table.

Table 176 - ADR Sub-channel Q Field

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

Table 177 - Sub-channel Q Control Bits

Bit	Equals zero	Equals one
0	Audio without pre-emphasis	Audio with pre-emphasis
1	Digital copy prohibited	Digital copy permitted
2	Audio track	Data track
3	Two-channel audio	Four-channel audio

The Track Number field specifies the track from which ISRC data is read. This field must have a value between 01h and 63h and is valid only when the sub-channel data format field is 03h. In this case, the C/DVD Logical Unit returns ISRC data for this track.

The Index Number specifies the index number in the current track.

The Absolute CD Address field gives the current location relative to the logical beginning of the media. If the MSF bit is zero, this field is a logical block address. If the MSF bit is one, this field is an absolute MSF address.

The Track Relative CD Address field gives the current location relative to the logical beginning of the current track. If the MSF bit is zero, this field is a track relative logical block address. (If the current block is in the pre-gap area of a track, this will be a negative value, expressed as a twos-complement number.) If the MSF bit is one, this field is the relative MSF address from the Q sub-channel.

10.1.9.2 Media Catalogue Number Data Format

A Media Catalogue Valid (MCVal) bit of one indicates that the media catalogue number field is valid. A MCVal bit of zero indicates that the media catalogue number field is not valid.

The Media Catalogue Number field contains the identifying number of this media according to the uniform product code values (UPC/EAN bar coding) expressed in ASCII. Non-zero values in this field are controlled by the Uniform Product Code Council 1) and the European Article Number Council 2). A value in this field of all ASCII zeros indicates that the media catalog number is not supplied.

If media catalogue number data is found, the MCVal bit is set to one. If MCN data is not detected, the MCVal bit is set to zero to indicate the Media Catalogue Number field is invalid.

Media catalogue number data returned by this command with sub-channel data format field code 02h may be from any block that has UPC bar code Q sub-channel data. (This code is constant anywhere in every applicable disc.)

The CD Drive may either return the UPC information that it has previously read (Cached data) or may scan for the information. As the UPC is only guaranteed to be contained in 1 out of 100 sectors and errors may be encountered, the time required to return the UPC data could be several seconds.

Table 178 - Media Catalogue Number Data Format (Format Code 02h)

Bit Byte	7	6	5	4	3	2	1	0
Sub Channel Data Header								
0	Reserved							
1	Audio Status							
2	MSE		Sub-channel Data Length					
3								LSB
Media Catalogue Number Data Block								
0	Sub Channel Data Format Code (02h)							
1	Reserved							
2	Reserved							
3	Reserved							
4	Media Catalogue Number (UPC/Bar Code)							
19	(See 'Table 179 - UPC Format' on page 218)							

1. The Uniform Product Code Council is located at 8163 Old Yankee Road, Suite J, Dayton, Ohio 45459.
2. The European Article Number Council is located at Rue des Colonies, 54-BTE8, 1000 Brussels, Belgium.

Table 179 - UPC Format

Bit Byte	7	6	5	4	3	2	1	0
0	MCVa	Reserved						
1	N1 (Most significant)							
2	N2							
3	N3							
4	N4							
5	N5							
6	N6							
7	N7							
8	N8							
9	N9							
10	N10							
11	N11							
12	N12							
13	N13							
14	Zero							
15	AFrame (Binary)							

N1 through N13 shall be retrieved from the Q channel in mode 2. The data shall be encoded as ASCII characters (i.e. if N1 of the UPC is 01bcd, then N1 of the above field shall be 49d or 31h).

10.1.9.3 Track International Standard Recording Code Data Format

The Track ISRC field contains the identifying number of this media according to the ISRC standards (DIN-31-621).

Table 180 - Track International Standard Recording Code Data Format

Bit Byte	7	6	5	4	3	2	1	0
Sub Channel Data Header								
0	Reserved							
1	Audio Status							
2	Sub-channel Data Length							
3	Sub-channel Data Length							
Track ISRC Data Block								
0	Sub Channel Data Format Code (03h)							
1	ADR (03)				Control			
2	Track Number							
3	Reserved							
4	Track International Standard Recording Code (ISRC)							
19	Track International Standard Recording Code (ISRC)							

If ISRC data is detected, the TCVal bit is set to one. If ISRC data is not detected, the TCVal bit is set to zero to indicate the ISRC field is invalid.

Track ISRC data returned by this command with sub-channel data format field 03h may be from any block in the specified track that has ISRC data. When ADR field is 3 (0011), it is used to assign a unique number to an audio track. This is done by means of the ISRC which is 12 characters long (represented by I1 to I12.) The ISRC can only change immediately after the TNO has been changed.

Table 181 - Raw ISRC Format on the CD Disc

S0, S1	Control	ADR	I1 I2	I3 I4 I5	00	I6 I7 I8 I9 I10 I11 I12	zero	AFrame	CRC
		3	ISRC 60 bits						

I1, I2 are the country code; I3, I4, I5 are the owner code; I6, I7 are the year of recording; I8, I9, I10, I11, I12 are the serial number of the recording. AFrame is the absolute frame number.

Note: The information returned for the ISRC shall be converted to ASCII. The translation used will translate media codes from 00h - 09h to ASCII '0' - '9' and media codes from 10h - 3Fh to ASCII '@' - '0'.

Table 182 - ISRC Format of Data Returned to Host

Bit Byte	7	6	5	4	3	2	1	0
0	TCVal	Reserved						
1	I1 (Country Code) Valid codes are ASCII 'A' - 'Z'							
2	I2							
3	I3 (Owner Code) Valid codes are ASCII '0' - '9' & 'A' - 'Z'							
4	I4							
5	I5							
6	I6 (Year of Recording) Valid codes are ASCII '0' - '9'							
7	I7							
8	I8 (Serial Number) Valid codes are ASCII '0' - '9'							
9	I9							
10	I10							
11	I11							
12	I12							
13	Zero							
14	AFrame							
15	Reserved							

Table 183 - Recommended Sense Key, ASC and ASCQ for Read Sub-channel Command Errors

Sense Key	ASC	ASCQ	Description of Error
01	17	01	RECOVERED DATA WITH RETRIES
01	18	01	RECOVERED DATA WITH ERROR CORRECTION & RETRIES APPLIED
01	18	04	RECOVERED DATA WITH ECC
01	5D	01	FAILURE PREDICTION THRESHOLD EXCEEDED - Predicted Media Failure
02	04	00	LOGICAL UNIT NOT READY - CAUSE NOT REPORTABLE
02	04	01	LOGICAL UNIT NOT READY - IN PROGRESS OF BECOMING READY
02	04	02	LOGICAL UNIT NOT READY - INITIALIZING COMMAND REQUIRED
02	04	03	LOGICAL UNIT NOT READY - MANUAL INTERVENTION REQUIRED
02	06	00	NO REFERENCE POSITION FOUND (media may be upside down)
02	3A	00	MEDIUM NOT PRESENT
03	02	00	NO SEEK COMPLETE
03	11	05	ECC UNCORRECTABLE ERROR
03	11	06	CIRC UNRECOVERED ERROR (CD Media only)
04	15	00	RANDOM POSITIONING ERROR
04	15	01	MECHANICAL POSITIONING ERROR
05	20	00	INVALID COMMAND OPERATION CODE
05	21	00	LOGICAL BLOCK ADDRESS OUT OF RANGE
05	24	00	INVALID FIELD IN COMMAND PACKET
05	30	01	CANNOT READ MEDIUM - UNKNOWN FORMAT
05	30	02	CANNOT READ MEDIUM - INCOMPATIBLE FORMAT
05	6F	03	READ OF SCRAMBLED SECTOR WITHOUT AUTHENTICATION
06	28	00	NOT READY TO READY TRANSITION
05	64	00	ILLEGAL MODE FOR THIS TRACK OR INCOMPATIBLE MEDIUM
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON OR HARD RESET OCCURRED
06	2E	00	INSUFFICIENT TIME FOR OPERATION
06	3F	00	DEVICE OPERATING CONDITIONS HAVE CHANGED
06	3F	01	MICROCODE HAS BEEN CHANGED

10.1.9.4 Caching of Sub-Channel Data

Sub-channel Q data shall be cached by the drive while playing audio. This is necessary so that the Read Sub-channel or Read CD commands can access the Sub-Channel Q data while executing an immediate command. The device shall generate an error if the data is not in the cache.

Read Sub-channel will return the “Current” data, while Read CD will return the specified data and remove any previous (older) data from the cache.

Using “FFFFFFFFh” on Read CD will work just like Read Sub-channel.

10.1.10 READ TOC/PMA/ATIP Command

The READ TOC/PMA/ATIP command requests that the C/DVD Logical Unit transfer data from the Table of Contents, the Program Memory Area (PMA), and the Absolute Time in Pre-Groove (ATIP).

Table 184 - READ TOC/PMA/ATIP Command

Byte	Bit	7	6	5	4	3	2	1	0
0		Operation code (43h)							
1		LUN			Reserved			MSF (Mandatory)	Reserved
2		Reserved			Format				
3		Reserved							
4		Reserved							
5		Reserved							
6		Track / Session Number							
7		MSE			Allocation Length				
8		LSB							
9		Vendor-Specific		Reserved			NALC	Flag	Link
10		PAD							
11		PAD							

See "5.5 CD Address Reporting Formats (MSF bit)" on page 64 for a description of the MSF bit. The Format field is defined in Table below.

The Track/Session Number field specifies the starting track number for which 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 COMMAND PACKET.

When a Read TOC/PMA/ATIP command is presented for a CD-R/E media, where the first TOC has not been recorded (no complete session) and the Format codes 0000b, 0100b, or 1000b are specified, this command shall be rejected with an INVALID FIELD IN COMMAND PACKET. Logical Units that are not capable of reading an incomplete session on CD-R/E media shall report NOT READY, MEDIA FORMAT NOT COMPATIBLE.

Table 185 - Format Code definitions for READ TOC/PMA/ATIP command

Format field	Returned Data	Optional/Mandatory	Description	Use of Track/Session Field
0h	TOC	M	The Track/Session Number field specifies starting track number for which the data will be returned. For multi-session discs, this command will return the TOC data for all sessions and for Track number <i>Ah</i> only the lead-out area of the last complete session. See 'Table 186 - READ TOC/PMA/ATIP Data Format (With Format Field = 0h)' on page 223	Contains the Track number
1h	Session Information	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 187 - READ TOC/PMA/ATIP Data Format (With Format Field = 1h)' on page 224	Reserved
2h	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 format, the drive will support Q Sub-channel POINT field value of A0h, A1h, A2h, Track numbers, B0h, B1h, B2h, B3h, B4h, C0h, and C1h. See 'Table 188 - READ TOC/PMA/ATIP Data Format (With Format Field = 2h)' on page 225	Contains the Session number
3h	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 <i>shall</i> be set to 00h. See 'Table 190 - READ TOC/PMA/ATIP Data Format (With Format Field = 3h)' on page 227	Reserved
4h	ATIP	O	This format returns ATIP data. In this format, the Track/Session Number field is reserved and <i>shall</i> be set to 00h. See 'Table 191 - READ TOC/PMA/ATIP Data Format (With Format Field = 4h)' on page 228	Reserved
5h - 0Fh			Reserved	

Table 186 - READ TOC/PMA/ATIP Data Format (With Format Field = 0h)

Bit Byte	7	6	5	4	3	2	1	0
0	MSE				TOC Data Length			
1								LSB
2	First Track Number							
3	Last Track Number							
TOC Track Descriptors								
0	Reserved							
1	ADR				Control			
2	Track Number							
3	Reserved							
4	MSE							
5	Logical Block Address							
6								
7								

The TOC/PMA/ATIP data consist of four header bytes and zero or more track descriptors. The TOC/PMA/ATIP data is dependent upon the format specified in the format field of the COMMAND PACKET.

The TOC data length specifies 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 176 - ADR Sub-channel Q Field" on page 215.

The Control Field indicates the attributes of the track. The possible control field values are defined in "Table 198 - Values for Control Field in Read TOC/PMA/ATIP" on page 234 . The Track Number field indicates the track number for which 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.

Table 187 - READ TOC/PMA/ATIP Data Format (With Format Field = 1h)

Bit Byte	7	6	5	4	3	2	1	0
0	MSB TOC Data Length (0Ah)							LSB
1								
2	First Complete Session Number (Hex)							
3	Last Complete Session Number (Hex)							
TOC Track Descriptors								
0	Reserved							
1	ADR			Control				
2	First Track Number in Last Complete Session							
3	Reserved							
4	MSB							LSB
5	Logical Block Address of First Track in Last Session							
6								
7								

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 176 - ADR Sub-channel Q Field" on page 215.

The Control Field indicates the attributes of the track. The possible control field values are defined in "Table 196 - Bit Definitions for the Control Field in Sub-channel Q" on page 232.

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.

Table 188 - READ TOC/PMA/ATIP Data Format (With Format Field = 2h)

Bit Byte	7	6	5	4	3	2	1	0
0	MSE			TOC Data Length				
1								LSB
2	First Complete Session Number							
3	Last Complete Session Number							
TOC Track Descriptors								
0	Session Number							
1	ADR				Control			
2	Byte 1 or TNO							
3	Byte 2 or POINT							
4	Byte 3 or Min							
5	Byte 4 or Sec							
6	Byte 5 or Frame							
7	Byte 6 or Zero							
8	Byte 7 or PMin							
9	Byte 8 or PSec							
10	Byte 9 or PFrame							

Multiple entries are recorded in the TOC area.

For Format field of 2h, the Logical Unit should 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 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 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 176 - ADR Sub-channel Q Field" on page 215.

The Control Field indicates the attributes of the track. The possible control field values are defined in "Table 196 - Bit Definitions for the Control Field in Sub-channel Q" on page 232.

Entries in bytes 2 through 10 of the descriptors shall be converted to hex by the Logical Unit if the media contains a value between 0 and 99bcd.

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, A1h, A2h, Track Numbers, B0h, B1h, B2h, B3h, B4h, C0h, and C1h.

Q sub-channel formats in the lead-in area of the TOC is described in "Table 195 - Lead in Area, Sub-channel Q formats" on page 231.

Table 189 - TOC/PMA/ATIP Track Descriptors

Byte	Action	Description
Byte 0	Return a hex value	Session Number
Byte 1	No conversion, return as is	ADR / Control
Byte 2	0	Track (C/DVD STRUCTURE = 0)
Byte 3	If 0-99bcd, then convert to hex	Point
Bytes 4 - 6	Conversion based on Point	MSF Field
Point 00-99	Value should be 00h	NRA Skip Values ORP / App Code Reserved
Point A0h - AFh	Value should be 00h	
Point B0h	Convert to hex	
Point B1h - EFh	Convert to hex	
Point C0	No Conversion	
Point C1 - FFh	No Conversion	
Byte 7	Conversion based on Point	ZERO Field
Point 00h - AFh	Value should be 00h	
Point B0h - EFh	Convert to Hex	#Ptrs / Skip
Point C0h - FFh	No Conversion	Reserved
Bytes 8 - 10	Conversion based on Point	ZERO Field
Point 00 - 99	Convert to hex	Track Start
Point A0h	Convert PMIN to hex, PSEC is returned as is	1st / Last / Start LO
Point A1h - AFh	Convert to hex	1st / Last / Start LO
Point B0h	Convert to hex	Lead Out Max
Point B1h - EFh	Convert to hex	Skip Values
Point C0h	Convert to hex	ORP / App Code
Point C1h - FFh	No conversion	Reserved

Table 190 - READ TOC/PMA/ATIP Data Format (With Format Field = 3h)

Bit Byte	7	6	5	4	3	2	1	0
0	MSB PMA Data Length							
1	LSB							
2	Reserved							
3	Reserved							
PMA Descriptors								
0	Reserved							
1	ADR				Control			
2	Byte 1 or TNO							
3	Byte 2 or POINT							
4	Byte 3 or Min							
5	Byte 4 or Sec							
6	Byte 5 or Frame							
7	Byte 6 or Zero							
8	Byte 7 or PMin							
9	Byte 8 or PSec							
10	Byte 9 or PFrame							

Multiple entries are recorded in the PMA area.

The PMA Data Length specifies 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.

The returned PMA descriptors are arranged in the order found in the PMA, with duplicates removed.

Entries in bytes 2 through 10 of the descriptors shall be converted to hex by the Logical Unit if the media contains a value between 0 and 99bcd.

Table 191 - READ TOC/PMA/ATIP Data Format (With Format Field = 4h)

Bit Byte	7	6	5	4	3	2	1	0	
0	MSEB		ATIP Data Length						
1							LSB		
2	Reserved								
3	Reserved								
ATIP Descriptors									
4	1	Indicative Device Writing Power			Reserved		Reference Speed		
5	0	URU		Reserved					
6	1	Disc Type	Disc Sub-Type			A1	A2	A3	
7	Reserved								
8	ATIP Start Time of lead-in (Min)								
9	ATIP Start Time of lead-in (Sec)								
10	ATIP Start Time of lead-in (FRAME)								
11	Reserved								
12	ATIP Last Possible Start Time of lead-out (Min)								
13	ATIP Last Possible Start Time of lead-out (Sec)								
14	ATIP Last Possible Start Time of lead-out (FRAME)								
15	Reserved								
16	0	Lowest Usable CLV Recording Speed			Highest Usable CLV Recording Speed				
17	0	Power Multiplication Factor p			Device y value of the Modulation Power function		Reserved		
18	1	Recommended Erase/Write Power Ratio (Peg/Weg)			Reserved				
19	Reserved								
20 - 22	A2 Values								
23	Reserved								
24 - 26	A3 Values								
27	Reserved								

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.

Indicative Device Writing Power - encoded information indicating the media's recommended initial laser power setting. The meaning of these bits varies between CD-R and CD-E media.

Reference Speed - encoded information indicating the recommended write speed for the media. 00h = reserved. 01h -2X recording. Valid only for CD-E media.

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

Disc Type - zero indicates CD-R media; one indicates CD-E 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.

ATIP Start time of Lead-in - 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.

ATIP Last Possible Start Time of Lead-out - 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 are 0 through 4Fh.

Lowest Usable CLV Recording Speed - valid only when A1 = 1.

Table 192 - Lowest Usable CLV Recording Speed

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

Highest Usable CLV Recording Speed - valid only when A1.

Table 193 - Highest Usable CLV Recording Speed

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

Power Multiplication Factor p - reported as recorded in ATIP.

Device y value of the Modulation/Power Ratio (P_{e0} / W_{e0}) - reported as recorded in ATIP.

A2 Values - Reserved

A3 Values - Reserved

Table 194 - Recommended Sense Key, ASC and ASCQ for Read TOC/PMA/ATIP Command Errors

Sense Key	ASC	ASCQ	Description of Error
01	17	01	RECOVERED DATA WITH RETRIES
01	18	01	RECOVERED DATA WITH ERROR CORRECTION & RETRIES APPLIED
01	18	04	RECOVERED DATA WITH ECC
01	5D	01	FAILURE PREDICTION THRESHOLD EXCEEDED - Predicted Media Failure
02	04	00	LOGICAL UNIT NOT READY - CAUSE NOT REPORTABLE
02	04	01	LOGICAL UNIT NOT READY - IN PROGRESS OF BECOMING READY
02	04	02	LOGICAL UNIT NOT READY - INITIALIZING COMMAND REQUIRED
02	04	03	LOGICAL UNIT NOT READY - MANUAL INTERVENTION REQUIRED
02	06	00	NO REFERENCE POSITION FOUND (media may be upside down)
02	3A	00	MEDIUM NOT PRESENT
03	02	00	NO SEEK COMPLETE
03	11	05	ECC UNCORRECTABLE ERROR
03	11	06	CIRC UNRECOVERED ERROR (CD Media only)
04	15	00	RANDOM POSITIONING ERROR
04	15	01	MECHANICAL POSITIONING ERROR
05	20	00	INVALID COMMAND OPERATION CODE
05	21	00	LOGICAL BLOCK ADDRESS OUT OF RANGE
05	24	00	INVALID FIELD IN COMMAND PACKET
05	30	01	CANNOT READ MEDIUM - UNKNOWN FORMAT
05	30	02	CANNOT READ MEDIUM - INCOMPATIBLE FORMAT
05	6F	03	READ OF SCRAMBLED SECTOR WITHOUT AUTHENTICATION
06	28	00	NOT READY TO READY TRANSITION
05	64	00	ILLEGAL MODE FOR THIS TRACK OR INCOMPATIBLE MEDIUM
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON OR HARD RESET OCCURRED
06	2E	00	INSUFFICIENT TIME FOR OPERATION
06	3F	00	DEVICE OPERATING CONDITIONS HAVE CHANGED
06	3F	01	MICROCODE HAS BEEN CHANGED

10.1.10.1 Sub-channel Q information

Table 195 - Lead in Area, Sub-channel Q formats

SQ,SI	Control / ADR	TMO	Point	Min	Sec	Frame	Zero	P min	P Sec	P Frame	CRC x16+x12 +x5+1
4h	1	00	01-99	00 (Absolute time is allowed)			00	Start position of track			
4h	1	00	A0	00 (Absolute time is allowed)			00	First Track num	Disc Type	00	
4h	1	00	A1	00 (Absolute time is allowed)			00	Last Track num	00	00	
4h	1	00	A2	00 (Absolute time is allowed)			00	Start position of the Lead-out area			
4h	5	00	B0	Start time of next possible program in the Recordable Area of the Hybrid Disc			# of pointers in Mode 5	Maximum start time of the outermost Lead Out area in the Recordable Area of the Hybrid Disc			
4h	5	00	B1	00	00	00	00	# of Skip Interval Pointers (N <= 40)	# of Skip Track Pointers (N <= 21)	00	
4h	5	00	B2-B4	Skip #	Skip #	Skip #	Skip #	Skip #	Skip #	Skip #	
4h	5	00	01-40	Ending time for the interval that should be skipped			Reserved	Start time for interval that should be skipped on playback			
4h	5	00	C0	Optimum recording power	Application Code	Reserved	Reserved	Start time of the first Lead In Area of the Hybrid Disc			

Point The Point field defines various types of information:

01-99 Track number references A0 First Track number in the program area A1 Last Track number in the program area A2 Start location of the Lead-out area B0 Used to identify a Hybrid Disc (Photo CD) Contains start time of next possible program area B1 Number of Skip Interval Pointers & Skip Track assignments 01-40 Skip Interval Pointers B2-B4 Skip Track Assignment Pointers C0 Start time of first Lead In area of Hybrid Disc This only exists in the first Lead In area C1 Copy of information from additional area in ATIP

Disc Type Byte This byte contains a definition of the type of disc

00h CD-DA or CD-ROM with first track in Mode 1 10h CD-I disc 20h CD-ROM XA disc with first track in Mode 2

Table 196 - Bit Definitions for the Control Field in Sub-channel Q

Control Field	Definition
00x0b	2 Audio without Pre-emphasis
00x1b	2 Audio with Pre-emphasis of 50/15µs
10x0b	Audio channels without pre-emphasis (Reserved in C D-E/E)
10x1b	Audio channels with pre-emphasis of 50/15 µs (Reserved in C D-E/E)
01x0b	Data track, recorded uninterrupted
01x1b	Data track, recorded incremental
11x0b	Reserved
xx0xb	Digital copy prohibited
xx1xb	Digital copy permitted

10.1.10.2 Example READ TOC/PMA/ATIP Operations

The following example is based on a 4 session, 12 track Photo CD disc. Data structure is shown as the data to Host.

Command Packet: 43h 00 00 00 00 00 00 10h 00 80h 00 00

Table 197 - Example Read TOC/PMA/ATIP Operations

Ses	A/C	TNO	Pnt	Min Sec Frame	Zero	P Min P Sec P Frame	Comments
01	14	00	A0	00 00 00	00	01 20 00	First track is 1. XA disc
01	14	00	A1	00 00 00	00	03 00 00	Last track is 3
01	14	00	A2	00 00 00	00	02 08 3F	Lead Out Area on 1st session
01	14	00	01	00 00 00	00	00 02 00	Start address of track 1
01	14	00	02	00 00 00	00	00 08 02	Start address of track 2
01	14	00	03	00 00 00	00	00 15 32	Start address of track 3
01	54	00	B0	04 26 3F	02	40 02 00	Next recordable area address
01	54	00	C0	C0 00 00	00	61 2C 00	Hybrid disc
02	14	00	A0	00 00 00	00	04 20 00	1st track on 2nd session is 4
02	14	00	A1	00 00 00	00	06 00 00	Last track on 2nd session is 6
02	14	00	A2	00 00 00	00	08 20 08	Lead Out Area on 2nd session
02	14	00	04	00 00 00	00	04 28 3F	Start address of track 4
02	14	00	05	00 00 00	00	04 2E 41	Start address of track 5
02	14	00	06	00 00 00	00	06 27 36	Start address of track 6
02	54	00	B0	09 2C 08	01	40 02 00	Next recordable area address
03	14	00	A0	00 00 00	00	07 20 00	1st track on 3rd session is 7
03	14	00	A1	00 00 00	00	09 00 00	Last track on 3rd session is 9
03	14	00	A2	00 00 00	00	0C 27 32	Lead Out Area on 3rd session
03	14	00	07	00 00 00	00	09 2E 08	Start address of track 7
03	14	00	08	00 00 00	00	09 34 10	Start address of track 8
03	14	00	09	00 00 00	00	0B 04 24	Start address of track 9
03	54	00	B0	20 09 32	01	40 02 00	Next recordable area address
04	14	00	A0	00 00 00	00	0A 20 00	1st track on 4th session is 10
04	14	00	A1	00 00 00	00	0C 00 00	Last track on 4th session is 12
04	14	00	A2	00 00 00	00	12 1B 1A	Lead Out Area on 4th session
04	14	00	0A	00 00 00	00	0E 0B 32	Start address of track 10
04	14	00	0B	00 00 00	00	0E 11 34	Start address of track 11
04	14	00	0C	00 00 00	00	11 08 22	Start address of track 12
04	54	00	B0	13 39 1A	01	40 02 00	Next recordable area address

Ses: session number
A/C: ADR/Control
TNO: 00 for Lead In area
Pnt: POINT

If you use the following command on this disc, Command Packet: 43h 00 00 00 00 00 00h 10h 00 40h 00 00, return data would be:

Table 198 - Values for Control Field in Read TOC/PMA/ATIP

Control Field value	Description
01h	First Session Number
04h	Last Session Number
00h	Reserved
14h	ADR/Control
0Ah [10d]	First Track Number in Last session
00h	Reserved
00h, 00h, F8h, EDh [In LBA format, 63725]	Absolute CD-ROM address of first track in last session -> 14M 9S 50F -> add 2 sec: 14M 11S 50F

10.1.11 READ TRACK INFORMATION Command

The READ TRACK INFORMATION command provides information about a track, regardless of its status.

Table 199 - READ TRACK INFORMATION Command

Byte	Bit	7	6	5	4	3	2	1	0
0	Operation Code (52h)								
1	LUN			Reserved		Reserved		Track	
2	(MSB)								
3	Logical Block Address/Track Number								
4									
5									
6									
6	Reserved								
7	MSB Allocation Length								
8	LSB								
9	Vendor-Specific			Reserved		NACA		Flag	Lmk
10	PAD								
11									

The Track flag in command packet byte 1 is used to specify the contents of bytes 2 through 5 of the command packet. If the Track flag is zero, then bytes 2 through 5 contain a Logical Block Address. If the Track flag is one, then the bytes 2 through 4 are reserved and byte 5 contains a track number.

The Logical Block Address/Track Number field, Bytes 2 through 5 are defined in "Table 200 - Track Number/LBA Field definition" on page 235.

Table 200 - Track Number/LBA Field definition

Track Flag	Logical Block Address/ Track Number	Track Number Used for Track Information
0	Logical Block Address	T_{LBA} , where T_{LBA} is the number of the track which contains the block associated with Logical Block Address.
1	T CDB, a valid track number	T CDB
1	FFh	T_{INV} where T_{INV} is the track number of the invisible track.

The number of Track Information Block bytes returned is limited by the Allocation Length parameter of the command packet. An Allocation Length of zero shall not to be considered an error.

The format and content of the Track Information Block is shown as follows:

Table 201 - Track Information Returned

Bit Byte	7	6	5	4	3	2	1	0	
0	MSE							Track Information length	
1								LSB	
Information Block									
2	Track Number								
3	Session Number								
4	Reserved								
5	Reserved		Damage	Copy	Track Mode				
6	RT	Blank	Packet	FP	Data Mode				
7	Reserved							NWA_V	
8	(MSE)								
9	Track Start Address								
10									
11									
12									(MSE)
13	Next Writable Address								
14									
15									
16									(MSE)
17	Free Blocks								
18									
19									
20									(MSE)
21	Fixed Packet Size								
22									
23									
									(MSE)

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.

Session Number is the number of the session containing this track.

The Copy bit indicates that this track is a second or higher generation copy.

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. The Damage bit, when set to one, and the NWA_V is set to one, an automatic repair may be attempted by the drive 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.

Track Mode is the control nibble as defined for mode 1 Q sub-channel for this track.

If the RT bit is zero, then the track is not reserved, otherwise the track is reserved. Reserved indicates that a PMA entry indicating the track's start and end addresses exists.

The Blank bit, when set to one, indicates that the track contains no written data. Tracks with the Track Descriptor Block recorded shall not be considered blank.

The Packet bit is valid only when the RT bit is set to one or the track indicated is the incomplete track. The Packet bit, when set to one, indicates that this track is to be written only with packets.

The FP (Fixed Packet) bit is valid only when the Packet bit is set to one. When the Packet 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 bit is set to one and the FP bit is set to zero, then the track is to be written only with variable packets.

When writing, certain parameters may be set via the write parameters page. The state of the track determines what parameters must be set and which parameters in the mode page must match. Required Write Parameters are defined in "Table 202 - Write Parameter Restrictions due to Track State" on page 237.

Table 202 - Write Parameter Restrictions due to Track State

RT	Blank	Packet	Track Status
0	0	0	Can't write to stamped disc, or during track at once on invisible track
0	0	1	Write type set to packet; all parameters common to READ TRACK.INFO and the write parameters mode page must match
0	1	0	Write type set to packet; all parameters common to READ TRACK.INFO and the write parameters mode page must match
0	1	1	Invalid State
1	0	0	Can't write to recorded track or during track at once on reserved track
1	0	1	Write type set to packet; all parameters common to READ TRACK.INFO and the write parameters mode page must match.
1	1	0	Write type 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 must match
1	1	1	Write type 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 must match.

When RT, Blank and Packet bits are set to one, FP bit of a Read Track Information result data is set to zero.

Data Mode defines the track content. Data Mode is defined in "Table 203 - Track Status Indications" on page 238.

RT	Blank	Packet	FP	Write Method	Track Status
0	0	0		Uninterrupted/TAD/SAO	Complete/During TAD/SAO
0	0	1	0	Variable	Incomplete
0	0	1	1	Fixed	Incomplete
0	1	0	0	TAD/Variable/Fixed In case last session is empty, SAO is also valid.	Invisible
0	1	1	0	-	(invalid)
0	1	1	1	-	(invalid)
1	0	0		TAD	Complete/During TAD
1	0	1	0	Variable	Complete/Partially Recorded Reserve
1	0	1	1	Fixed	Complete/Partially Recorded Reserve
1	1	0	-	TAD	Empty Reserved
1	1	1	0	Variable/Fixed	Empty Reserved
1	1	1	1	-	(invalid)

Table 203 - Track Status Indications

Table 204 - Data Mode

Value	Definition
1	Mode 1 (ISO/IEC 10149)
2	Mode 2 (ISO/IEC 10149 or CD-ROM XA)
F	Data Block Type unknown (No track descriptor block)
0, 3-E	Reserved

The Next Writable Address Valid (NWA_V) flag validates the next writable address. If NWA_V is zero, then the next writable address field is not valid. Otherwise, the next writable address field is valid. The NWA_V flag shall be set to zero if the track is not writable for any reason.

The Track Start Address is the starting address for the track specified.

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. Next Writable Address is independent of the Write Type setting in the Write Parameters Mode page. It shall be associated with the RT, Blank, Packet and FP bits as defined in "Table 205 - Next Writable Address definition" on page 239. When streaming in any write type, the Next Writable Address shall be the next user data block the drive expects to receive if no underrun occurs.

RT	Blank	Packet	FP	NWA_V	Definition
0	0	0	-	0*4	LEA that shall be specified by next write command *2
0	0	1	0	1*1	LEA that shall be specified by next write command *2
0	0	1	1	1*1	LEA that shall be specified by next write command *2, *3
0	1	0	0	1	LEA of the first datablock after pre-gap
0	1	1	0	-	-
0	1	1	1	-	-
1	0	0	-	0*4	LEA that shall be specified by next write command *2
1	0	1	0	1*1	LEA that shall be specified by next write command *2
1	0	1	1	1*1	LEA that shall be specified by next write command *2, *3
1	1	0	-	1	LEA of the first datablock after pre-gap
1	1	1	0	1	LEA of the first datablock after pre-gap
1	1	1	1	-	-
<p>*1 - When "Free Blocks" is 0 (data full), NWA_V is 0.</p> <p>*2 - NWA shall be taken account of datablocks in buffer that has not yet been written to media. If the drive 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.</p> <p>*3 - NWA shall follow the Addressing Method-2 if Method-2 bit in Mode CD Capabilities and Mechanical Status Page is set to one.</p> <p>*4 - During TAO, NWA_V is 1.</p>					

Table 205 - Next Writable Address definition

The Free Blocks field represents the maximum number of user data blocks available for recording in the track.

The Fixed Packet Size is valid only when the Packet and the FP bits are both set to one.

NOTE: Read Track Information shall provide certain valid fields for a disc with the Un-recordable status: Track Number, Session Number, Track Mode, Data Mode, Track Start Address.

If the disc is stamped, then DAMAGE = 0, BLANK = 0, RT = 0, and NWA_V = 0.

Table 206 - Recommended Sense Key, ASC and ASCQ for READ TRACK INFORMATION Command Errors

Sense Key	ASC	ASCQ	Description of Error
01	17	01	RECOVERED DATA WITH RETRIES
01	18	01	RECOVERED DATA WITH ERROR CORRECTION & RETRIES APPLIED
01	18	04	RECOVERED DATA WITH ECC
01	5D	01	FAILURE PREDICTION THRESHOLD EXCEEDED - Predicted Media Failure
02	04	00	LOGICAL UNIT NOT READY - CAUSE NOT REPORTABLE
02	04	01	LOGICAL UNIT NOT READY - IN PROGRESS OF BECOMING READY
02	04	02	LOGICAL UNIT NOT READY - INITIALIZING COMMAND REQUIRED
02	04	03	LOGICAL UNIT NOT READY - MANUAL INTERVENTION REQUIRED
02	06	00	NO REFERENCE POSITION FOUND (media may be upside down)
02	3A	00	MEDIUM NOT PRESENT
03	02	00	NO SEEK COMPLETE
03	11	05	ECC UNCORRECTABLE ERROR
03	11	06	CIRC UNRECOVERED ERROR (CD Media only)
04	15	00	RANDOM POSITIONING ERROR
04	15	01	MECHANICAL POSITIONING ERROR
05	20	00	INVALID COMMAND OPERATION CODE
05	21	00	LOGICAL BLOCK ADDRESS OUT OF RANGE
05	24	00	INVALID FIELD IN COMMAND PACKET
05	30	01	CANNOT READ MEDIUM - UNKNOWN FORMAT
05	30	02	CANNOT READ MEDIUM - INCOMPATIBLE FORMAT
05	6F	03	READ OF SCRAMBLED SECTOR WITHOUT AUTHENTICATION
06	28	00	NOT READY TO READY TRANSITION
05	64	00	ILLEGAL MODE FOR THIS TRACK OR INCOMPATIBLE MEDIUM
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON OR HARD RESET OCCURRED
06	2E	00	INSUFFICIENT TIME FOR OPERATION
06	3F	00	DEVICE OPERATING CONDITIONS HAVE CHANGED
06	3F	01	MICROCODE HAS BEEN CHANGED

10.1.12 SCAN Command

The SCAN command requests a fast forward or fast reverse scan operation starting from the Scan Starting Address. The command shall scan all the way to the end of the media (last audio track).

This command responds with immediate status, allowing overlapped commands. See also "11.9 Immediate Command Processing Considerations" on page 253.

For ATAPI Logical Units, this command shall set the DSC bit upon command completion.

A Direction (DIRECT) bit of zero indicates a fast forward. A DIRECT bit of one indicates a fast reversed operation.

The Scan Starting Address specifies the address at which the Audio Fast Scan shall begin. The Type Field determines the interpretation of the address.

Like the Audio Play Command, the SCAN Command shall terminate the scan at the last audio track or upon receipt of the STOP PLAY / SCAN Command. Upon receipt of the STOP PLAY / SCAN Command the Logical Unit shall set the current address to the last address output during the SCAN Command. Subsequent Audio Play Commands shall cause the Logical Unit to begin playing at the location last output by the SCAN Command. If the drive receives a PAUSE/RESUME Command with the resume bit clear, the drive shall pause. After that, if the drive receives a PAUSE/RESUME Command with the resume bit set, the drive shall resume audio play (note: not scan) from the address where the audio pause occurred. See "Figure 13 - Stop Play/Play Audio/Audio Scan/Pause/Resume Sequencing" on page 246 for additional information.

If the drive receives a SCAN Command during play or pause, the drive shall stop play or pause and perform Scan.

Upon receipt of a READ SUB-CHANNEL Command during scan, the drive shall return an Audio Status of 11h (Audio Play operation in Progress).

If the drive receives a SCAN Command during play or pause for which a valid stop address was specified, the drive will remember the stop address but ignore it during the scan command. The stop address becomes valid again when audio play resumes. Thus, upon resumption of audio play, if the current address is greater than the former stop address, the drive shall stop playing and return good status. After this, if the drive receives a READ SUB-CHANNEL Command, the drive shall return an Audio Status of 13h (Audio Play operation successfully completed).

If the drive reaches a data track, it shall stop scan.

Request to the implementer: The following implementation of forward and reverse scan speed will provide good quality sound: Forward scan - [Play six CD-DA blocks and then jump 190* CD-DA blocks in the forward direction. Reverse scan - play six CD-DA blocks and then jump 150* CD-DA blocks (from the last block of the six) in the reverse direction.

**This can be some fixed number between 150 and 200..*

Table 207 - SCAN Command

Byte	Bit	7	6	5	4	3	2	1	0																
0		Operation code (EAh)																							
1		LUN		DIRECT		Reserved		Rel Ad																	
2		Scan Starting Address Field																							
3										MSB															
4																		LSB							
5																									
6		Reserved																							
7		Reserved																							
8		Reserved																							
9		Type		Reserved																					
10		Reserved																							
11		Vendor-Specific		Reserved		NACA	Flag	Link																	

Bits 7-6 Type This field specifies the “Type” of address contained in the Scan Starting Address Field.

0 0 Logical Block Address format 0 1 AMIN, ASEC and AFRAME format 1 0 Track Number (TNO) format 1 1 Reserved

See "10.1.2.1 Play Audio with Immediate Packet Commands" on page 180 for information on overlapped commands during a SCAN operation.

Table 208 - Scan Starting Address in Logical Block Format

Bit Byte	7	6	5	4	3	2	1	0
2	Scan Starting Address Field							
3								
4								
5								

Table 209 - Scan Starting Address in AMIN, ASEC and AFRAME Format

Bit Byte	7	6	5	4	3	2	1	0
2	Reserved							
3	CD-absolute time (AMIN)							
4	CD-absolute time (ASEC)							
5	CD-absolute time (AFRAME)							

The AMIN, ASEC and AFRAME fields specifies the relative running time from the beginning of the disc. The AMIN field has a range of 00 to 99d (63h). The ASEC ranges from 00 to 59d (3Bh). The AFRAME field has a range of 00 to 74d (4Ah). All MSF fields shall be Binary.

Table 210 - Scan Starting Address in Track Number (TNO) Format

Bit Byte	7	6	5	4	3	2	1	0
2	Reserved							
3	Reserved							
4	Reserved							
5	Track Number (TNO)							

The Track Number field specifies the track in binary notation at which the scan operation will begin. This field has a range of 01h to 63h.

Table 211 - Recommended Sense Key, ASC and ASCQ for Scan Command Errors

Sense Key	ASC	ASCQ	Description of Error
02	04	00	LOGICAL UNIT NOT READY - CAUSE NOT REPORTABLE
02	04	01	LOGICAL UNIT NOT READY - IN PROGRESS OF BECOMING READY
02	04	02	LOGICAL UNIT NOT READY - INITIALIZING COMMAND REQUIRED
02	04	03	LOGICAL UNIT NOT READY - MANUAL INTERVENTION REQUIRED
02	3A	00	MEDIUM NOT PRESENT
02	06	00	NO REFERENCE POSITION FOUND (media may be upside down)
04	15	00	RANDOM POSITIONING ERROR
04	15	01	MECHANICAL POSITIONING ERROR
05	20	00	INVALID COMMAND OPERATION CODE
05	21	00	LOGICAL BLOCK ADDRESS OUT OF RANGE
05	24	00	INVALID FIELD IN COMMAND PACKET
05	30	01	CANNOT READ MEDIUM - UNKNOWN FORMAT
05	30	02	CANNOT READ MEDIUM - INCOMPATIBLE FORMAT
05	63	00	END OF USER AREA ENCOUNTERED ON THIS TRACK
05	64	00	ILLEGAL MODE FOR THIS TRACK OR INCOMPATIBLE MEDIUM
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON OR HARD RESET OCCURRED
06	3F	00	LOGICAL UNIT OPERATING CONDITIONS HAVE CHANGED
06	3F	01	MICROCODE HAS BEEN CHANGED

When a Play CD command is actively using one of the Digital Output ports a Scan command shall be aborted with error (05/64) ILLEGAL MODE FOR THIS TRACK.

10.1.13 STOP PLAY / SCAN Command

The STOP PLAY/ SCAN Command stops playback of audio or scan commands.

Table 212 - STOP PLAY / SCAN Command

Byte	Bit	7	6	5	4	3	2	1	0
0		Operation code (4EH)							
1		LUN			Reserved				
2		Reserved							
3		Reserved							
4		Reserved							
5		Reserved							
6		Reserved							
7		Reserved							
8		Reserved							
9		Vendor-Specific		Reserved			NACA	Flag	Link
10		PAD							
11		PAD							

Table 213 - Recommended Sense Key, ASC and ASCQ for STOP PLAY/SCAN Command Errors

Sense Key	ASC	ASCQ	Description of Error
02	04	00	LOGICAL UNIT NOT READY - CAUSE NOT REPORTABLE
02	04	01	LOGICAL UNIT NOT READY - IN PROGRESS OF BECOMING READY
02	04	02	LOGICAL UNIT NOT READY - INITIALIZING COMMAND REQUIRED
02	04	03	LOGICAL UNIT NOT READY - MANUAL INTERVENTION REQUIRED
02	05	00	MEDIA LOAD OR EJECT FAILED
02	06	00	NO REFERENCE POSITION FOUND (media may be upside down)
02	3A	00	MEDIUM NOT PRESENT
03	02	00	NO SEEK COMPLETE
05	20	00	INVALID COMMAND OPERATION CODE
05	24	00	INVALID FIELD IN COMMAND PACKET
05	30	01	CANNOT READ MEDIUM - UNKNOWN FORMAT
05	30	02	CANNOT READ MEDIUM - INCOMPATIBLE FORMAT
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON OR HARD RESET OCCURRED
06	2E	00	INSUFFICIENT TIME FOR OPERATION
06	3F	00	DEVICE OPERATING CONDITIONS HAVE CHANGED
06	3F	01	MICROCODE HAS BEEN CHANGED

Issuing a Stop Play / Scan command while the Logical Unit is scanning shall result in continuation of the play command. Issuing a Stop Play / Scan command while the Logical Unit is paused shall stop the play command

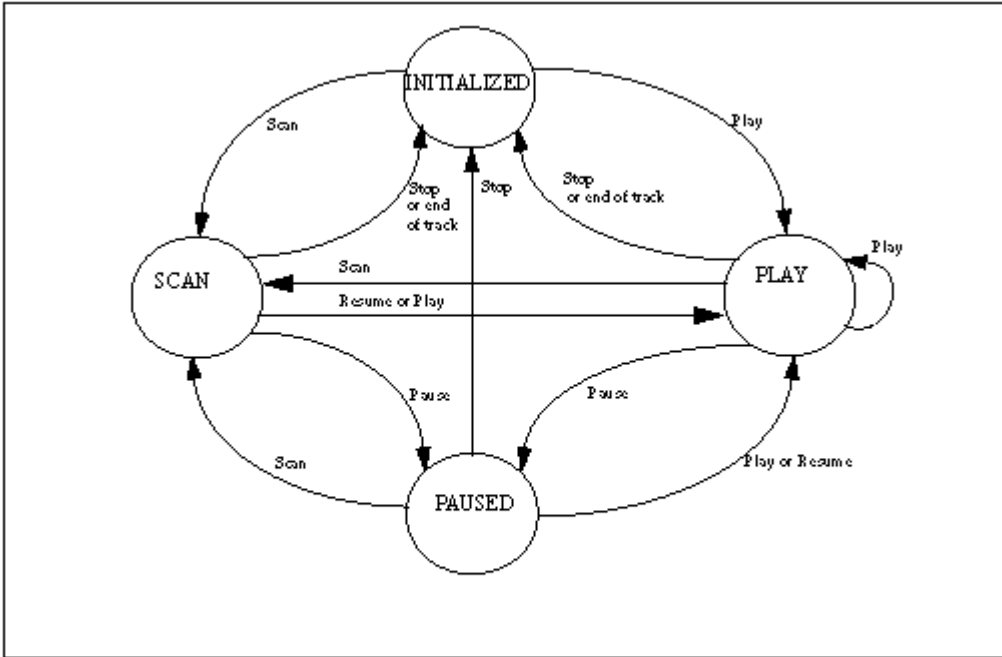


Figure 13 - Stop Play/Play Audio/Audio Scan/Pause/Resume Sequencing