Philips Components

PHILIPS

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System Development

Modules & Drives

CDD3610
Command Specification

Document History.

Date	Status / Version	Author	Change
22-11-1996	Proposed 1.0	M Severi B. Brams	Proposal for Review.
20-12-1996	Final 1.0	M. Severi	Editorial changes.
	Final 1.1	M. Severi	Editorial changes
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1. Introduction.

1.1 Summary.

This CDD3610 MMC manual describes the interface of the CDD3610 and is based on the Functional Requirements as stated in Ref. 001.

Main Requirements are:

- ◊ CD-Recordable/Rewritable[1] (CD-R/W)
- ◊ ATAPI/IDE interface (ATAPI 2.6)
- ◊ Multi-Media Command set[2] (MMC v.8.0)

1.2 Goal.

This document specifies the functionality of the CDD3610 CD-Recordable/Rewritable drive.
In the event of interpretation conflicts between one of the base documents (ATA, ATAPI, MMC) and this document, the interpretation of this document shall prevail.

1.3 Terms and abbreviations.

FRS	Functional Requirements Specification
HSI	Hardware Software Interface
MMC	Multi Media Command set
SDP	Software Development Plan
SRS	Software Requirements Specification
MCN	Media Catalog Number
ISRC	International Standard Recording Code
NPA	Next Possible Program Area

1.4 References.

ref.	Description.
001	FRS Half Height CD-Recordable/Rewritable family Modelnumbers.: CDD2600, CDD3600, CDD3610 (rev. E, date 10 August 1996)
002	X3T10/0948D ATA-2 Revision 4c - Defines ATA command set
003	SFF8020i ATAPI Revision 2.6 - Defines CD-ROM command set
004	X3T10/1048D MMC Revision 8.0 - Defines CD-R/W command set

[1] "Rewritable" is also referenced as "Erasable" (meaning is the same)
[2] It is assumed that any changes to MMC 8.0 will be handled conform a Change Request Procedure.

2. Requirements.

See Ref [1] (Functional Requirements Specification).

2.1 User Interface[3].

The CDD3610 user-interface consists of :

- ◊ Open/Close Button
- ◊ Write Indicator
- ◊ Disc In/Read/Error indicator

Open/Close Key[4]:

Table 1 : Open/Close Key

Current State	Action	Next State
tray is closed or just closing	press Open/Close Key	tray will open
tray is open or just opening	press Open/Close Key	tray will close
Special Case: during write	press Open/Close Key	rejected, ERROR indicator goes on/off

Write/Disc In/Read/Error Indicator:

Table 2 : Disc In/Write/Read.

Orange-LED	Bi-LED	Description
OFF	OFF	No disc inserted or not readable
OFF	GREEN	Disc is present
OFF	GREEN flashing	Data is being transferred from disc
OFF	GREEN flashing	starting up a disc
OFF	RED	Error
ORANGE	GREEN flashing	Data is being transferred to disc
ORANGE flashing	GREEN flashing	Test writing a disc

[3] This User Interface description is copied from Ref [1].

[4] Open/Close key terminates the current command except during write or if medium removal is prevented. During write, the drive is locked and the open/close key will be rejected. The Error LED will go on/off.
NOTE: open/close notification to the host is available by issuing TEST UNIT READY command.

2.2 Supported Commands (ATA, ATAPI Packet, MMC CD-R/W).

The command-set of the CDD3610 consist of 3 'types' of commands:
1. ATA commands: (see Ref. 002)
2. CD-ROM commands: ATAPI 2.6 Packet Commands (see Ref. 003)
3. CD-R/E commands: MMC 8.0 Commands (see Ref. 004)

2.2.1 ATA Commands:

Table 3 : ATA Commands.

ATA Commands (see Ref. 2: X3T10/258)	**Op-Code**	**See Page.**
ATAPI Soft Reset	08h	
Check Power Mode	E5h	
Execute Device Diagnostics	90h	
Identify Device	ECh	
~~**Idle**~~	~~**E3h**~~	
Idle Immediate	E1h	
NOP	00h	
ATAPI Packet Command	A0h	
ATAPI Identify Device	A1h	13
Read Sectors (S) (w/ retry)[5]	20h	
Read Sectors (S) (w/o retry)[5]	21h	
~~**Service**~~	~~**A2h**~~	
Set Features	EFh	
Sleep	E6h	
~~**Standby**~~	~~**E2h**~~	
Standby Immediate	E0h	

[5] Commands have special ATA register response, the commands are not executed (See ATAPI SFF-8020i V.26 specification for details).

2.2.2 CD-ROM Commands (ATAPI Packet Commands):

Table 4 : ATAPI Packet Commands

ATAPI Packet Commands (see Ref. 3: SFF-8020 v2.6)	Op-Code	See Pag.
Inquiry	12h	17
~~Load/Unload CD~~	~~A6h~~	
Mechanism Status	BDh	20
Mode Select (10)	55h	22
Mode Sense (10)	5Ah	24
Pause/Resume	4Bh	47
Play Audio (10)[6]	45h	49
Play Audio (12)[7]	A5h	49
Play Audio MSF	47h	53
~~Play CD~~	~~BCh~~	
Prevent/Allow Media Removal	1Eh	56
Read (10)	28h	58
Read (12)	A8h	60
Read CD-ROM Capacity[8]	25h	62
Read CD	BEh	64
Read CD MSF	B9h	69
Read Header	44h	71
Read Sub-Channel	42h	74
Read TOC - TOC - Session Info - Full TOC - ~~PMA~~ - ~~ATIP~~	43h	82
Request Sense	03h	92
Rezero Unit[9]	01h	98
~~Scan~~	~~BAh~~	
Seek (10)	2Bh	99
Service Commands[10]	F0h..FFh	
Set CD Speed	BBh	101
Start/Stop Unit	1Bh	104
Stop Play/Scan	4Eh	103
Test Unit Ready	00h	107
Other Commands	**Op-Code**	**See Pag.**
Verify (12)[11]	AFh	109

[6] Needed to allow Windows 95 to start
[7] For compliance with ATA-8020 v1.2
[8] Necessary for NT or Linux
[9] For compliance with ATA-8020 v1.2
[10] Vendor Specific commands for factory testing etc.
[11] Not in ATAPI revision 2.6.

2.2.3 CD-R/W Commands (MMC CD-R/W Commands):

Table 5 : CD-R/W Commands

MMC CD-R/W Commands (see Ref. 4: MMC 8.0)	Op-Code	See Page.
BLANK Command - blank whole disc - minimally blank disc - blank track - ~~**unreserve track**~~ - blank track tail - ~~**unclose last session**~~ - ~~**erase session**~~	A1h	112
CLOSE TRACK/SESSION	5Bh	114
FORMAT UNIT	04h	117
~~**READ BUFFER CAPACITY**~~	~~**5Ch**~~	
READ DISC INFORMATION	51h	120
~~**READ MASTER CUE**~~	~~**59h**~~	
READ TRACK INFORMATION	52h	125
~~**REPAIR PACKET TRACK**~~[12]	~~**58h**~~	
RESERVE TRACK	53h	132
~~**SEND CUE SHEET**~~	~~**5Dh**~~	
SEND OPC INFORMATION	54h	134
SYNCHRONIZE CACHE	35h	137
WRITE (10) - packet - track at once - ~~**session at once**~~ - raw	2Ah	139

[12] CDD3610 supports Automatic Repair

2.3 Information Commands

2.3.1 ATAPI Identify Device Return Data

Table 6 : ATAPI Identify Device Return Data.

Word	Value	Description	Comments
0	85A0h	General Configuration (if CMD DRQ Type=Interrupt DRQ) bits 15-14 Atapi Protocol (10b) bits 12-8 CD-ROM (00101b) bit 7 Removable (1b) bits 6-5 Interrupt DRQ Type (10b) bits 1-0 Command Packet size = 12 bytes (00b)	(default) Reserved bits 13, and 4-2 set = 0
1	0000h	Cylinders	Unused
2	0000h	Reserved	Unused
3	0000h	Heads	Unused
4	0000h	Number of Unformatted Bytes per Track	Unused
5	0000h	Number of Unformatted Bytes per Sector	Unused
6	0000h	Number of Sectors per Track	Unused
7	0000h	Reserved	Unused
8	0000h	Reserved	Unused
9	0000h	Reserved	Unused
10	xxxxh	Serial Number[13] (spaces = unsupported)	Supported
11	xxxxh	Serial Number	Supported
12	xxxxh	Serial Number	Supported
13	xxxxh	Serial Number	Supported
14	xxxxh	Serial Number	Supported
15	xxxxh	Serial Number	Supported
16	xxxxh	Serial Number	Supported
17	xxxxh	Serial Number	Supported
18	xxxxh	Serial Number	Supported
19	xxxxh	Serial Number	Supported
20	0003h	Buffer Type	
21	0800h	Buffer Size in 512 Byte Increments	1MByte DRAM buffer
22	0000h	ECC Bytes Available	Unused
23	xxxxh	Firmware Revision	‘v :’
24	xxxxh	Firmware Revision	‘nn’
25	xxxxh	Firmware Revision	‘n.’
26	xxxxh	Firmware Revision	‘nn’
27	xxxxh	Model Number	‘CD’
28	xxxxh	Model Number	‘D-’
29	xxxxh	Model Number	‘36’
30	xxxxh	Model Number	‘10’
31	2020h	Model Number	
32	2020h	Model Number	
33	2020h	Model Number	
34	2020h	Model Number	
35	2020h	Model Number	
36	2020h	Model Number	
37	2020h	Model Number	
38	2020h	Model Number	
39	2020h	Model Number	
40	2020h	Model Number	

[13] Requirement: Serial Number + Model Number shall match the barcode sticker on the drive

41	2020h	Model Number	
42	2020h	Model Number	
43	2020h	Model Number	
44	2020h	Model Number	
45	2020h	Model Number	
46	2020h	Model Number	
47	0000h	Multiple Sector Command count	Unused
48	0000h	Double word I/O	Cannot Perform
49	0B00h	Capabilities	
		(00001011 00000000b)	
		bits 15-12 Reserved	Unused
		bit 11 IORDY Supported (1b)	1 = Yes
		bit 10 IORDY can be disabled (0b)	0 = No
		bit 09 LBA supported (1b)	1 = Yes
		bit 08 DMA supported (1b)	1 = Yes
		bits 07-00 Vendor unique	Unused
50	0000h	Reserved	Unused
51	0200h	PIO Data Transfer Cycle Timing Mode 8 bit DRAM mode using mode 2 for bits 15-8 (0200h)	PIO Mode 2
52	0200h	Single Word DMA data transfer Cycle Timing Mode 15-8 DMA data transfer Cycle Timing Mode 7-0 Vendor specific	Single Word DMA 2.
53	0002h	Field Validity bit 1 Words 64 - 70 are Valid (1b)	
54	0000h	Number of Current Cylinders	Unused
55	0000h	Number of Current Heads	Unused
56	0000h	Number of Current Sectors per Track	Unused
57	0000h	Current capacity in sectors	Unused
58	0000h	Current capacity in sectors	Unused
59	0000h	Reserved	Unused
60	0000h	User Addressable Sectors	Unused
61	0000h	User Addressable Sectors	Unused
62	0000h	Reserved (Single Word DMA Transfer)	Unused
63	0207h	Multi Word DMA Transfer 15-8 Multi Word DMA Transfer Mode Active 7-0 Multi Word DMA Transfer Modes Supported	 MultiWord DMA 1 active Supports MW DMA 0 & 1
64	0001h	Enhanced PIO Modes supported	PIO Mode 3 supported
65	0096h	Minimum Multiword DMA Transfer Cycle Time Per Word 15-0 Cycle time in nanoseconds	150 nano seconds Multiword DMA 1
66	0096h	Manufacturer's Recommended Multiword DMA Xfer Cycle Time 15-0 Cycle time in nanoseconds	150 nano seconds
67	00E3h	Minimum PIO Transfer Cycle Time Without Flow Control	227 nano seconds
68	00B4h	Minimum PIO Transfer Cycle Time With IORDY Flow Control	180 nano seconds PIO Mode 3
69-255	0000h	Reserved	Unused

3. Command Description.

3.1 ATA Commands.

For detailed information about ATA Commands and ATA commands for ATAPI, see Ref[2] and Ref[3]; ATA and ATAPI_2.6 documentation. See Table 3 for a global overview of the ATA commands.

3.2 ATAPI 2.6 CD-ROM Packet Commands.

3.2.1 Introduction.

The implemented CD-ROM packet commands are listed in Table 4.

3.2.2 Inquiry.

Table 7 : INQUIRY command.

Bit Byte	7	6	5	4	3	2	1	0
0	Operation code (12h)							
1	Reserved							
2	Reserved							
3	Reserved							
4	Allocation Length							
5	Reserved							
6	Reserved							
7	Reserved							
8	Reserved							
9	Reserved							
10	Reserved							
11	Reserved							

3.2.2.1 Description.

The INQUIRY command requests that information regarding parameters of the CDD3610 be sent to the Host Computer. This option allows the Host Computer to request additional information about the CDD3610.

The INQUIRY command ***shall*** return CHECK CONDITION status only when the CDD3610 cannot return the requested INQUIRY data. The INQUIRY data should be returned even though the CDD3610 may not be ready for other commands.

If an INQUIRY command is received with a pending unit attention condition (i.e. before the CDD3610 reports CHECK CONDITION status), the CDD3610 ***shall*** perform the INQUIRY command and ***shall not*** clear the unit attention condition.

3.2.2.2 Parameters.

The Allocation Length field specifies the number of bytes allocated by the host to accept the inquiry data list. This is the number of bytes that will be transferred to the host (unless allocation length is greater then the amount of available inquiry data, in which case only the available data will be transferred). An allocation length of zero indicates that no data ***shall*** be transferred. This condition ***shall not*** be considered as an error.

3.2.2.3 Response Data.

The INQUIRY data contains 56 bytes.

Table 8 : INQUIRY Data Format.

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved			Peripheral Device Type=05				
1	RMB=1	Reserved						
2	ISO Version=0		ECMA Version=0			ANSI Version =0		
3	ATAPI Version=2				Response Data Format = 1			
4	Additional Length (Number of bytes following this one)=33							
5	Reserved							
6	Reserved							
7	Reserved							
8-15	Vendor Identification =”PHILIPS “							
16-31	Product Identification=”CDD3610 “							
32-35	Product Revision Level=”1.00”							
36-51	Serial Number=”0000000000000000 ”							
52-55	Servo Revision Number=”1.00”							

3.2.2.4 Response Data Parameters.

The Peripheral Device Type ***shall*** be set to 05h to indicate a CD-ROM Device.

A Removable Medium Bit (RMB) ***shall*** be set to one to indicate that the medium is removable.

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

The ANSI-approved version field must contain a zero to comply with this version of the Specification.

The ATAPI Version field must contain 02h to indicate that it complies with the SFF-8020i V.26 specification.

A response data format value of 01h indicates that the data ***shall*** be in the format specified in this Specification. Other response data format values are not supported.

The Additional Length field ***shall*** specify the length in bytes of the parameters. If the allocation length of the Command Packet is too small to transfer all of the parameters, the additional length ***shall*** not be adjusted to reflect the truncation. The Additional Length field ***shall*** be 1Fh.

The Vendor Identification field contains 8 bytes of ASCII data identifying the vendor of the product[14]. The data ***shall*** be left aligned within this field. The Vendor Identification will be : ‘PHILIPS ’

The Product Identification field contains 16 bytes of ASCII data as defined by the vendor. The data ***shall*** be left-aligned within this field. The Product Identification will be : ‘CDD3610’

14. It is intended that this field provide a unique vendor identification of the manufacturer of the CDD3610. In the absence of a formal registration procedure, X3T9.2 maintains a list of vendor identification codes in use. Vendors are requested to voluntarily submit their identification codes to X3T9.2 to prevent duplication of codes.

The Product Revision Level field contains 4 bytes of ASCII data as defined by the vendor. The data ***shall*** be left-aligned within this field. The initial Product Revision Level will be : '1.00' but can be incremented in future upgrades.

The Serial Number field contains 16 bytes of ASCII data as defined by the vendor. The data ***shall*** be left-aligned within this field. The initial Serial Number field Level will be : '0000000000000000' but can be incremented in future upgrades.

The Servo Revision Number field contains 4 bytes of ASCII data as defined by the vendor. The data ***shall*** be left-aligned within this field. The initial Servo Revision Number will be : '1.00' but can be incremented in future upgrades.

Table 9 shows where the Inquiry Data is placed in the Identify Device Data.

Table 9 : Inquiry Data versus Identify Device Data

Inquiry Data	byte position	tot.	Identify Device Data	word position	tot.
Vendor Id	8..15	8	Model Number : Vendor Id	27..30	8
Product Id	16..31	16	Model Number : Product Id	31..38	16
			Model Number : Spare	39..46	16
Product Revision	32..35	4	Firmware Revision	23..26	8
Vendor Specific	36..55	20	Serial Number	10..19	20

Note :

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

Table 10 : Inquiry : Supported Sense Key, ASC and ASCQ.

Sense Key	ASC	ASCQ	Description of Error
05	24	00	INVALID FIELD IN COMMAND PACKET

3.2.3 Mechanism Status.

Table 11 : MECHANISM STATUS Command.

Bit Byte	7	6	5	4	3	2	1	0
0	Operation code (BDh)							
1	Reserved							
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	Reserved							
8	MSB			Allocation Length				
9								LSB
10	Reserved							
11	Reserved							

3.2.3.1 Description.

The MECHANISM STATUS command requests that the CDD3610 respond with the current status of the CD Device. This command is intended to provide information to the Host about the current operational state of the Device. The CD Devices take operational direction from both the Host and the user (Person). Movement of media in/out of the device are at the control of the user. This command has been provided to allow the Host to know what as transpired at the user level.

3.2.3.2 Parameters.

The Allocation Length field specifies the maximum length in bytes of the Slot Table Data that ***shall*** be transferred from the CDD3610 to the Host Computer. A parameter list length of zero indicates that no data ***shall*** be transferred. This condition ***shall not*** be considered as an error.

The CDD3610 ***shall*** terminate the command with CHECK CONDITION status if the parameter list length results in the truncation of the Mechanism Status header. The sense key ***shall*** be set to ILLEGAL REQUEST, and the additional sense code ***shall*** be set to PARAMETER LIST LENGTH ERROR.

The Mechanism Status List contains a header (No Slot Tables are returned).

Table 12 : Mechanism Status Header.

Bit Byte	7	6	5	4	3	2	1	0
0	Fault =0	Changer State =0		Current Slot =0				
1	CD Mechanism State =0			Reserved				
2	MSB							
3				Current LBA				
4								LSB
5	Number of Slots Available =0							
6	MSB			Length of Slot Table(s) = 0				
7								LSB

Byte 0 :

Bit 0-4 Current Slot — Because the CDD3610 is not a changer, this field is reserved.

Bit 5-6 Changer State — Because the CDD3610 is not a changer, this field is reserved.

Bit 7 Fault — Because the CDD3610 is not a changer, this field is reserved.

Byte 1 :

Bit 7-5 CD Mechanism State — Because the CDD3610 is not a changer, this field is reserved.

The Current LBA value returns the location that was last used while reading or playing. Once a Read or Play operation has been completed the value of this field may be undefined. While a Read or Play is in progress this field will contain the LBA of the current block being processed.

The Number of Slots Available field ***shall*** return the number of physical Slots that the device supports. The Number of slots shall be set to zero.

The Length of Slot Tables field specifies the length in bytes of the all the slot information that follows : the length shall be set to zero.

Table 13 : Mechanism Status : Supported Sense Key, ASC and ASCQ.

Sense Key	ASC	ASCQ	Description of Error
05	01	00	MECHANICAL POSITION OR CHANGER ERROR
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON, RESET OR BUS DEVICE RESET OCCURRED

3.2.4 Mode Select (10).

Table 14 : Mode Select Command.

Bit Byte	7	6	5	4	3	2	1	0
0	Operation code (55h)							
1	Reserved			PF = 1	Reserved			SP = 0
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	Parameter List Length (MSB)							
8	Parameter List Length (LSB)							
9	Reserved							
10	Reserved							
11	Reserved							

3.2.4.1 Description.

The MODE SELECT command provides a means for the Host Computer to specify medium, or peripheral device parameters to the CDD3610. Host Computers ***can*** issue MODE SENSE prior to each MODE SELECT to determine supported pages, page lengths, and other parameters.

3.2.4.2 Parameters.

The Save Pages (SP) bit of ***shall*** always be zero : the CDD3610 ***shall*** perform the specified MODE SELECT operation, and ***shall not*** save any pages. If the SP bit is set to one, 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.

The Parameter List Length field specifies the length in bytes of the mode parameter list that ***shall*** be transferred from the Host Computer to the CDD3610 after the Command Packet is transferred. A parameter list length of zero indicates that no data ***shall*** be transferred. This condition ***shall not*** be considered as an error.

The CDD3610 ***shall*** terminate the command with CHECK CONDITION status if the parameter list length results in the truncation of any mode parameter header, or mode page. The sense key ***shall*** be set to ILLEGAL REQUEST, and the additional sense code ***shall*** be set to PARAMETER LIST LENGTH ERROR.

The mode parameter list for the MODE SELECT and MODE SENSE commands is defined in 3.2.6 Mode Select/Sense Parameters.

The CDD3610 ***shall*** terminate the MODE SELECT command with CHECK CONDITION status, set the sense key to ILLEGAL REQUEST, set the additional sense code to INVALID FIELD IN PARAMETER LIST, and ***shall not*** change any mode parameters for the following conditions:

1. If the Host Computer sets any field that is reported as not changeable by the CDD3610 to a value other than its current value.
2. If the Host Computer sets any unreserved field in the mode parameter header to an unsupported value.
3. If a Host Computer sends a mode page with a page length not equal to the page length returned by the MODE SENSE command for that page.

Because rounding is not implemented the CDD3610 ***shall*** terminate the command with CHECK CONDITION status, the sense key set to ILLEGAL REQUEST, and set the additional sense code to INVALID FIELD IN PARAMETER LIST.

An CDD3610 may alter any mode parameter in any mode page (even those reported as non-changeable) as a result of changes to other mode parameters[15].

The CDD3610 validates the non-changeable mode parameters against the current values that existed for those mode parameters prior to the MODE SELECT command.

Table 15 : Mode Select : Supported Sense Key, ASC and ASCQ.

Sense Key	ASC	ASCQ	Description of Error
02	04	04	NOT READY, WRITE IN PROGRESS
05	24	00	INVALID FIELD IN COMMAND PACKET
05	26	00	INVALID FIELD IN PARAMETER LIST
05	39	00	SAVING PARAMETERS NOT SUPPORTED
05	64	00	ILLEGAL MODE FOR THIS TRACK
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON, RESET OR BUS DEVICE RESET OCCURRED
06	2A	01	MODE PARAMETER CHANGED

15. If the current values calculated by the CDD3610 affect the Host Computer's operation, the Host Computer ***should*** issue a MODE SENSE command after each MODE SELECT command.

3.2.5 Mode Sense (10).

Table 16 : Mode Sense Command.

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

3.2.5.1 Description.

The MODE SENSE command provides a means for a CDD3610 to report parameters to the Host Computer. It is a complementary command to the MODE SELECT command.

3.2.5.2 Parameters .

The Allocation Length field specifies the number of bytes allocated by the host to accept the mode sense data. This is the number of bytes that will be transferred to the host (unless allocation length is greater then the amount of available mode sense data, in which case only the available data will be transferred). An allocation length of zero indicates that no data ***shall*** be transferred. This condition ***shall not*** be considered as an error.

The Page Control (PC) field defines the type of mode parameter values to be returned in the mode pages. See sections "3.2.5.2.1Current Values " - "3.2.5.2.4 Saved Values " below.

Table 17 : Page Control Field.

Code	Type of Parameter
00b	Current values
01b	Changeable values
10b	Default values
11b	Saved values(not supported)

NOTE The Page Control field only affects the mode parameters within the mode pages, however the PS bit, Page Code and Page Length fields **shall** return current values since they have no meaning when used with other types. The mode parameter header **shall** return current values. (see also 3.2.6. Mode Select/Sense Parameters.)

The Page Code specifies which mode page(s) to return[16]. See "Table 20 : Mode Page Codes for CD-ROM ." for a description of the Mode pages.

16. Mode pages ***shall*** be returned in ascending page code order.

A Host Computer may request any one or all of the supported mode pages from an CDD3610. If a Host Computer issues a MODE SENSE command with a page code value not implemented by the CDD3610, the CDD3610 ***shall*** return CHECK CONDITION status and ***shall*** set the sense key to ILLEGAL REQUEST and the additional sense code to INVALID FIELD IN COMMAND PACKET.

A Page Code of 3Fh indicates that all mode pages implemented by the CDD3610 ***shall*** be returned to the Host Computer. If the mode parameter list exceeds 65534 bytes for a MODE SENSE command, the CDD3610 ***shall*** return CHECK CONDITION status and the sense key ***shall*** be set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN COMMAND PACKET.

A Page Code of 00h shall only return the Mode Parameter Header.

3.2.5.2.1 Current Values.

A PC field value of 0h requests that the CDD3610 return the current values of the mode parameters. The current values returned are:

1. the current values of the mode parameters established by last successful MODE SELECT command.
2. the default values of the mode parameters, if a MODE SELECT command has not successfully completed since the last power-on, hard RESET condition.

Current values are accessible even if the device is not ready.

3.2.5.2.2 Changeable Values.

A PC field value of 1h requests that the CDD3610 return a mask denoting those mode parameters that are changeable. In the mask, the fields of the mode parameters that are changeable shall be set to all one bits and the fields of the mode parameters that are non-changeable (i.e. defined by the CDD3610) ***shall*** be set to all zero bits.

An attempt to change a non-changeable mode parameter (via MODE SELECT) results in an error condition.

The Host Computer ***shall*** issue a MODE SENSE command with the PC field set to 1h and the Page Code field set to 3Fh to determine which mode pages are supported, which mode parameters within the mode pages are changeable, and the supported length of each mode page prior to issuing any MODE SELECT commands. Changeable values are accessible even if the device is not ready.

3.2.5.2.3 Default Values.

A PC field value of 2h requests that the CDD3610 return the default values of the mode parameters. Parameters not supported by the CDD3610 shall be set to zero. Default values are accessible even if the device is not ready.

3.2.5.2.4 Saved Values.

Because saved values are not implemented, the command ***shall*** be terminated with CHECK CONDITION status, the sense key set to ILLEGAL REQUEST and the additional sense code set to SAVING PARAMETERS NOT SUPPORTED.

Table 18 : Mode Sense : Supported Sense Key, ASC and ASCQ.

Sense Key	ASC	ASCQ	Description of Error
02	04	04	NOT READY, WRITE IN PROGRESS
05	1A	00	PARAMETER LIST LENGTH ERROR
05	24	00	INVALID FIELD IN COMMAND PACKET
05	39	00	SAVING PARAMETERS NOT SUPPORTED
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON, RESET OR BUS DEVICE RESET OCCURRED

3.2.6 Mode Select/Sense Parameters.

This section describes the pages used with MODE SELECT and MODE SENSE commands.

The Mode Parameter List contains a header, followed by zero or more variable-length pages.

Table 19 : Mode Parameter List.

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

Each mode page contains a page code, a page length, and a set of mode parameters.

Table 20 : Mode Page Codes for CD-ROM .

Page code	Description
00h	Mode Parameter Header (valid only for the MODE SENSE command)
01h	Read error recovery page
05h	Write Parameters Mode Page
0Dh	CD-ROM Device Parameters Page
0Eh	CD-ROM audio control page
2Ah	CD-ROM Capabilities & Mechanical Status Page (valid only for the MODE SENSE command)
3Fh	Return all pages (valid only for the MODE SENSE command)

Table 21 : Mode Page Format.

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

The PS bit ***shall*** always be zero indicating that the supported parameters cannot be saved. When using the MODE SELECT command, the PS bit is reserved.

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

When using the MODE SENSE command with Page Code 00h only the ModeParameter Header is returned. A Page Code of 3Fh indicates that all mode pages implemented by the CDD3610 ***shall*** be returned to the Host Computer.

The Page Length field specifies the length in bytes of the mode parameters that follow. If the Host Computer does not set this value to the value that is returned for the page by the MODE SENSE command, the CDD3610 ***shall*** terminate the command with CHECK CONDITION status. The sense key ***shall*** be set to ILLEGAL REQUEST with the additional sense code set to INVALID FIELD IN PARAMETER LIST. The CDD3610 is permitted to implement a mode page that is less than the full page length defined in this Specification, provided no field is truncated and the Page Length field correctly specifies the actual length implemented.

The mode parameters for each page are defined here. Mode parameters not implemented by the CDD3610 ***shall*** be set to zero.

Table 22 : Mode Parameter Header.

Bit Byte	7	6	5	4	3	2	1	0
0	MSB			Mode Data Length				
1								LSB
2	Medium Type							
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	Reserved							

When using the MODE SENSE command, the mode data length field specifies the length in bytes of the following data that is available to be transferred. The mode data length is the total byte count of all data following the mode data length field. When using the MODE SELECT command, this field is reserved.

Table 23 : CD-ROM Media Type Codes.

Code	Medium Type Description
00h	Door closed, medium type unknown
01h	120 mm CD-ROM data only, door closed
02h	120 mm CD-DA audio only, door closed
03h	120 mm CD-ROM data and audio combined, door closed
04h	120 mm CD-ROM Hybrid disc (Photo CD), door closed
05h	80 mm CD-ROM data only, door closed
06h	80 mm CD-DA audio only, door closed
07h	80 mm CD-ROM data and audio combined, door closed
08h	80 mm CD-ROM Hybrid disc (Photo CD), door closed
09h-0Fh	Reserved
10h	Door closed, medium type (CD-R) size unknown
11h	120 mm CD-ROM (CD-R) data only, door closed
12h	120 mm CD-DA (CD-R) audio only, door closed
13h	120 mm CD-ROM (CD-R) data and audio combined, door closed
14h	120 mm CD-ROM (CD-R) Hybrid disc (Photo CD), door closed
15h	80 mm CD-ROM (CD-R) data only, door closed
16h	80 mm CD-DA (CD-R) audio only, door closed
17h	80 mm CD-ROM (CD-R) data and audio combined, door closed
18h	80 mm CD-ROM (CD-R) Hybrid disc (Photo CD), door closed
19h-1Fh	Reserved
20h	Door closed, medium type size(CD-R/W) unknown
21h	120 mm CD-ROM (CD-R/W) data only, door closed
22h	120 mm CD-DA (CD-R/W) audio only, door closed
23h	120 mm CD-ROM (CD-R/W) data and audio combined, door closed
24h	120 mm CD-ROM (CD-R/W Hybrid disc) , door closed
25h	80 mm CD-ROM (CD-R/W) data only, door closed
26h	80 mm CD-DA (CD-R/W) audio only, door closed
27h	80 mm CD-ROM (CD-R/W) data and audio combined, door closed
28h	80 mm CD-ROM (CD-R/W) Hybrid disc door closed
29h-2Fh	Reserved
32h-34h	Reserved
36h-6Fh	Reserved
70h	Door closed, no disc present
71h	Door open
72h-FFh	Reserved

3.2.6.1 Read Error Recovery Parameters Page.

The Read Error Recovery Parameters Page specifies the error recovery parameters the CDD3610 ***shall*** use during any command that performs a data read operation from the media (e.g. READ, READ CD, etc.).

Table 24 : Read Error Recovery Parameters Page Format.

Bit Byte	7	6	5	4	3	2	1	0
0	PS =0	Reserved	Page Code (01h)					
1	Page Length (06h)							
2	Error Recovery Parameter, Default = 00h							
	Reserved	VR	TB	RC	Reserved	PER	DTE	DCR
3	Read Retry Count default = 05h							
4	Reserved							
5	Reserved							
6	Reserved							
7	Reserved							

The Parameters Savable (PS) bit is only used with the MODE SENSE command. This bit is reserved with the MODE SELECT command.

A Verify Rewritable (VR) bit of one indicates that READ and VERIFY commands will cause the drive to perform an additional checking for rewritable media. The algorithm behind this checking can be used used to inform the host about the rewritability of that specific media.
This is only applicable using rewritable media, for other media the VR bit will be ignored.

A Transfer Block (TB) bit of one indicates that a data block that is not recovered within the recovery limits specified, ***shall*** be transferred to the Host Computer before CHECK CONDITION status is returned. A TB bit of zero indicates that such a data block ***shall not*** be transferred to the Host Computer. The TB bit does not affect the action taken for recovered data.

A Read Continuous (RC) bit of one indicates that the CD-ROM drive ***shall*** transfer the entire requested length of data without adding delays to perform error recovery procedures. This implies that the CD-ROM drive may send data that is erroneous or fabricated in order to maintain a continuous flow of data. A RC bit of zero indicates that error recovery operations that cause delays are acceptable during the data transfer.

A Post Error (PER) bit of one indicates that the CD-ROM drive ***shall*** report recovered errors. A PER bit of zero indicates that the CD-ROM drive ***shall not*** report recovered errors. Error recovery procedures ***shall*** be performed within the limits established by the error recovery parameters.

A Disable Transfer on Error (DTE) bit of one indicates that the CD-ROM drive ***shall*** terminate the data transfer to the Host upon detection of a recovered error. A DTE bit of zero indicates that the CD-ROM drive ***shall not*** terminate the data transfer upon detection of a recovered error.

A Disable Correction (DCR) bit of one indicates that error correction codes ***shall not*** be used for data error recovery. A DCR bit of zero allows the use of error correction codes for data error recovery.

The interpretation of the bit settings for CD-ROM devices is given in "Table 25 : CD-ROM Error Recovery Descriptions.". If the error recovery parameter is set to any other value, 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 PARAMETER LIST.

Table 25 : CD-ROM Error Recovery Descriptions.

Code	Error Recovery Description
00h	The maximum error recovery procedures available are used. If an error occurs which is uncorrectable with the error correction codes (ECC) on the media, data transfer is terminated with CHECK CONDITION status. The block with the error is not transferred. The sense key is set to MEDIUM ERROR. The information bytes give the address of the block where the unrecovered error was detected. Recovered errors are not reported.
01h	Only retries of the read operation and CIRC are used (layered error correction is not used). Only CIRC unrecovered data errors are reported. If a CIRC unrecovered data error occurs, data transfer is terminated with CHECK CONDITION status. The block with the error is not transferred. The sense key is set to MEDIUM ERROR. The information bytes give the address of the block where the unrecovered error was detected. Recovered errors are not reported.
04h	The maximum error recovery procedures available are used. Recovered data errors are reported. If a recovered data error occurs, data transfer is not terminated. However, when the data transfer has completed CHECK CONDITION status is reported. The sense key is set to RECOVERED ERROR. The information bytes give the address of the last block where a recovered data error was detected. If a data error occurs that is uncorrectable with the ECC information available on the media, data transfer is terminated and CHECK CONDITION status is reported. The block with the error is not transferred. The sense key is set to MEDIUM ERROR. The information bytes give the address of the block where the uncorrectable error was detected.
05h	Only retries of the read operation and CIRC are used (layered error correction is not used). Recovered data errors are reported. If a recovered data error occurs, data transfer is not terminated. However, when the data transfer has completed CHECK CONDITION status is reported. The sense key is set to RECOVERED ERROR. The information bytes give the address of the last block where a CIRC recovered data error was detected. If an unrecovered data error occurs, data transfer is terminated and CHECK CONDITION status is reported. The block with the error is not transferred. The sense key is set to MEDIUM ERROR. The information bytes give the address of the block where the unrecovered error was detected.
06h	The maximum error recovery procedures are used. Recovered data errors are reported. If a recovered data error occurs data transfer is terminated and CHECK CONDITION status is reported. The block with the recovered error is not transferred. The sense key is set to RECOVERED ERROR. The information bytes give the address of the block where the recovered data error was detected. If a data error occurs that is uncorrectable with the ECC information on the medium, data transfer is terminated with CHECK CONDITION status. The block with the error is not transferred. The sense key is set to MEDIUM ERROR. The information bytes give the address of the block where the uncorrectable error was detected.
07h	Only retries of the read operation are used (layered error correction is not used) and CIRC recovered data errors are reported. If a CIRC recovered data error occurs, data transfer is terminated with CHECK CONDITION status. The block with the recovered error is not transferred. The sense key is set to RECOVERED ERROR. The information bytes give the address of the block where the recovered data error was detected. If a CIRC unrecovered data error occurs, data transfer is terminated with CHECK CONDITION status. The block with the error is not transferred. The sense key is set to MEDIUM ERROR. The information bytes give the address of the block where the unrecovered error was detected.
10h	If data transfer can be maintained, the maximum error recovery procedures available are used. (RC = 1.) If an error occurs which is uncorrectable with the error correction codes (ECC) on the media, or is uncorrectable in time to maintain data transfer, the data transfer is not terminated. However, when the data transfer has completed, CHECK CONDITION status is reported. The sense key is set to MEDIUM ERROR. The information bytes give the address of the block where the first unrecovered error was detected. Recovered errors are not reported.
11h	If data transfer can be maintained, retries of the read operation and CIRC are used (layered error correction is not used). (RC = 1.) Only CIRC unrecovered data errors are reported. If a CIRC unrecovered data error occurs, data transfer is not terminated. However, when the data transfer has completed, CHECK CONDITION status is reported. The sense key is set to MEDIUM ERROR. The information bytes give the address of the block where the first unrecovered error was detected. Recovered errors are not reported.
14h	If data transfer can be maintained, the maximum error recovery procedures available are used. (RC = 1.) Recovered data errors are reported. If a recovered data error occurs, data transfer is not terminated. However, when the data transfer has completed, CHECK CONDITION status is reported. The sense key is set to RECOVERED ERROR. The information bytes give the address of the block where a recovered data error was detected. If an data error occurs that

	is uncorrectable with the ECC information available on the media, or is uncorrectable in time to maintain data transfer, the data transfer is not terminated. However, when the data transfer has completed CHECK CONDITION, status is reported. The sense key is set to MEDIUM ERROR. The information bytes give the address of the block where the first uncorrectable error was detected. Reporting unrecovered errors takes precedence over reporting recovered errors.
15h	If data transfer can be maintained, retries of the read operation and CIRC are used (layered error correction is not used, RC = 1.) Recovered data errors are reported. If a recovered data error occurs, data transfer is not terminated. However, when the data transfer has completed CHECK CONDITION status is reported. The sense key is set to RECOVERED ERROR. The information bytes give the address of the block where a CIRC recovered data error was detected. If an unrecovered data error occurs, data transfer is not terminated. However, when the data transfer has completed CHECK CONDITION status is reported. The sense key is set to MEDIUM ERROR. The information bytes give the address of the block where the first unrecovered error was detected. Reporting unrecovered errors takes precedence over reporting recovered errors.
20h	The maximum error recovery procedures available are used. If an error occurs which is uncorrectable with the error correction codes (ECC) on the media, data transfer is terminated with CHECK CONDITION status. The block with the error is transferred. The sense key is set to MEDIUM ERROR. The information bytes give the address of the block where the unrecovered error was detected. Recovered errors are not reported.
21h	Only retries of the read operation and CIRC are used (layered error correction is not used). Only CIRC unrecovered data errors are reported. If a CIRC unrecovered data error occurs data transfer is terminated with CHECK CONDITION status. The block with the error is transferred. The sense key is set to MEDIUM ERROR. The information bytes give the address of the block where the unrecovered error was detected. Recovered errors are not reported.
24h	The maximum error recovery procedures available are used. Recovered data errors are reported. If a recovered data error occurs data transfer is not terminated. However, when the data transfer has completed, CHECK CONDITION status is reported. The sense key is set to RECOVERED ERROR. The information bytes give the address of the last block where a recovered data error was detected. If a data error occurs that is uncorrectable with the ECC information available on the media data transfer is terminated and CHECK CONDITION status is reported. The block with the error is transferred. The sense key is set to MEDIUM ERROR. The information bytes give the address of the block where the uncorrectable error was detected.
25h	Only retries of the read operation and CIRC are used (layered error correction is not used). Recovered data errors are reported. If a recovered data error occurs, data transfer is not terminated. However, when the data transfer has completed, CHECK CONDITION status is reported. The sense key is set to RECOVERED ERROR. The information bytes give the address of the last block where a CIRC recovered data error was detected. If an unrecovered data error occurs, data transfer is terminated and CHECK CONDITION status is reported. The block with the error is transferred. The sense key is set to MEDIUM ERROR. The information bytes give the address of the block where the unrecovered error was detected.
26h	The maximum error recovery procedures are used. Recovered data errors are reported. If a recovered data error occurs, data transfer is terminated and CHECK CONDITION status is reported. The block with the recovered error is transferred. The sense key is set to RECOVERED ERROR. The information bytes give the address of the block where the recovered data error was detected. If a data error occurs that is uncorrectable with the ECC information on the media, data transfer is terminated with CHECK CONDITION status. The block with the error is transferred. The sense key is set to MEDIUM ERROR. The information bytes give the address of the block where the uncorrectable error was detected.
27h	Only retries of the read operation are used (layered error correction is not used). CIRC recovered data errors are reported. If a CIRC recovered data error occurs, data transfer is terminated with CHECK CONDITION status. The block with the recovered error is transferred. The sense key is set to RECOVERED ERROR. The information bytes give the address of the block where the recovered data error was detected. If a CIRC unrecovered data error occurs, data transfer is terminated with CHECK CONDITION status. The block with the error is transferred. The sense key is set to MEDIUM ERROR. The information bytes give the address of the block where the unrecovered error was detected.
30h	Same as code 10H.
31h	Same as code 11H.
34h	Same as code 14H.
35h	Same as code 15H
40h	For rewritable media the VR bit can be used in combination with all other bit settings. However the VR criteria will be the most severe.

The Read Retry Count field specifies the number of times that the controller ***shall*** attempt its read recovery algorithm.

A CIRC Recovered Data Error is defined as a block for which the CIRC based error correction algorithm was unsuccessful for a read attempt, but on a subsequent read operation no error was reported. The number of subsequent read operations is limited to the read retry count. Layered error correction was not used.

A CIRC Unrecovered Data Error is defined as a block for which the CIRC based error correction algorithm was unsuccessful on all read attempts up to the read retry count. Layered error correction was not used.

An L-EC Recovered Data Error is defined as a block for which the CIRC based error correction algorithm was unsuccessful, but the layered error correction was able to correct the block within the read retry count.

An L-EC Uncorrectable Data Error is defined as a block which could not be corrected by layered error correction within the read retry count.

3.2.6.2 Write Parameters Mode Page

The Write Parameters Mode Page (see Table 26) contains parameters needed for the correct execution of write commands.
The values in this page do not necessarily reflect the status on a given track. They will be used as applicable when a write operation occurs. If any parameters have values incompatible with the current track, a check condition status shall occur when a write is attempted.

Table 26 : Write parameters Mode page

Byte	Bit 7	6	5	4	3	2	1	0
0	PS	Reserved	Page Code (05h)					
1	Page Length (32h)							
2	Reserved			Test Write def = 0	Write Type default = 1			
3	Multi-session default = 11		FP def= 0	Copy def=0	Track Mode default = 0			
4	Reserved				Data Block Type default = 8			
5	Reserved							
6	Reserved							
7	Reserved		Host Application Code default =0					
8	Session Format default = 0							
9	Reserved							
10	(MSB)							

11	Packet Size	
12	default = 0	
13	(LSB)	
14	Audio Pause Length	
15	default = 150	
16	MCVAL	Reserved
17	N1 (Most significant)	
18	N2 (Media Catalog Number)	
19	N3	
	...	
28	N12	
29	N13 (Least significant)	
30	Zero	
31	AFRAME	
32	TCVAL	Reserved
33	I1 (Country Code)	
34	I2 (International Standard Recording Code)	
35	I3 (Owner Code)	
36	I4	
37	I5	
38	I6 (Year of Recording)	
39	I7	
40	I8 (Serial Number)	
41	I9	
42	I10	
43	I11	
44	I12	
45	Zero	
46	AFRAME	
47	Reserved	
48	Sub-header Byte 0	
49	Sub-header Byte 1	
50	Sub-header Byte 2	
51	Sub-header Byte 3	

Byte 0:
The PS flag (parameters savable) is only used with the MODE SENSE command and shall always be zero. This flag is reserved with the MODE SELECT command.

Byte 2:

Bit 4:

The Test Write flag is valid only for Write Type 1 (Track at Once). When the Test Write flag is set to one, it indicates that the device performs the write process, but does not write data to the media. When the flag is set to zero the Write laser power is set such that user data is transferred to the CD media. In addition, all track and disc information collected, during test write mode, shall be cleared. It should be noted that the number of tracks reserved or written will be limited in test write mode to the same extent as in real write mode.

Bit 0-3:
Write Type (Table 27) specifies the CD-R/E stream type to be used during writing. Write Type values are shown in Table 27.

Table 27 : Write Type Field.

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

Packet - the device shall perform packet writing when write commands are issued.
Track at Once - the device shall perform track at once recording when write commands are issued.
Raw - the device shall write data as received from the host. In this mode, the host sends the lead-in. As the host must provide Q sub-channel in this mode, the only valid Data Block Type is 1. The Next Writable Address starts at the beginning of the lead-in (which shall be a negative LBA on a blank disc).

Byte 3:

Bit 6-7:
The Multi-session field defines how session closure affects the opening of the next session. See Table 28.

Table 28 : Multi-session Field Definition

Multisession Field	Action Upon Session Closure
00b	No B0 pointer. Next Session not allowed
01b	B0 pointer = FF:FF:FF. Next session not allowed
10b	Reserved
11b	Next session allowed. B0 pointer = next possible program area.

Bit 5:
The FP flag, when set to one indicates that the packet type is fixed. Otherwise, the packet type is variable. This flag is ignored unless the write type is set to 0 (Packet).

Bit 0-3:
Track Mode is the Control nibble in all mode 1 Q sub-channel in the track.

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

Byte 4:

Bit 0-3:
Data Block Type defines both the specific data fields in a user data block and its size. The Data Block Type is as defined in Table 29. This size is used for writing instead of the block size set in the mode select header.

Table 29 : Data Block Type Codes

Value	Block Size	Definition
0	2352	Raw data 2352 bytes of raw data (not valid for write type = packet)
1	2368	Raw data with P and Q sub-channel 2352 bytes of raw data, 16 bytes buffer for Q sub-channel: Bytes 0..9 are Q sub-channel data Bytes 10..11 are Q sub-channel EDC Bytes 12..14 are zero Byte 15, most significant bit has state of P sub-channel bit (Valid for write type = RAW only)
2 - 7		Reserved values
8	2048	Mode 1 (ISO/IEC 10149) 2048 bytes of user data
9	2336	Mode 2 (ISO/IEC 10149) 2336 bytes of user data (not valid for write type = packet)
10	2048	Mode 2 (CD-ROM XA, form 1) 2048 bytes of user data, sub-header from write parameters
11	2056	Mode 2 (CD-ROM XA, form 1): 8 bytes of sub-header, 2048 bytes of user data
12	2324	Mode 2 (CD-ROM XA, form 2) 2324 bytes of user data, sub-header from write parameters
13	2332	Mode 2 (CD-ROM XA, form 1, form 2, or mixed form): 8 bytes of sub-header 2324 bytes of user data
14-15	-	Reserved

NOTES:

1. When a track has been designated for packet writing, the device shall ensure that the TDB (Track Descriptor Block) is written upon receipt of the write command.
2. With the exception of data block type 1, the device shall generate all P sub-channel and all mode 1, mode 2, and mode 3 Q sub-channel
3. For data block types 8 through 13, the device shall generate all sync fields and all headers.
4. For data blocks of mode 1 or of mode 2, form 1, the device shall generate EDC and L-EC parity.
5. For data block types 0 and 1 , the device shall perform no data scrambling per ISO/IEC 10149.
6. For data block types 8 through 13, the device shall perform data scrambling per ISO/IEC 10149.

Byte 7:

Bit 0-5:
The Host Application Code is typically zero. When the unrestricted Use Disc flag in Disc Information Block (see Table 128) is one, the Host Application Code shall be ignored by the device. If the Unrestricted Use Disc flag is zero, then the Host Application Code shall be set to the appropriate value for the medium in order that writing be allowed. A Host Application Code of zero is used for a Restricted Use - General Purpose Disc.

Byte 8:
The Session Format code is to be written in the TOC of the session containing this track. The Session Format code is the PSEC byte of the Mode 1, point A0 TOC entry. See Table 30.

Table 30 : Session Format Codes.

Disc Type Code	Session Format
00h	CD-DA or CD-ROM Disc
10h	CD-I Disc
20h	CD-ROM XA Disc
All Other Values	Reserved

Byte 10-13:
The Packet Size field specifies the number of User Data Blocks per fixed packet.

Byte 14-15:
Audio Pause Length is the number of blocks from the beginning of the track for which the Mode 1 Q sub-channel INDEX shall be zero. If this number is zero, then there is no period where the Mode 1 Q sub-channel INDEX shall be zero. The default value shall be 150. This field is valid only for audio tracks, otherwise it is ignored.

Byte 16:

Bit 7:
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.

Byte 17-29:
The Media Catalog Number (MCN) is formatted as in Table 26. The MCN will be written in a mode 2 Q sub-channel in at least one out of every 100 blocks in the program area.

Byte 31:
AFRAME may return the frame number in which the MCN was found. This shall be a value from 00h to 4Ah. All other values are reserved.

Byte 32:

Bit 7:
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.

Byte 33-44:
The International Standard Recording Code (ISRC) is formatted as in Table 26.
Note : ISRC can only be written when writing audio tracks.

Byte 46:
AFRAME may return the frame number in which the MCN was found. This shall be a value from 00h to 4Ah. All other values are reserved.

Byte 48-51:
The sub-header bytes 0..3 are used in the XA sub-header bytes during the encoding of XA data blocks.

Table 31: Matrix of the sense code (write type versus data type).

wr_type	0	1	2	3	>3
	(packet)	(TAO)	(SAO)	(RAW)	(illegal)
data_type					
0	05,26		05,26	05,26	05,26
1	05,26	05,26	05,26		05,26
(reserved) 2-7	05,26	05,26	05,26	05,26	05,26
8			05,26	05,26	05,26
9	05,26		05,26	05,26	05,26
10			05,26	05,26	05,26
11			05,26	05,26	05,26
12			05,26	05,26	05,26
13			05,26	05,26	05,26
(reserved) 14-15	05,26	05,26	05,26	05,26	05,26

Table 32: Matrix of the sense code (write type , data type versus track mode).

wr_type	0	1	1
	(packet)	(TAO)	(TAO)
data_type	x	0	>7
track_mode			
0	05,26		05,26
1	05,26		05,26
2	05,26		05,26
3	05,26		05,26
4	05,26	05,26	
5		05,26	05,26
6	05,26	05,26	
7		05,26	05,26

8 - 9	05,26	05,26	05,26

3.2.6.3 CD-ROM Device Parameters Page.

The CD-ROM Device parameters page specifies parameters that affect all CD-ROM data types.

Table 33: CD-ROM Parameters Page Format.

Bit Byte	7	6	5	4	3	2	1	0
0	PS =0	Reserved	Page Code (0Dh)					
1	Page Length (06h)							
2	Reserved							
3	Reserved				Inactivity Time Multiplier default = Ch			
4	MSB	Number of MSF - S Units per MSF - M Unit						
5		= 60 (3Ch)						LSB
6	MSB	Number of MSF - F Units per MSF - S Unit						
7		= 75 (4Bh)						LSB

The Parameters Savable (PS) bit is only used with the MODE SENSE command and ***shall*** set to zero. This bit is reserved with the MODE SELECT command.

The Inactivity Timer Multiplier specifies the length of time that the drive ***shall*** remain in the hold track state after completion of a seek or read operation.

NOTE Higher values in this parameter may have an adverse effect on the drive MTBF, in some implementations.

Table 34 : Inactivity Time Multiplier Values.

Inactivity Timer Multiplier	Minimum Time in Hold Track State	Inactivity Timer Multiplier	Minimum Time in Hold Track State
0h	Vendor-specific	8h	16s
1h	125 ms	9h	32s
2h	250 ms	Ah	1 min
3h	500 ms	Bh	2 min
4h	1 s	**Ch**	**4 min**
5h	2 s	Dh	8 min
6h	4 s	Eh	16 min
7h	8 s	Fh	32 min

The number of S units per M unit field gives the ratio of these MSF address values. For media conforming to the CD-ROM and CD-DA Specification, this value is 60.

The number of F units per S unit field gives the ratio of these MSF address values. For media conforming to the CD-ROM and CD-DA Specification, this value is 75.

3.2.6.4 CD-ROM Audio Control Parameters Page.

The CD-ROM Audio Control Parameters Page sets the playback modes and output controls for subsequent PLAY AUDIO commands and any current audio playback operation.

Table 35 : CD-ROM Audio Control Mode Page Format.

Bit Byte	7	6	5	4	3	2	1	0
0	PS =0	Reserved	Page Code =0Eh					
1	Page Length =0Eh							
2	Reserved					Immed = 1	SOTC = 0	Reserved
3	Reserved							
4	Reserved							
5	Reserved							
6	Logical Block Per Second of Audio Playback Default 75							
7								
8	Reserved				CDDA Output Port 0 Channel Selection			
9	Output Port 0 Volume							
10	Reserved				CDDA Output Port 1 Channel Selection			
11	Output Port 1 Volume							
12	Reserved				Reserved			
13	Reserved							
14	Reserved				Reserved			
15	Reserved							

The Parameters Savable (PS) bit is only used with the MODE SENSE command and ***shall*** always be zero. This bit is reserved with the MODE SELECT command.

The Immediate Bit (Immed) is used for information purposes only; the audio commands will always send completion status as soon as the playback operation has been started. This bit ***shall*** always be set to 1.

A Stop On Track Crossing (SOTC) bit of zero indicates the CDD3610 ***shall*** terminate the audio playback operation when the transfer length is satisfied. Multiple tracks ***shall*** be played as necessary. Periods of time encoded as audio pause/silence at the beginning of tracks, (index 0) ***shall*** also be played. A SOTC bit of one indicates the CDD3610 ***shall*** terminate the audio playback operation when the beginning of a following track is encountered.

The CDDA Output Port Channel Selection field specifies the Red Book audio channels from the disc to which a specific output port ***shall*** be connected. Only the following settings are possible:
-Channel 0 to port 0 and Channel 1 to port 1.
-All ports muted.

Table 36 : CDDA Output Port Channel Selection Codes.

Code	Description
0000b	Output port muted
0001b	Connect audio channel 0 to this output port
0010b	Connect audio channel 1 to this output port

The Output Port Volume Control indicates the relative volume level for this audio output port. The value used is specified as an attenuation of the normal volume level. A value of zero indicates the minimum volume level (Mute), and a value of FFh indicates maximum volume (No attenuation) level. The MUTE and VOLUME settings are implemented so that they will be equal for channel 0 and 1. In case of conflicts, port 0 settings are taken for port 1 also. Volume control can also be changed with a sound card or with the volume control at the front of the drive.

3.2.6.5 CD-ROM Capabilities and Mechanical Status Page.

This page is read only and may not be set by the Mode Select command. The format and content of the page is defined inTable 37 : CD Capabilities and Mechanical Status Page.

Table 37 : CD Capabilities and Mechanical Status Page.

Bit Byte	7	6	5	4	3	2	1	0
0	PS	Reserved	Page Code (2Ah)					
1	Page Length (14h)							
2	Reserved					Method 2 =1	CD-E Read = 1	CD-R Read = 1
3	Reserved					Test Write = 1	CD-E Write = 1	CD-R Write = 1
4-7 Cap-ability bits	Reserved	Multi Session = 1	Mode 2 Form 2 = 1	Mode 2 Form 1 = 1	Digital Port (2) = 0	Digital Port (1) = 0	Composite = 0	Audio Play = 1
	Read Bar Code = 0	UPC = 1	ISRC = 1	C2 Pointers are supported = 0	R-W De-interleaved & corrected = 0	R-W Supported = 1	CD-DA Stream is Accurate = 1	CD-DA Commands Supported = 1
	Loading Mechanism Type =001			Reserved	Eject (Individual or Cartridge) =1	Prevent Jumper =1	Lock State = var	Lock = 1
	Reserved				S/W Slot Selection (SSS) =0	Changer Supports Disc Present reporting =0	Separate Channel Mute Supported =0	Separate volume levels per channel = 1
8	(MSB) Maximum Read Speed Supported (in kBps) = 0423h							
9	(LSB)							
10	(MSB) Number of Volume Levels Supported = 007Fh							
11	(LSB)							
12	(MSB) Buffer Size supported by Drive (in Kbytes) = 0300h							
13	(LSB)							
14	(MSB) Current Read Speed Selected (in kBps)							
15	(default = 6x, except CDI discs and unclosed sessions 2x) (LSB)							
16	Reserved							
17	Reserved		Length=0		LSBF=0	RCK=0	BCK=0	Reserved
18	(MSB) Maximum Write Speed Supported (in kBps) = 0161h							
19	(LSB)							
20	(MSB) Current Write Speed Selected (in kBps)							
21	(default = 2x) (LSB)							

Implementors note : The buffer can contain 384 (0180h) blocks. The calculation is then : (384 * 2048 bytes) / 1024 = 768 Kbytes or 300h Kbytes. This defines also the maximum fixed packet size.

Media Function Capabilities:

Byte 0 :

Bit 7:

The PS flag (parameters savable) is only used with the MODE SENSE command and shall always be zero. This flag is reserved with the MODE SELECT command.

Byte 2 :

Bit 0:
The CD-R Read Field is set to one, indicating that the drive ***shall*** support the read function of CD-R disc (Orange Book Part II).

Bit 1:
The CD-E Read Field is set to one, indicating that the drive ***shall*** support the read function of CD-RW disc (Orange Book Part III).

Bit 2:
The Method 2 is set to one, indicating that the drive ***shall*** support the read function of CD-R and CD-RW media written using fixed packet tracks using Addressing Method 2.

Byte 3 :

Bit 0:
The CD-R Write Field is set to one, indicating that the drive ***shall*** support the write function of CD-R disc (Orange Book Part II).

Bit 1:
The CD-E Write Field is set to one, indicating that the drive ***shall*** support the write function of CD-RW disc (Orange Book Part III).

Bit 2:
The Test Write is set to one, indicating that the drive ***shall*** support the test write function. See Write Parameters Mode Page.

The individual capabilities of the drive are specified by bytes 4 through 7. Each of the bits indicate if that specific capability is supported. A value of zero indicates that the capability is NOT supported; a value of one indicates the capability IS supported.

Byte 4:

Bit 0	Audio Play	The Audio Play bit is set to 1 indicating that the drive is capable of Audio Play operation. This also indicates that the drive is capable of overlapping Play and other commands such as reading of the Sub-channel information.
Bit 1	Composite	The Composite bit is set to 0 indicating that the drive is not capable of delivering a composite Audio and Video data stream.
Bit 2	Digital Port(1)	The Digital Port(1) bit is set to 0 indicating that the drive does not supports digital output (IEC958) on port 1
Bit 3	Digital Port(2)	The Digital Port(1) bit is set to 0 indicating that the drive does not supports digital output(IEC958) on port 2

Bit 4	Mode 2 Form 1	The Mode 2 Form 1 bit is set to 1 indicating that the drive is capable of reading sectors in Mode 2 Form 1 (XA) format.
Bit 5	Mode 2 Form 2	The Mode 2 Form 1 bit is set to 1 indicating that the drive is capable of reading sectors in Mode 2 Form 2 format.
Bit 6	Multi Session	The Multi Session bit is set to 1 indicating that the drive is capable of reading multiple session or Photo-CD discs.
Byte 5 :		
Bit 0	CD-DA Commands	Set to 1 to indicate that Supported Red Book audio can be read using the READ-CD command.
Bit 1	CD-DA Stream is Accurate	This bit is set to 1 indicating that the drive supports an advanced feature that allows it to return to an audio location without losing place to continue the READ CD-DA command at all speeds. The drive can continue from a loss of streaming condition and no error will be generated.
Bit 2	R-W Supported	R-W is supported by returning the RAW data. Bit is set to 0, indicating that there is no support.
Bit 3	R-W De-interleaved & Corrected	This bit is set to 0 indicating that the R-W sub-channel data will not be returned de-interleaved and error corrected. .
Bit 4	C2 Pointers are Supported	The bit is set to 1 indicating that the drive does support the C2 Error Pointers. This also indicates that the drive is capable of returning the C2 Error Pointers and C2 Block Error flags in the READ CD command.
Bit 5	ISRC	The ISRC bit is set to one indicating that the drive can return the International Standard Recording Code Information.
Bit 6	UPC	The UPC bit is set to one indicating that the drive can return the Media Catalog Number (UPC)
Bit 7	Read Bar Code	The Read Bar Code bit is set to zero, indicating that the drive can not return the disc bar codes
Byte 6 :		
Bit 0	Lock	The LOCK bit is set to one, indicating that the PREVENT/ALLOW command is capable of actually locking the media into the drive.
Bit 1	Lock State	This indicates the current state of the drive. 0 The drive is currently in the allow (Unlocked) state. Media may be inserted or ejected. 1 The drive is currently in the prevent (Locked) state. Media loaded in the drive may not be removed via a soft or hard eject. If the drive is empty, media may

not be inserted if the Prevent Jumper is not present. If the jumper is present, then media may be inserted.

Bit 2	Prevent Jumper	This indicates the state of the (Optional) Prevent/Allow Jumper. 0 Jumper is present. Drive will power up to the Allow State. Locking the drive with the Prevent/Allow Command ***shall*** NOT prevent the insertion of media.
Bit 3	Eject Command	The drive can eject the disc via the normal START/STOP command with the LoEj bit set.
Bit 4	Reserved	Reserved
Bit 5-7	Loading Mechanism Type	This field specifies the type of disc loading the drive supports. 7 6 5 0 0 1 Tray type loading mechanism

Byte 7 :

Bit 0	Separate Volume Levels	This bit is set to 1, indicating that the audio level for each channel can be controlled independently.
Bit 1	Separate Channel Mute	This bit is set to 0, indicating that the mute capability for each channel can be controlled independently.
Bit 2	Supports Disc Present (SDP)	This bit is set to 0, indicating that the CDD3610 is not an embedded changer device.
Bit 3	Software Slot Selection (SSS)	This bit is set to 0, because the CDD3610 is not a changer.

Byte 8-9:
The Maximum Speed Supported field indicates the actual maximum data rate that the drive supports. This value is returned as the number of kilobytes per/second (Speed/1000) that the data is read from the drive.

Table 38 : Speed Settings.

			Selected speed		
		n speed	1	2	6
		hex value	0x00b0	0x0161	0x0423
		kbytes/sec	176	353	1.059
Recorder Speed					
Read	Closed Session	All media	1	2	6
	Open Session	CD-R Media	1	2	rounded to 2
		CD-RW Media	1	2	rounded to 2
	Audio	All Media	1	2	6
Write		CD-R Media	1	2	rounded to 2
		CD-RW Media	rounded to 2	2	rounded to 2

Note that these are the raw data rates and do not reflect any overhead resulting from headers, error correction data, etc. It is also important to understand that the reported data rate is a theoretical maximum and the actual data rates to the host will be lower. The data rates are dynamic and will change as the drive changes its speed.

Byte 10-11:
The Number of Volume Levels Supported field returns the number of discrete levels. the drive only supports turning audio on and off, therefore the Number of Volume Levels field ***shall*** be set to 7Fh.

Byte 12-13:
The Buffer Size Supported field returns the number of bytes of buffer dedicated to the data stream returned to the Host Computer. This value is returned in Kbytes (Size/1024). The buffer size is 0300h (768) for a 1 Meg DRAM.

Byte 14-15:
The Current Speed Selected field indicates the actual data rate that the drive is currently using. This value is returned as the number of kilobytes per/second (Speed/1000) that the data is read from the drive.

Byte 17 is used to describe the format of the drive's digital output.

Bit 1	BCKF	Reserved
Bit 2	RCK	Reserved
Bit 3	LSBF	Reserved
Bit 4-5	Length	Reserved
Bit 6-7		Reserved

Byte 18-19:
The Maximum Write Speed Supported field indicates the actual maximum data rate that the drive supports independent of media type. This value is returned as the number of kilobytes per/second (Speed/1000) that the data may be written to the drive. The Maximum Write Speed Supported field shall be 0161h (n=2).

Byte 20-21:
The Current Write Speed Selected field indicates the actual data rate that the device is currently using. This value is returned as the number of kilobytes per/second (Speed/1000) that the data is read from the drive.

3.2.7 Pause / Resume.

3.2.7.1 Description.

The PAUSE/RESUME command requests that the device stop or start an audio play operation. This command is used with PLAY AUDIO commands that are currently executing.

Table 39 : PAUSE/RESUME Command.

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (4Bh)							
1	Reserved							
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	Reserved							
8	Reserved							Resume
9	Reserved							
10	Reserved							
11	Reserved							

3.2.7.2 Parameters.

Byte 8:

Bit 0:
A Resume bit of zero causes the drive to enter the hold track state with the audio output muted after the current block is played. A Resume bit of one causes the drive to release the pause and begin play at the block following the last block played.

If an audio play operation cannot be resumed and the resume bit is one, the command is terminated with CHECK CONDITION status. 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.

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 40: Pause/Resume : Supported Sense Key, ASC and ASCQ.

Sense Key	ASC	ASCQ	Description of Error
02	04	01	LOGICAL DRIVE NOT READY - IN PROGRESS OF BECOMING READY
02	04	04	NOT READY, WRITE IN PROGRESS
02	3A	01	MEDIUM NOT PRESENT, TRAY CLOSED
02	3A	02	MEDIUM NOT PRESENT, TRAY OPEN
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
0B	B9	00	PLAY OPERATION ABORTED

3.2.8 Play Audio (10).

Table 41 : PLAY AUDIO (10) Command.

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (45h)							
1	Reserved							
2	MSB							
3	Starting Logical Block Address							
4								
5								LSB
6	Reserved							
7	MSB			Transfer Length				
8								LSB
9	Reserved							
10	Reserved							
11	Reserved							

3.2.8.1 Description.

The PLAY AUDIO (10) command requests that the CDD3610 begins an audio playback operation.

The command function and the output of the audio signals shall be specified by the settings of the CDROM Audio Control Mode Page 0E.

This command responds with immediate status, allowing executing of other commands (See Table 43). This command ***shall*** set the DSC bit upon command completion.
The DSC-bit is bit 4 in the ATAPI status register. (see ref. 003 : SFF8020i ATAPI Revision 2.6)

The PLAY AUDIO (10) command ***is*** implemented to allow a method for the Host Computer to determine if audio operations are supported. An CDD3610 responds to a PLAY AUDIO (10) command that has a transfer length of zero without CHECK CONDITION status, indicating that the drive supports audio play operations.

3.2.8.2 Parameters.

Byte 2-5:
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.

Byte 7-8:
The Transfer 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 CD-ROM 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 starting address is not found, or if the address is not within an audio track, or if a not ready condition exists, the command ***shall*** be terminated with CHECK CONDITION status.

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 42 : Play Audio : Supported Sense Key, ASC and ASCQ.

Sense Key	ASC	ASCQ	Description of Error
02	04	01	LOGICAL DRIVE NOT READY - IN PROGRESS OF BECOMING READY
02	04	04	NOT READY, WRITE IN PROGRESS
02	3A	01	MEDIUM NOT PRESENT, TRAY CLOSED
02	3A	02	MEDIUM NOT PRESENT, TRAY OPEN
03	02	00	NO SEEK COMPLETE
05	21	00	LOGICAL BLOCK ADDRESS OUT OF RANGE
05	24	00	INVALID FIELD IN COMMAND PACKET
05	64	00	ILLEGAL MODE FOR THIS TRACK OR INCOMPATIBLE MEDIUM
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON, RESET OR BUS DEVICE RESET OCCURRED

3.2.8.3 Play Audio with Immediate Packet Commands.

The PLAY AUDIO commands will continue to play while other commands are processed by the drive. 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.

A PLAY AUDIO command will be terminated when any of the commands in Table 43 : Commands That Will Stop a Play Operation are received.

Table 43 : Commands That Will Stop a Play Operation[17]

Opcode(s)	Command Description
4Bh	PAUSE/RESUME
45h	PLAY AUDIO (10)
A9h	PLAY AUDIO (12)
47h	PLAY AUDIO MSF
28h	READ (10)
A8h	READ (12)
BCh	READ CD
44h	READ HEADER
D5h	READ CD MSF
2Bh	SEEK
1Bh	START/STOP UNIT

ATA commands other than A2, A0 (See Table 3) will stop play.
All MMC CD-R/W commands (See Table 5) will stop play.
The above list (Table 43 : Commands That Will Stop a Play Operation.) is not an exhausted list of commands that will stop play operation.

A PLAY AUDIO command will not be terminated when any of the commands in Table 44: Commands That Will Not Stop a Play Operation" are received.

Table 44 : Commands That Will Not Stop a Play Operation.

Opcode	Command Description	Action Taken
ANY	When it generates an Illegal Field in Command Packet CHECK CONDITION.	Will terminate normally
12h	INQUIRY	The Inquiry data will be returned
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
1Eh	PREVENT/ALLOW MEDIA REMOVAL	Will execute normally
25h	READ CD-ROM 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 TOC	The CDD3610 will be able to respond to this command while the play is in progress, because the drive support caching.
03h	REQUEST SENSE	Will execute normally
00h	TEST UNIT READY	Will execute normally

[17] It's possible that other commands will be able to stop a play operation in the future.

3.2.9 Play Audio (12).

Table 45 : PLAY AUDIO (12) Command.

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (A5h)							
1	Reserved							
2	MSB							
3	Starting Logical Block Address							
4								
5								LSB
6	MSB							
7	Transfer Length							
8								
9								LSB
10	Reserved							
11	Reserved							

3.2.9.1 Description.

The PLAY AUDIO (12) command requests that the CDD3610 begin an audio playback operation.

The command function and the output of the audio signals shall be specified by the settings of the CDROM Audio Control Mode Page 0E.

3.2.9.2 Parameters.

See the Play Audio (10) command for a description of the fields in this command.

3.2.10 Play Audio MSF.

Table 46 : PLAY AUDIO MSF Command.

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (47h)							
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	Reserved							
11	Reserved							

3.2.10.1 Description.

The PLAY AUDIO MSF command requests that the CDD3610 begins an audio playback operation, using MSF (Minute, Second, Frame) values.

The command function and the output of the audio signals shall be specified by the settings of the CDROM Audio Control Mode Page 0E.

3.2.10.2 Parameters.

Byte 3-8:
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.

This command responds with immediate status, allowing executing of other commands. This command ***shall*** set the DSC bit upon command completion.(See Table 43).

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, if the address is not within an audio track, or if a not ready condition exists, the command ***shall*** be terminated with CHECK CONDITION status.

Table 47 : Play Audio MSF : Supported Sense Key, ASC and ASCQ.

Sense Key	ASC	ASCQ	Description of Error
02	04	01	LOGICAL DRIVE NOT READY - IN PROGRESS OF BECOMING READY
02	04	04	NOT READY, WRITE IN PROGRESS
02	3A	01	MEDIUM NOT PRESENT, TRAY CLOSED
02	3A	02	MEDIUM NOT PRESENT, TRAY OPEN
05	21	00	LOGICAL BLOCK ADDRESS OUT OF RANGE
05	24	00	INVALID FIELD IN COMMAND PACKET
05	64	00	ILLEGAL MODE FOR THIS TRACK OR INCOMPATIBLE MEDIUM
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON, RESET OR BUS DEVICE RESET OCCURRED

3.2.11 Prevent / Allow Media Removal.

3.2.11.1 Description.

The PREVENT/ALLOW MEDIUM REMOVAL command requests that the CDD3610 enables or disables the removal of the medium. The prevention of media removal ***is*** accomplished through the use of a Locking Mechanism.

If power is off it is always impossible to load or unload the drive.
If power is applied and the tray is open, it is always possible to load the drive with a disc.

Opening /closing of the tray is possible with a press on the EJECT-button.

Table 48: PREVENT ALLOW MEDIUM REMOVAL Command.

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (1Eh)							
1	Reserved							
2	Reserved							
3	Reserved							
4	Reserved							Prevent
5	Reserved							
6	Reserved							
7	Reserved							
8	Reserved							
9	Reserved							
10	Reserved							
11	Reserved							

3.2.11.2 Parameters.

Byte 4:

Bit 0:
If the Prevent bit is set to one, it is impossible to unload the drive, by command or pressing eject button.

If the Prevent bit is set to zero, medium removal is allowed.

The prevention of medium removal ***shall*** begin when the Host Computer issues a PREVENT/ALLOW MEDIUM REMOVAL command with a prevent bit of one (medium removal prevented). The prevention of medium removal ***shall*** terminate:

1. after the Host Computer has issued a PREVENT ALLOW MEDIUM REMOVAL command with a prevent bit of zero (Unlock).
2. during a write, when the CDD3610 has completed writing all data in its buffer to the disc.
3. upon a hard RESET condition.

The default state of the drive at power on is unlocked.

Table 49 : Prevent/Allow : Supported Sense Key, ASC and ASCQ.

Sense Key	ASC	ASCQ	Description of Error
02	04	01	LOGICAL DRIVE NOT READY - IN PROGRESS OF BECOMING READY
02	04	04	NOT READY, WRITE IN PROGRESS
02	3A	01	MEDIUM NOT PRESENT, TRAY CLOSED
02	3A	02	MEDIUM NOT PRESENT, TRAY OPEN
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON, RESET OR BUS DEVICE RESET OCCURRED

3.2.12 Read (10).

3.2.12.1 Description.

The READ (10) command requests that the CDD3610 transfer data to the Host Computer. The most recent data value written in the addressed logical block ***shall*** be returned.

Table 50 : READ (10) Command.

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (28h)							
1	Reserved							
2	MSB							
3	Logical Block Address							
4								
5								LSB
6	Reserved							
7	MSB			Transfer Length				
8								LSB
9	Reserved							
10	Reserved							
11	Reserved							

3.2.12.2 Parameters.

Byte 2-5:
The Logical Block Address specifies the address where reading is to begin.

Byte 7-8:
The Transfer Length field specifies the number of contiguous logical blocks of data that ***shall*** be transferred. A transfer length of zero indicates that no logical blocks ***shall*** be transferred. This condition ***shall not*** be considered an error. Any other value indicates the number of logical blocks that ***shall*** be transferred.

Although the CD-ROM is capable of returning a variety of data, this command ***shall*** only return the "User Data" portion of the sector. This field is **always** 2048 bytes in length for Mode 1 and Mode 2 Form 1 sectors, which are the only sector types allowed. For all other sector types, the device ***shall*** set the ILI bit in the Request Sense Standard Data and return a "ILLEGAL MODE FOR THIS TRACK" error if any read to them using this command is attempted.

Table 51 : READ (10) : Supported Sense Key, ASC and ASCQ.

Sense Key	ASC	ASCQ	Description of Error
01	17	07	RECOVERED DATA WITHOUT ECC- RECOMMENDED REASSIGNEMENT
02	3A	01	MEDIUM NOT PRESENT, TRAY CLOSED
02	3A	02	MEDIUM NOT PRESENT, TRAY OPEN
02	04	01	LOGICAL DRIVE NOT READY - IN PROGRESS OF BECOMING READY
02	04	04	NOT READY, WRITE IN PROGRESS
03	11	06	CIRC UNRECOVERED ERROR
05	21	00	LOGICAL BLOCK ADDRESS OUT OF RANGE
05	24	00	INVALID FIELD IN COMMAND PACKET
05	64	00	ILLEGAL MODE FOR THIS TRACK OR INCOMPATIBLE MEDIUM
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON, RESET OR BUS DEVICE RESET OCCURRED

3.2.13 Read (12).

3.2.13.1 Description.

The READ (12) command requests that the CDD3610 transfer data to the Host Computer. The most recent data value written in the addressed logical block ***shall*** be returned.

Table 52 : READ (12) Command.

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (A8h)							
1	Reserved							
2	MSB							
3	Logical Block Address							
4								
5								LSB
6	MSB							
7	Transfer Length							
8								
9								LSB
10	Reserved							
11	Reserved							

3.2.13.2 Parameters.

Byte 2-5:
The Logical Block Address specifies the address where reading is to begin.

Byte 6-9:
The Transfer Length field specifies the number of contiguous logical blocks of data that ***shall*** be transferred. A transfer length of zero indicates that no logical blocks ***shall*** be transferred. This condition ***shall not*** be considered an error. Any other value indicates the number of logical blocks that ***shall*** be transferred.

Although the CD-ROM is capable of returning a variety of data, this command ***shall*** only return the "User Data" portion of the sector. This field is **always** 2048 bytes in length for Mode 1 and Mode 2 Form 1 sectors, which are the only sector types allowed. For all other sector types, the device ***shall*** set the ILI bit in the Request Sense Standard Data and return a "ILLEGAL MODE FOR THIS TRACK" error if any read to them using this command is attempted.

Table 53 : READ (12) : Supported Sense Key, ASC and ASCQ .

Sense Key	ASC	ASCQ	Description of Error
01	17	07	RECOVERED DATA WITHOUT ECC- RECOMMENDED REASSIGNEMENT
02	3A	01	MEDIUM NOT PRESENT, TRAY CLOSED
02	3A	02	MEDIUM NOT PRESENT, TRAY OPEN
02	04	01	LOGICAL DRIVE NOT READY - IN PROGRESS OF BECOMING READY
02	04	04	NOT READY, WRITE IN PROGRESS
03	11	06	CIRC UNRECOVERED ERROR
05	21	00	LOGICAL BLOCK ADDRESS OUT OF RANGE

05	24	00	INVALID FIELD IN COMMAND PACKET
05	64	00	ILLEGAL MODE FOR THIS TRACK OR INCOMPATIBLE MEDIUM
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON, RESET OR BUS DEVICE RESET OCCURRED

3.2.14 Read CD-ROM Capacity.

Table 54 : READ CD-ROM CAPACITY Command.

Bit Byte	7	6	5	4	3	2	1	0
0	Operation code (25h)							
1	Reserved							
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	Reserved							
8	Reserved							
9	Reserved							
10	Reserved							
11	Reserved							

3.2.14.1 Description.

The READ CD-ROM CAPACITY command provides a means for the Host Computer to request information regarding the capacity of the Disc. When the last track is an audio track, a possibly inexact value (but one with a known error boundary) based on CD-ROM table of contents data can be returned. This error boundary occurs, and could cause the last block to be +/- 75 sectors from the actual end of the track. This error is a tolerance in the addressing of Audio data built into the Media specifications for CD-ROM . This implementation allows a quicker response.

3.2.14.2 Response data.

Eight bytes of READ CD-ROM CAPACITY data ***shall*** be returned to the Host Computer. This shall return information as a CD-ROM device will do. This means that it limits returned data up to information within closed sessions.
If there is no closed session available, the returned capacity will be 0x00.

Table 55 : READ CAPACITY DATA.

Bit Byte	7	6	5	4	3	2	1	0
0	MSB			Logical Block Address				
1								
2								
3								LSB
4	MSB			Block Length in Bytes (Length reported ***shall*** be 800h)				
5								
6								
7								LSB

Byte 0-3:
The Logical Block Address contains the last valid logical block address of the unit for seek operations.
Byte 4-7:
The block length shall be reported as 2048.

Table 56: Read Capacity : Supported Sense Key, ASC and ASCQ.

Sense Key	ASC	ASCQ	Description of Error
02	04	01	LOGICAL DRIVE NOT READY - IN PROGRESS OF BECOMING READY
02	04	04	NOT READY - WRITE IN PROGRESS
02	3A	01	MEDIUM NOT PRESENT - TRAY CLOSED
02	3A	02	MEDIUM NOT PRESENT - TRAY OPEN
05	10	04	
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON, RESET OR BUS DEVICE RESET OCCURRED

3.2.15 Read CD.

3.2.15.1 Description.

The READ CD command 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 57 : READ CD Command.

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

3.2.15.2 Parameters.

Byte 1:

Bit 2-4:
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.

Bit 0:
The REL ADR bit ***shall*** be set to zero.

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 58 : 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 device ***shall*** 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 ***shall*** be allowed. An attempt to read any other format ***shall*** result in the reporting of an error.
010b	Mode 1 (Mandatory)	Only Yellow Book sectors which have a "user" data field of 2048 bytes ***shall*** be allowed. An attempt to read any other format ***shall*** result in the reporting of an error.
011b	Mode 2 (Mandatory)	Only Yellow Book sectors which have a "user" data field of 2336 bytes ***shall*** be allowed. An attempt to read any other format ***shall*** 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 ***shall*** be allowed. An attempt to read any other format ***shall*** 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 ***shall*** be allowed. An attempt to read any other format ***shall*** 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

Byte 2-5:
The Logical Block Address specifies the address where reading is to begin.

Byte 7-8:
The Transfer Length field specifies the number of contiguous logical blocks of data that ***shall*** be transferred. A transfer length of zero indicates that no logical blocks ***shall*** be transferred. This condition ***shall not*** be considered an error. Any other value indicates the number of logical blocks that ***shall*** be transferred.

Byte 9:

Bit 7:
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.

Bit 5-6:
The Header(s) Code is an encoded field that indicates the Header/Sub-header information to be placed in the data stream.

Table 59 : READ CD, Header*(s) Code Field Definition.*

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

Bit 4:
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 0, user data ***shall*** not be returned to the initiator. The setting of the Mode Select Block Size does not apply to this command. When set to 1, the whole user data will be returned to the host. If the current track is an Audio Track then the Audio Data will be returned, else the normal CD-ROM data will be returned. The possible data lengths are 2048, 2336, 2328 and 2352.

Bit 3:
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.

Bit 1-2 :
The Error Flag(s) shall be set to 00b because the CDD3610 does not support the C2 pointers (as reported in the Mode Sense Capabilities page).

Byte 10:

Bit 0-2:
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 60 : READ CD, Sub-channel Data Selection Field Definition.

Sub-channel Data Selection	Definition	Description
000b	No Sub-channel	
001b	RAW	Raw Sub-channel data will be transferred
010b - 111b	Reserved	

The CDD3610 shall support raw Sub-channel Data Selections. The inclusion of the sub-channel data will only be valid for Audio sectors.

The general data format of channel Q is[18] :
CONTROL : The Control Field indicates the attributes of the track. The possible control field values are defined in
Bit 0-3:
The Control Field indicates the attributes of the track. The possible control field values are defined in Table 77 : Sub-channel Q Control Bits.

ADR : The Address Field contains 4 flag bits to define the kind of information encoded in the Q sub-channel. See also Table 76: ADR Sub-channel Q Field.

DATA-Q : 72 bits data.
CRC : A 16 bit CRC on CONTROL, ADR and DATA-Q.

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

[18] See also Table 102 : R-W Raw on page 152 of the SFF-8020i ATAPI-specification (V2.6).

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 61 : Number of Bytes Returned Based on Data Selection Field

Data to be transferred	Flag Bits	CD-DA	Mode 1	Mode 2 non XA	Mode 2 Form 1	Mode 2 Form 2
User Data	10h	2352	2048	2336	2048	2328
User Data + EDC/ECC	18h	(10h)	2336	(10h)	2336	(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)	2344	(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)	(18h)	2344	(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)	(38h)	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)	2344	(30h)	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)	(10h)	(10h)	Illegal	Illegal
Sync & Sub Header & User Data + EDC/ECC	D8h	(10h)	(10h)	(10h)	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)

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 61 : Number of Bytes Returned Based on Data Selection Field.," on page 63 specifies how the drive responds to many of the requests possible. Requests for transfers not specified by this table (other then all flags cleared) ***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.

The CD-DA audio data includes 16 bits of information for each channel. See Table 62 : CD-DA (Digital Audio) Data Block Format.

Table 62 : 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 while streaming the drive must stop there will be no error, only some time delay for rotational latency.

Table 63 : Read CD : Supported Sense Key, ASC and ASCQ.

Sense Key	ASC	ASCQ	Description of Error
02	3A	01	MEDIUM NOT PRESENT, TRAY CLOSED
02	3A	02	MEDIUM NOT PRESENT, TRAY OPEN
02	04	01	LOGICAL DRIVE NOT READY - IN PROGRESS OF BECOMING READY
02	04	04	NOT READY - WRITE IN PROGRESS
03	02	00	NO SEEK COMPLETE
05	21	00	LOGICAL BLOCK ADDRESS OUT OF RANGE
05	24	00	INVALID FIELD IN COMMAND PACKET
05	64	00	ILLEGAL MODE FOR THIS TRACK OR INCOMPATIBLE MEDIUM
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON, RESET OR BUS DEVICE RESET OCCURRED

3.2.16 Read CD MSF.

Table 64 : READ CD MSF Command.

Bit Byte	7	6	5	4	3	2	1	0
0	Operation code (B9h)							
1	Reserved			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	EDC & ECC	Error flag(s)		Reserved
10	Reserved					Sub-Channel Data Selection Bits		
11	Reserved							

3.2.16.1 Description.

The READ CD MSF command 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.

3.2.16.2 Parameters.

Byte 3-8:
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 "3.2.15 Read CD. " for a description of Expected Sector Type, Flag Bits and Sub-channel Data Selection Bits.

Table 65 : Read CD MSF : Supported Sense Key, ASC and ASCQ.

Sense Key	ASC	ASCQ	Description of Error
02	04	01	LOGICAL DRIVE NOT READY - IN PROGRESS OF BECOMING READY
02	04	04	NOT READY -WRITE IN PROGRESS
02	3A	01	MEDIUM NOT PRESENT, TRAY CLOSED
02	3A	02	MEDIUM NOT PRESENT, TRAY OPEN
03	02	00	NO SEEK COMPLETE
05	21	00	LOGICAL BLOCK ADDRESS OUT OF RANGE
05	24	00	INVALID FIELD IN COMMAND PACKET
05	64	00	ILLEGAL MODE FOR THIS TRACK OR INCOMPATIBLE MEDIUM
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON, RESET OR BUS DEVICE RESET OCCURRED

3.2.17 Read Header.

Table 66 : READ HEADER Command.

Bit Byte	7	6	5	4	3	2	1	0
0	Operation code (44h)							
1	Reserved						MSF	Reserved
2	MSB	Logical Block Address						
3								
4								
5								LSB
6	Reserved							
7	MSB	Allocation Length						
8								LSB
9	Reserved							
10	Reserved							
11	Reserved							

3.2.17.1 Description.

The READ HEADER command requests that the CDD3610 return the CD-ROM Data Block Address Header of the requested logical block.
See the READ (10) command for exception handling with respect to data types.

3.2.17.2 Parameters.

Byte 1:

Bit 1:
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.

Byte 2-5:
The Logical Block Address field specifies the logical block at which the read header operation ***shall*** begin.

Byte 7-8:
The Allocation Length field specifies the number of bytes allocated by the host to accept the read header data . This is the number of bytes that will be transferred to the host (unless allocation length is greater then the amount of available read header data, in which case only the available data will be transferred). An allocation length of zero indicates that no data ***shall*** be transferred. This condition ***shall not*** be considered as an error.

3.2.17.3 Response data.

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

Table 67 : 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	Absolute CD-ROM Address						
5								
6								
7								LSB

Byte 0:
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 68 : CD-ROM Data Mode Codes. "

Byte 4..7
The Absolute CD-ROM 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.

Table 68 : CD-ROM Data Mode Codes.

CD-ROM Data Mode	User Data Field Contents	Auxiliary Field Contents
00h	All bytes zero	All bytes zero
01h	User data	L-EC symbols
02h	User data	User data
03h - FFh	Reserved	Reserved

Byte 4-7:
These bytes contain the requested Logical Block Address of the header.

Table 69: 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							

3.2.17.4 Response data parameters.

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 68 : CD-ROM Data Mode Codes."

Table 70 : Read HEADER : Supported Sense Key, ASC and ASCQ.

Sense Key	ASC	ASCQ	Description of Error
02	04	01	LOGICAL DRIVE NOT READY - IN PROGRESS OF BECOMING READY
02	04	04	NOT READY - WRITE IN PROGRESS
02	3A	01	MEDIUM NOT PRESENT, TRAY CLOSED
02	3A	02	MEDIUM NOT PRESENT, TRAY OPEN
03	02	00	NO SEEK COMPLETE
05	21	00	LOGICAL BLOCK ADDRESS OUT OF RANGE
05	24	00	INVALID FIELD IN COMMAND PACKET
05	64	00	ILLEGAL MODE FOR THIS TRACK OR INCOMPATIBLE MEDIUM
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON, RESET OR BUS DEVICE RESET OCCURRED

3.2.18 Read Sub-Channel.

Table 71 : READ SUB-CHANNEL Command.

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

3.2.18.1 Description.

The READ SUB-CHANNEL command requests that the CDD3610 returns the requested sub-channel data plus the state of play operations.

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 CDD3610 may access the media to read the sub-channel data. The CDD3610 is responsible for ensuring that the data returned are current and consistent.

3.2.18.2 Parameters.

Byte 1:

Bit 1:
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.

Byte 2:

Bit 6:
The subQ bit set to one requests that the CDD3610 return the Q sub-channel data. The subQ bit set to zero requests that no sub-channel data be returned. This ***shall*** not be considered an error. When the subQ bit is Zero, only the Sub-Channel data header is returned.

Byte 3:
The sub-channel data format field specifies the returned sub channel data. If this field is 01h, 02h or 03h, the requested subQ data item is returned. Table 72 lists the data that will be returned.

Table 72 : Sub-channel Data Format Codes.

Format Code	Returned data	Support Requirement
00h	Reserved	Reserved
01h	CD-ROM 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

Byte 6:
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).

Byte 7-8:
The Allocation Length field specifies the number of bytes allocated by the host to accept the read sub-channel data. This is the number of bytes that will be transferred to the host (unless allocation length is greater then the amount of available read sub-channel data, in which case only the available data will be transferred). An allocation length of zero indicates that no data ***shall*** be transferred. This condition ***shall not*** be considered as an error.

3.2.18.3 Response Data.

The response data consist of a four byte header followed by a sub-channel data block.

Table 73 : 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								

Byte 1:
The Audio Status field indicates the status of play operations. The audio status values are defined in "Table 74 : Audio Status Codes.. 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 74 : 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

Byte 2-3:
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.

3.2.18.4 CD-ROM Current Position Data Format.

Table 75 : CD-ROM 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							
3								LSB
CD-ROM Current Position Data Block								
4	Sub Channel Data Format Code (01h)							
5	ADR				Control			
6	Track Number							
7	Index Number							
8	MSB Absolute CD-ROM Address							
9								
10								
11								LSB
12	MSB Track Relative CD-ROM Address							
13								
14								
15								LSB
16-47	Identification Data							

Byte 5:

Bit 4-7:
The ADR (ADDRESS) field gives the type of information encoded in the Q sub-channel of this block, as shown in Table 76.

Table 76: 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

Bit 0-3:
The Control Field indicates the attributes of the track. The possible control field values are defined in Table 77 : Sub-channel Q Control Bits.

Table 77 : Sub-channel Q Control Bits.

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

Byte 6:
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 CDD3610 returns ISRC data for this track.

Byte 7:
The Index Number specifies the index number in the current track.

Byte 8-11:
The Absolute CD-ROM 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.

Byte 12-15:
The Track Relative CD-ROM 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.

3.2.18.5 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[19]) and the European Article Number Council[20]. A value in this field of all ASCII zeros indicates that the media catalog number is not supplied.

Media catalogue number data returned by Read Sub-Channel 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.)

19. The Uniform Product Code Council is located at 8163 Old Yankee Road, Suite J, Dayton, Ohio 45459.

20. The European Article Number Council is located at Rue des Colonies, 54-BTE8, 1000 Brussels, Belgium.

The CD-ROM 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 78 : 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	MSB Sub-channel Data Length							
3								LSB
Media Catalogue Number Data Block								
4	Sub Channel Data Format Code (02h)							
5	Reserved							
6	Reserved							
7	Reserved							
8	MCVal	Reserved						
9	N1 (Most significant)							
10	N2							
11	N3							
12	N4							
13	N5							
14	N6							
15	N7							
16	N8							
17	N9							
18	N10							
19	N11							
20	N12							
21	N13							
22	Zero							
23	AFrame (Binary)							

Byte 10-22:
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).

Byte 23:
Aframe is the absolute framenumber.

3.2.18.6 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).
Note : ISRC fields can only be written with audio tracks.

Table 79 : 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								
Track ISRC Data Block								
4	Sub Channel Data Format Code (03h)							
5	ADR (03)				Control			
6	Reserved							
7	Reserved							
8	TCVal	Reserved						
9	Track International Standard Recording Code (ISRC)							
23								

Byte 8:

Bit 7:
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.

Byte 9-22:
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 80 : ISRC Format of Data Returned to Host.

Bit Byte	7	6	5	4	3	2	1	0
8	TCVal	Reserved						
9	I1 (Country Code)							
10	I2							
11	I3 (Owner Code)							
12	I4							
13	I5							
14	I6 (Year of Recording)							
15	I7							
16	I8 (Serial Number)							
17	I9							
18	I10							
19	I11							
20	I12							
21	Zero							
22	AFrame							
23	Reserved							

Table 81 : Read Sub-channel : Supported Sense Key, ASC and ASCQ.

Sense Key	ASC	ASCQ	Description of Error
02	3A	01	MEDIUM NOT PRESENT, TRAY CLOSED
02	3A	02	MEDIUM NOT PRESENT, TRAY OPEN
02	04	01	LOGICAL DRIVE NOT READY - IN PROGRESS OF BECOMING READY
02	04	04	NOT READY - WRITE IN PROGRESS
03	02	00	NO SEEK COMPLETE
05	00	11	PLAY OPERATION IN PROGRESS
05	00	12	PLAY OPERATION PAUSED
05	00	13	PLAY OPERATION SUCCESSFULLY COMPLETED
05	00	14	PLAY OPERATION STOPPED DUE TO ERROR
05	00	15	NO CURRENT AUDIO STATUS TO RETURN
05	21	00	LOGICAL BLOCK ADDRESS OUT OF RANGE
05	24	00	INVALID FIELD IN COMMAND PACKET
05	64	00	ILLEGAL MODE FOR THIS TRACK OR INCOMPATIBLE MEDIUM
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON, RESET OR BUS DEVICE RESET OCCURRED

3.2.18.7 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 CDD3610 ***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 “FFFFFFFF” on Read CD will work just like Read Sub-channel.(See also p.64 Read CD.)

3.2.19 Read TOC.

The READ TOC/Command requests that the target transfer data from the Table of Contents.

Table 82 : READ TOC Command Descriptor Block

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

3.2.19.1 Parameters.

Byte 1:

Bit 1:
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.

Byte 2:

Bit 0-3:
The Format field is defined in Table 83.

Table 83 : Format Field.

Format	Source	Description	Track/ Session Usage
0000b	TOC	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 AAh only the lead-out area of the last complete session. See Table 84 : READ TOC response data (Format = 0000b).	Track
0001b	Session Info	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 85 : READ TOC response data (Format = 0001b).	Reserved
0010b	Full TOC	This format returns all Q sub-code data in the lead-in (TOC) area starting from a session number as specified in the Track/Session Number field. In this mode, 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 86: READ TOC response data (Format = 0010b).	Session
All Other Format Codes		Reserved.	Reserved

Implementor's Note : To be also compatible with SFF-8020i, the format field in byte 9 from SFF-8020i are "OR"-ed with this format field.

Byte 6:
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 CDB.

Byte 7-8:
The Allocation Length gives the number of bytes that will be transferred to the host

When a ReadTOC 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, 0001b, or 0010b are specified, this command shall be rejected with an INVALID FIELD in COMMAND PACKET.

***Implementor's Note** : There exist discs such as CDI-discs where some (1 or more) data tracks are not contained in the TOC and followed by 0 or more audio tracks. The CDD3610 will not list those data tracks in the READ TOC command. The tracks not mentioned in the TOC will be seen as a single track by the READ DISC INFO command, having the track number preceding the first track number mentioned in the TOC or in the case that no audio tracks exist on the disc, the associated track number will be one. The host can issue a READ TRACK INFO command for this track. This single track will reflect the length going from MSF 00:02:00 up to the first track from the TOC or the start of the lead out when the disc contains no audio tracks.*

3.2.19.2 TOC Response Data Format 0000b (TOC).

The response data consist of four header bytes and zero or more track descriptors. The response data is dependent upon the format specified in the format field of the CDB. The response data returned for Format 0000b is specified in Table 84.

Table 84: READ TOC response data (Format = 0000b).

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

Byte 0-1:
The TOC data length specifies the length in bytes of the following TOC data that is available to be transferred during the DATA IN phase. 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.

Byte 2:
The First Track Number field indicates the first track number in the first complete session Table of Contents.

Byte 3:
The Last Track Number field indicates the last track number in the last complete session Table of Contents before the lead-out.

Track descriptor :
Byte 1:

Bit 4-7:
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 76: ADR Sub-channel Q Field.

Bit 0-3:
The Control Field indicates the attributes of the track. The possible control field values are defined in
Bit 0-3:
The Control Field indicates the attributes of the track. The possible control field values are defined in
Table 77 : Sub-channel Q Control Bits.
Table 77: Sub-channel Q Control Bits.

Byte 2:
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.
Byte 4-7:
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 addres .

3.2.19.3 TOC Response Data Format 0001b (Session Info).

The response data returned for Format 0001b is specified in Table 85: READ TOC response data (Format = 0001b).

Table 85 : READ TOC response data (Format = 001b).

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

Byte 0-1:
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.

Byte 2:
The First Complete Session Number is set to one.

Byte 3:
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 device does not support multi-session discs.

Track descriptor:

Byte 1:

Bit 4-7:
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 76 : ADR Sub-channel Q Field.

Bit 0-3:
The Control Field indicates the attributes of the track. The possible control field values are defined in

Bit 0-3:
The Control Field indicates the attributes of the track. The possible control field values are defined in **Table 77 : Sub-channel Q Control** Bits.
Table 77: Sub-channel Q Control Bits.

Byte 2:
First Track Number In Last Complete Session returns the first track number in the last complete session.
Byte 4-7:
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.

3.2.19.4 TOC Response Data Format 0010b (Full TOC).

The response data returned for Format 0010b is specified in Table 86: READ TOC response data (Format = 0010b).

Table 86 : READ TOC response data (Format = 0010b).

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

Multiple entries are recorded in the TOC area.
For Format field of 0010b, the CDD3610 should return TOC data for Q sub-channel modes 1 and 5 (except mode 5, point 1 through 40) in the lead-in area.

Byte 0-1:
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.

Byte 2:
The First Complete Session Number is set to one.

Byte 3:
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 device does not support multi-session discs.

Toc Track Descriptor:

Byte 1:

Bit 4-7:
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 76: ADR Sub-channel Q Field.

Bit 0-3:
The Control Field indicates the attributes of the track. The possible control field values are defined in
Bit 0-3:
The Control Field indicates the attributes of the track. The possible control field values are defined in
Table 77 : Sub-channel Q Control Bits.
Table 77 : Sub-channel Q Control Bits.
Entries in bytes 2 through 10 of the descriptors shall be converted to hex by the CDD3610 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 87 : Lead-in Area (TOC), Q sub-channel Formats.

Table 87 : Lead-in Area (TOC), Q sub-channel Formats.

S0, S1	CTRL	ADR	TNO (hex)	POINT (hex)	MIN (hex)	SEC (hex)	FRAME (hex)	ZERO (hex)	PMIN (hex)	PSEC (hex)	PFRAME (hex)	CRC $x^{16}+x^{12}+x^5+1$
	4 or 6	1	00	01-63	ATIME (Absolute time)			00	Start position of track			
	4 or 6	1	00	A0	ATIME (Absolute time)			00	First Track Number	Disc Type	00	
	4 or 6	1	00	A1	ATIME (Absolute time)			00	First Track Number	00	00	
	4 or 6	1	00	A2	ATIME (Absolute time)			00	Start position of lead-out			
	4 or 6	5	00	B0	Start time of next possible program in the Recordable Area of the disc			# of pointers in Mode 5	Maximum start time of outer-most lead-out area in the Recordable Area of the disc			
	4 or 6	5	00	B1	00	00	00	00	# of skip interval Pointers (N<=40)	# of skip Track Pointers (N<=21)	00	
	4 or 6	5	00	B2-B4	Skip #	Skip #	Skip #	Skip #	Skip #	Skip #	Skip #	
	4 or 6	5	00	01-40	Ending time for the interval that should be skipped			Resrv'd	Start time for interval that should be skipped on playback			
	4 or 6	5	00	C0	optimum recording power	Reserved	Resrv'd	Resrv'd	Start time of the first lead-in Area of the disc			
	4 or 6	5	00	C1	Copy of information from A1 point in ATIP.							

The POINT Field (Table 88: POINT Field) defines various types of information within the TOC lead-in area.

Table 88 : POINT Field.

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

The Disc Type Byte (Table 89: Disc Type Byte Format) contains the definition of the type of disc inserted.

Table 89 : Disc Type Byte Format.

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

The Control Field in the Q sub-channel is defined in
Bit 0-3:
The Control Field indicates the attributes of the track. The possible control field values are defined in **Table 77 : Sub-channel Q Contro**Bits.
Table 77 : Sub-channel Q Control Bits.

Table 90 : READ TOC : Supported Sense Key, ASC and ASCQ.

Sense Key	ASC (hex)	ASCQ (hex)	Description of Error
02	04	01	Logical unit not ready-in process of becoming ready
02	04	04	In process of becoming ready - writing
02	3A	01	Medium not present, tray closed
02	3A	02	Medium not present, tray open
02	57	00	Unable to recover Table of Contents
05	24	00	Invalid Field in Command Packet
06	28	00	Not Ready to Ready Transition
06	29	00	Power on, Reset or Bus Device Reset Occurred

3.2.20 Request Sense.

Table 91 : Request Sense Command.

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

3.2.20.1 Description.

The REQUEST SENSE command requests that the CDD3610 transfer sense data to the Host Computer regarding completion conditions of the host's previous command or deferred errors. Sense data is stored on completion of each command and preserved until receipt of the next command from the host. The sense data is cleared after completion of a REQUEST SENSE command.
The sense data:

1. ***shall*** be available if an error condition (CHECK CONDITION) had previously been reported to the Host Computer;
2. ***shall*** be available if other information (e.g. medium position) is available in any field.

If the CDD3610 has no other sense data available to return, it ***shall*** return a sense key of NO SENSE and an additional sense code of NO ADDITIONAL SENSE INFORMATION.

The sense data ***shall*** be preserved by the CDD3610 until retrieved by a REQUEST SENSE command or until the receipt of any other I/O Command.

The CDD3610 ***shall*** return CHECK CONDITION status for a REQUEST SENSE command only to report exception conditions specific to the command itself. For example:

1. A CDD3610 malfunction prevents return of the sense data.

If a recovered error occurs during the execution of the REQUEST SENSE command, the CDD3610 ***shall*** return the sense data with GOOD status. If an CDD3610 returns CHECK CONDITION status for a REQUEST SENSE command, the sense data may be invalid.

3.2.20.2 Parameters.

A CDD3610 ***shall*** be capable of returning at least 18 bytes of data in response to a REQUEST SENSE command. If the allocation length is 18 or greater, and a CDD3610 returns less than 18 bytes of data, the Host Computer should assume that the bytes not transferred would have been zeros had the CDD3610 returned those bytes. Host Computers can determine how much sense data has been returned by examining the allocation length parameter in the Command Packet and the additional sense length in the sense data. A CDD3610 ***shall*** not adjust the additional sense length to reflect truncation if the allocation length is less than the sense data available.

3.2.20.3 Request Sense Standard Data Response Data.

The sense data format for error codes 70h (current errors) are defined in "Table 92: Request Sense Standard Data.". Error code values of 72h to 7Eh are reserved. Error code 7Fh is for a vendor-specific sense data format. A CDD3610 ***shall*** implement error code 70h; implementation of error code 71h is optional. Error code values of 00h to 6Fh are not defined by this Specification and their use is not recommended.

Table 92: Request Sense Standard Data.

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

Byte 0:

Bit 7:
A Valid bit of zero indicates that the information field is not as defined in this Specification. A Valid bit of one indicates the information field contains valid information as defined in this Specification. The CDD3610 ***shall*** implement the Valid bit.

Byte 1:

The Segment Number field is Reserved.

Byte 2:
Bit 5:
An Incorrect Length Indicator (ILI) bit of one indicates that the requested allocation length did not match the logical block length of the data on the medium.

Bit 0-3:
The Sense Key, Additional Sense Code and Additional Sense Code Qualifier provide a hierarchy of information. The intention of the hierarchy is to provide a top-down approach for a Host Computer to determine information relating to the error and exception conditions. The Sense Key provides generic categories in which error and exception conditions can be reported. Host Computers would typically use sense keys for high-level error recovery procedures. Additional Sense Codes provide further detail describing the sense key. Additional Sense Code Qualifiers add further detail to the additional sense code. The Additional Sense Code and Additional Sense Code Qualifier can be used by Host Computers where sophisticated error recovery procedures require detailed information describing the error and exception conditions.

The Sense Key field is mandatory and indicates generic information describing an error or exception condition. The sense keys are defined in section Table 93 : Sense Key Descriptions., on page 92.

Byte 3:
The contents of the Information field is command-specific and is defined within the appropriate section for the command of interest. The CDD3610 ***shall*** implement the Information field. Unless specified otherwise, this field contains the unsigned logical block address associated with the sense key.

Byte 7:
The Additional Sense Length field indicates the number of additional sense bytes to follow. If the allocation length of the Command Packet is too small to transfer all of the additional sense bytes, the Additional Sense Length is not adjusted to reflect the truncation.

Byte 8:
The Command-specific Information field contains information that depends on the command that was executed. Further meaning for this field is defined within the command description.

Byte 12:
The Additional Sense Code (ASC) field indicates further information related to the error or exception condition reported in the Sense Key field. The CDD3610 ***shall*** support the Additional Sense Code field. Support of the additional sense codes not explicitly required by this Specification is optional. A list of additional sense codes is in " Table 94 : Supported ASC and ASCQ." on page 93. If the CDD3610 does not have further information related to the error or exception condition, the Additional Sense Code is set to NO ADDITIONAL SENSE INFORMATION.

Byte 13:
The Additional Sense Code Qualifier (ASCQ) indicates detailed information related to the Additional Sense Code. The ASCQ is optional. If the error or exception condition is reportable by the CDD3610, the value returned ***shall*** be as specified in "Table 94 : Supported ASC and ASCQ." on page 93. If the CDD3610 does not have detailed information related to the error or exception condition, the ASCQ is set to zero.

Byte 18:
The Additional Sense Bytes field may contain command specific data, peripheral CDD3610 specific data, or vendor-specific data that further defines the nature of the CHECK CONDITION status.

3.2.20.4 Sense-key and Sense Code Definitions.

Table 93 : Sense Key Descriptions.

Sense key	Description
0h	NO SENSE. Indicates that there is no specific sense key information to be reported. This would be the case for a successful command.
1h	RECOVERED ERROR. Indicates that the last command completed successfully with some recovery action performed by the CDD3610. Details may be determinable by examining the additional sense bytes and the information field. When multiple recovered errors occur during one command, the choice of which error to report (first, last, most severe, etc.) is device specific.
2h	NOT READY. Indicates that the CDD3610 cannot be accessed. Operator intervention may be required to correct this condition.
3h	MEDIUM ERROR. Indicates that the command terminated with a non-recovered error condition that was probably caused by a flaw in the medium or an error in the recorded data. This sense key may also be returned if the CDD3610 is unable to distinguish between a flaw in the medium and a specific hardware failure (sense key 4h).
4h	HARDWARE ERROR. Indicates that the CDD3610 detected a non-recoverable hardware failure (for example, controller failure, device failure, parity error, etc.) while performing the command or during a self test.
5h	ILLEGAL REQUEST. Indicates that there was an illegal parameter in the Command Packet or in the additional parameters supplied as data for some commands. If the CDD3610 detects an invalid parameter in the Command Packet, then it ***shall*** terminate the command without altering the medium. If the CDD3610 detects an invalid parameter in the additional parameters supplied as data, then the CDD3610 may have already altered the medium.
6h	UNIT ATTENTION. Indicates that the removable medium may have been changed or the CDD3610 has been reset.
7h	DATA PROTECT. Indicates that a command that reads the medium was attempted on a block that is protected from this operation. The read operation is not performed.
8h	Reserved
9h - Ah	Reserved
Bh	ABORTED COMMAND. Indicates that the CDD3610 has aborted the command. The Host may be able to recover by trying the command again. This error is reported for conditions such as an overrun etc.
Eh	MISCOMPARE. Indicates that the source data did not match the data read from the medium.
Fh	Reserved

3.2.20.5 Using the REQUEST SENSE Command.

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

Table 94 : Supported ASC and ASCQ.

ASC	ASC Q	DESCRIPTION
00	00	NO ADDITIONAL SENSE INFORMATION
00	11	PLAY OPERATION IN PROGRESS
00	12	PLAY OPERATION PAUSED
00	13	PLAY OPERATION SUCCESSFULLY COMPLETED
00	14	PLAY OPERATION STOPPED DUE TO ERROR
00	15	NO CURRENT AUDIO STATUS TO RETURN
01	00	MECHANICAL POSITIONING OR CHANGER ERROR
02	00	NO SEEK COMPLETE
04	00	LOGICAL UNIT NOT READY, CAUSE NOT REPORTABLE
04	01	LOGICAL DRIVE NOT READY , IN PROGRESS OF BECOMING READY
04	02	LOGICAL UNIT NOT READY, INITIALIZING COMMAND REQUIRED
04	03	LOGICAL DRIVE NOT READY - MANUAL INTERVENTION REQUIRED
04	04	LOGICAL UNIT NOT READY, FORMAT IN PROGRESS
05	00	LOGICAL UNIT DOES NOT RESPOND TO SELECTION
05	01	MEDIA LOAD - EJECT FAILED
06	00	NO REFERENCE POSITION FOUND
08	00	LOGICAL UNIT COMMUNICATION FAILURE
08	01	LOGICAL UNIT COMMUNICATION TIME-OUT
08	02	LOGICAL UNIT COMMUNICATION PARITY ERROR
09	00	TRACK FOLLOWING ERROR
09	01	TRACKING SERVO FAILURE
09	02	FOCUS SERVO FAILURE
09	03	SPINDLE SERVO FAILURE
11	00	UNRECOVERED READ ERROR
11	06	CIRC UNRECOVERED ERROR
15	00	RANDOM POSITIONING ERROR
15	01	MECHANICAL POSITIONING OR CHANGER ERROR
15	02	POSITIONING ERROR DETECTED BY READ OF MEDIUM
17	00	RECOVERED DATA WITH NO ERROR CORRECTION APPLIED
17	01	RECOVERED DATA WITH RETRIES
17	02	RECOVERED DATA WITH POSITIVE HEAD OFFSET
17	03	RECOVERED DATA WITH NEGATIVE HEAD OFFSET
17	04	RECOVERED DATA WITH RETRIES AND/OR CIRC APPLIED
17	05	RECOVERED DATA USING PREVIOUS SECTOR ID
18	00	RECOVERED DATA WITH ERROR CORRECTION APPLIED
18	01	RECOVERED DATA WITH ERROR CORRECTION & RETRIES APPLIED
18	02	RECOVERED DATA - THE DATA WAS AUTO-REALLOCATED
18	03	RECOVERED DATA WITH CIRC
18	04	RECOVERED DATA WITH L-EC
1A	00	PARAMETER LIST LENGTH ERROR
20	00	INVALID COMMAND OPERATION CODE
21	00	LOGICAL BLOCK ADDRESS OUT OF RANGE
24	00	INVALID FIELD IN COMMAND PACKET
25	00	LOGICAL UNIT NOT SUPPORTED
26	00	INVALID FIELD IN PARAMETER LIST
26	01	PARAMETER NOT SUPPORTED
26	02	PARAMETER VALUE INVALID
28	00	NOT READY TO READY TRANSITION, MEDIUM MAY HAVE CHANGED
29	00	POWER ON, RESET OR BUS DEVICE RESET OCCURRED
2A	00	PARAMETERS CHANGED
2A	01	MODE PARAMETERS CHANGED

30	00	INCOMPATIBLE MEDIUM INSTALLED
30	01	CANNOT READ MEDIUM - UNKNOWN FORMAT
30	02	CANNOT READ MEDIUM - INCOMPATIBLE FORMAT
39	00	SAVING PARAMETERS NOT SUPPORTED
3A	01	MEDIUM NOT PRESENT, TRAY CLOSED
3A	02	MEDIUM NOT PRESENT, TRAY OPEN
3E	00	LOGICAL UNIT HAS NOT SELF-CONFIGURED YET
3F	00	CDD3610 OPERATING CONDITIONS HAVE CHANGED
3F	01	MICROCODE HAS BEEN CHANGED
40	NN	DIAGNOSTIC FAILURE ON COMPONENT NN (80H-FFH)
44	00	INTERNAL CDD3610 FAILURE
4C	00	LOGICAL UNIT FAILED SELF-CONFIGURATION
4E	00	OVERLAPPED COMMANDS ATTEMPTED
53	00	MEDIA LOAD OR EJECT FAILED
53	02	MEDIUM REMOVAL PREVENTED
57	00	UNABLE TO RECOVER TABLE OF CONTENTS
5A	00	OPERATOR REQUEST OR STATE CHANGE INPUT (UNSPECIFIED)
5A	01	OPERATOR MEDIUM REMOVAL REQUEST
63	00	END OF USER AREA ENCOUNTERED ON THIS TRACK
64	00	ILLEGAL MODE FOR THIS TRACK
B9	00	PLAY OPERATION ABORTED
BF	00	LOSS OF STREAMING
		Vendor-specific. ASC : 80h through FFh ASCQ : 80h through DDh
ALL CODES NOT SHOWN ARE RESERVED.		

Table 95 : Request Sense : Supported Sense Key, ASC and ASCQ.

Sense Key	ASC	ASCQ	Description of Error
05	24	00	INVALID FIELD IN COMMAND PACKET

3.2.21 Rezero Unit.

Table 96 : Rezero Unit Command.

Bit Byte	7	6	5	4	3	2	1	0
0	Operation code (01h)							
1	Reserved							
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	Reserved							
8	Reserved							
9	Reserved							
10	Reserved							
11	Reserved							

3.2.21.1 Description.

The REZERO UNIT command requests that the target set the logical unit to a specific state

If a disc is mounted, REZERO UNIT performs the same function as the START/STOP command (Loej=0, Start=1).
If no disc is mounted, a check condition is given. The sense codes are set to (MEDIUM NOT PRESENT, TRAY OUT / IN).

In addition if RESET, POWER UP or a SEND DIAGNOSTICS command resulted in a SELFTEST failure, the error will be cleared by this command.

3.2.22 Seek (10).

Table 97 : SEEK Command.

Bit Byte	7	6	5	4	3	2	1	0
0	Operation code (2Bh)							
1	Reserved							
2	MSB			Logical Block Address				
3								
4								
5								LSB
6	Reserved							
7	Reserved							
8	Reserved							
9	Reserved							
10	Reserved							
11	Reserved							

3.2.22.1 Description.

The SEEK command request that the CDD3610 seeks to the specified logical block address. All Logical Block Addresses are valid targets for a seek operation. The content of the Sector at the specified LBA ***shall not*** affect the seek operation nor cause an error to be generated.

The SEEK Command will always be executed as an immediate command. The command will return completion stations as soon as the seek operation has been started.

3.2.22.2 Parameters.

Byte 2-5:
The Logical Block Address specifies to which block the head will seek.

The range for valid seek addresses are from zero till the value returned by CD-ROM Capacity. For CD-R/RW Media the seek range is extended up to the outermost lead out address.

Note that either READ, WRITE, VERIFY, PLAY AUDIO,... commands perform an implied seek, so use of the SEEK command is not required for normal operation.

Table 98: Seek : Supported Sense Key, ASC and ASCQ.

Sense Key	ASC	ASCQ	Description of Error
02	3A	01	MEDIUM NOT PRESENT, TRAY CLOSED
02	3A	02	MEDIUM NOT PRESENT, TRAY OPEN

02	04	01	LOGICAL DRIVE NOT READY - IN PROGRESS OF BECOMING READY
02	04	04	NOT READY - WRITE IN PROGRESS
03	02	00	NO SEEK COMPLETE
05	21	00	LOGICAL BLOCK ADDRESS OUT OF RANGE
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON, RESET OR BUS DEVICE RESET OCCURRED

3.2.23 Set CD Speed.

Table 99 : SET CD-ROM SPEED Command.

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation code (BBh)							
1	Reserved							
2	MSB	Read Drive Speed in Kbytes/Second						
3								LSB
4	MSB	Write Drive Speed in Kbytes/Second						
5								LSB
6	Reserved							
7	Reserved							
8	Reserved							
9	Reserved							
10	Reserved							
11	Reserved							

3.2.23.1 Description.

The SET CD SPEED command provides a means for the Host to set the spindle speed to be used for reading and writing CD data.
Note that the Play commands will not use the speed set by this command.

3.2.23.2 Parameters.

The Drive Speed parameter contains the requested Data Rate the drive should use. The drive may choose to select the speed specified or any slower rate. A value of FFFFh will set the Drive Speed to the maximum supported. Requesting a speed faster than the drive supports will not generate an error. The actual maximum speed supported is returned in the Capabilities Mode Sense page (See p.40 : CD-ROM Capabilities and Mechanical Status Page.

Implementor's Note : The actual Read speed in the Capabilities Mode Sense page will not update until the next access to the media. It reports the actual current read speed.
If CD-RW media is in the drive, selecting a write speed = 1X will be rounded to 2X.
If a CD-R/RW media is in the drive, and does not have at least one closed session. Then selecting a read speed = 6x will be rounded down to 2x.

Table 100 : Supported speed settings.

Speed	Data Rate (hex)	Data Rate (dec)
X1	B0 Kbytes/second	176 Kbytes/second
X2	161 Kbytes/second	353 Kbytes/second
X6	423 Kbytes/second	1059 Kbytes/second

If the speed selected is less than 1x, then the drive ***shall*** reject the command, and not change the speed.

Table 101 : SET CD SPEED : Supported Sense Key, ASC and ASCQ.

Sense Key	ASC	ASCQ	Description of Error
02	04	04	NOT READY - WRITE IN PROGRESS
05	24	00	INVALID FIELD IN COMMAND PACKET
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON, RESET OR BUS DEVICE RESET OCCURRED

3.2.24 Stop Play / Scan.

The STOP PLAY/ SCAN CD-ROM Command stops playback of audio commands.

Table 102 : STOP PLAY / SCAN CD-ROM Command.

Bit Byte	7	6	5	4	3	2	1	0
0	Operation code (4Eh)							
1	Reserved							
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	Reserved							
8	Reserved							
9	Reserved							
10	Reserved							
11	Reserved							

Table 103 : STOP PLAY CD-ROM : Supported Sense Key, ASC and ASCQ.

Sense Key	ASC	ASCQ	Description of Error
02	04	01	LOGICAL DRIVE NOT READY - IN PROGRESS OF BECOMING READY
02	04	04	NOT READY - WRITE IN PROGRESS
02	3A	01	MEDIUM NOT PRESENT, TRAY CLOSED
02	3A	02	MEDIUM NOT PRESENT, TRAY OPEN
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON, RESET OR BUS DEVICE RESET OCCURRED

Issuing a Stop Play command while the drive is paused ***shall*** stop the play command.

3.2.25 Start/Stop Unit.

Table 104 : START/STOP UNIT Command.

Bit Byte	7	6	5	4	3	2	1	0
0	Operation code (1Bh)							
1	Reserved							Immed
2	Reserved							
3	Reserved							
4	Reserved						LoEj	Start
5	Reserved							
6	Reserved							
7	Reserved							
8	Reserved							
9	Reserved							
10	Reserved							
11	Reserved							

3.2.25.1 Description.

The START/STOP command request that the CDD3610 either start or stop the spindle motor, load or unload the tray.

3.2.25.2 Parameters.

Byte 4:

Bit 0:
A start bit of one requests the CDD3610 be made ready for use. A start bit of zero requests that the CDD3610 be stopped (media cannot be accessed by the Host Computer).

Bit 1:
A load eject (LoEj) bit of zero requests that no action be taken regarding loading or ejecting the medium. A LoEj bit of one requests that the medium be unloaded if the start bit is zero. A LoEj bit of one requests that the medium be loaded if the start bit is one.

Table 105 : Start/Stop and Eject Operations.

LoEj	Start	Operation to be Performed
0	0	Stop the Disc
0	1	Start the Disc and read the TOC (Tray must be in closed position)
1	0	Eject the Disc if possible (See " Table 106 : Actions for Eject/Load Disc.)"
1	1	Load the Disc and read the TOC (Close Tray) (See "Table 106 : Actions for Eject/Load Disc.)"

Byte 1:

Bit 0:

An immediate (Immed) bit of one indicates that status ***shall*** be returned as soon as the Command Packet has been validated, and after a check of the tray and media status. An Immed bit of zero indicates that status ***shall*** be returned after the operation is completed.

Table 106 : Actions for Eject/Load Disc.

Operation	Locked / Unlocked	If Drive Not Ready (No Media)	If Drive Ready (Media Present)
Eject	Unlocked	No Error and Tray is opened	No Error: Media Ejects
	Locked	Error: 02 Not ready, 53 Media Removal Prevented	Error: 02 Not ready, 53 Media Removal Prevented
Manual Eject	Unlocked	Tray opens (If tray exists)	Media is Ejected
	Locked	No operation occurs	No operation, Media stays locked in drive

Table 107 : START/STOP UNIT : Supported Sense Key, ASC and ASCQ.

Sense Key	ASC	ASCQ	Description of Error
02	04	01	LOGICAL DRIVE NOT READY - IN PROGRESS OF BECOMING READY
02	04	04	NOT READY - WRITE IN PROGRESS
02	3A	01	MEDIUM NOT PRESENT, TRAY CLOSED
02	3A	02	MEDIUM NOT PRESENT, TRAY OPEN
03	57	00	UNABLE TO RECOVER TABLE OF CONTENTS
04	53	00	MEDIA LOAD OR EJECT FAILED
05	53	02	MEDIA REMOVAL PREVENTED
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON, RESET OR BUS DEVICE RESET OCCURRED

3.2.26 Test Media Status

The TEST Media Status command provides a means to check the status of the media in the CDD3610. The implementation of this is done by having a specific byte in the TEST UNIT READY command.

Table 108 : Test Media Status Command

Bit Byte	7	6	5	4	3	2	1	0
0	Operation code (00h)							
1	01h							
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	Reserved							
8	Reserved							
9	Reserved							
10	Reserved							
11	Reserved							

3.2.26.1 Using the TEST MEDIA STATUS Command

The TEST MEDIA STATUS command is useful in that it allows a Host Computer to poll the CDD3610 to determine the status of the media without the need to allocate space for returned data. ATAPI CD-ROM Drives are expected to respond promptly to indicate the current status of the device. If a media event has occurred since the last issuance of this command a check condition will be returned. The host then will be required to issue a Request Sense command to get the Sense code describing the Media event.

An application can prevent the media to be ejected by using the PREVENT command. When the application uses TEST MEDIA STATUS, it is able to detect whenever the user pushed the eject button. The application can update to the disc whatever is required, then allow the eject and unload the media.

Table 109 : TEST MEDIA STATUS : SupportedSense Key, ASC and ASCQ

Sense Key	ASC	ASCQ	Description of Error
02	04	01	LOGICAL DRIVE NOT READY - IN PROGRESS OF BECOMING READY
02	04	04	NOT READY - WRITE IN PROGRESS
02	3A	01	MEDIUM NOT PRESENT - TRAY CLOSED
02	3A	02	MEDIUM NOT PRESENT - TRAY OPEN
06	28	00	NOT READY TO READY CHANGE, MEDIUM MAY HAVE CHANGED
06	29	00	POWER ON, RESET OR BUS DEVICE RESET OCCURRED
06	5A	01	OPERATOR MEDIUM REMOVAL REQUEST

3.2.27 Test Unit Ready.

Table 110 : Test Unit Ready Command.

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

3.2.27.1 Description.

The TEST UNIT READY command provides a means to check if the CDD3610 is ready. This is not a request for a self-test. If the CDD3610 would accept an appropriate medium-access command without returning CHECK CONDITION status, this command ***shall*** return a GOOD status. If the CDD3610 cannot become operational or is in a state such that an Host Computer action (e.g. START/STOP UNIT command with LoEj = 0 & Start = 1) is required to make the unit ready, the CDD3610 ***shall*** return CHECK CONDITION status with a sense key of NOT READY.

3.2.27.2 Using the TEST UNIT READY Command.

The TEST UNIT READY command is useful in that it allows a Host Computer to poll the CDD3610 until it is ready without the need to allocate space for returned data.

Table 111: TEST UNIT READY : Supported Sense Key, ASC and ASCQ.

Sense Key	ASC	ASCQ	Description of Error
02	04	01	LOGICAL DRIVE NOT READY - IN PROGRESS OF BECOMING READY
02	04	04	NOT READY - WRITE IN PROGRESS
02	3A	01	MEDIUM NOT PRESENT - TRAY CLOSED
02	3A	02	MEDIUM NOT PRESENT - TRAY OPEN
06	28	00	NOT READY TO READY CHANGE, MEDIUM MAY HAVE CHANGED
06	29	00	POWER ON, RESET OR BUS DEVICE RESET OCCURRED

3.2.28 Verify (12).

Table 112 : Verify Command.

Bit Byte	7	6	5	4	3	2	1	0
0	Operation code (AFh)							
1	Reserved			DPO=0	Reserved		BytChk=0	RelAdr=0
2	MSB							
3	Logical Block Address							
4								
5								LSB
6	MSB							
7	Verification Length							
8								
9								LSB
10	Reserved							
11	Reserved							

3.2.28.1 Description.

The VERIFY command requests that the target verify the data on the medium.

This command is almost identical to a READ command. Data is read and EDC is checked, however data is not transferred to the host.

3.2.28.2 Parameters.

Byte 2-5:
The Logical Block Address specifies the LBA to start verifying.

Byte 6-9:
The Verification Length specifies the number of contiguous logical blocks that shall be verified.

Byte 1:

Bit 4 :

DPO : Disable Page Out shall be set to 0.

Table 113: Verify : Supported Sense Key, ASC and ASCQ.

Sense Key	ASC	ASCQ	Description of Error
01	17	07	RECOVERED DATA WITHOUT ECC, RECOMMEND REASSIGNEMENT
02	3A	01	MEDIUM NOT PRESENT, TRAY CLOSED
02	3A	02	MEDIUM NOT PRESENT, TRAY OPEN

02	04	01	LOGICAL DRIVE NOT READY - IN PROGRESS OF BECOMING READY
02	04	04	NOT READY - WRITE IN PROGRESS
03	02	00	NO SEEK COMPLETE
03	11	06	CIRC UNRECOVERED ERROR.
05	21	00	LOGICAL BLOCK ADDRESS OUT OF RANGE
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON, RESET OR BUS DEVICE RESET OCCURRED

3.3 MMC 8.0 CD-R/W Packet Commands.

Table 114 : MMC 8.0 CD-R/W Packet Commands

MMC CD-R/W Commands (see Ref. 4: MMC 8.0)	Op-Code
BLANK Command - blank whole disc - minimally blank disc - blank track - blank track tail	A1h
CLOSE TRACK/SESSION	5Bh
FORMAT UNIT	04h
READ DISC INFORMATION	51h
READ TRACK INFORMATION	52h
RESERVE TRACK	53h
SEND OPC INFORMATION	54h
SYNCHRONIZE CACHE	35h
WRITE (10) - packet - track at once - raw	2Ah

3.3.1 Blank.

Table 115 : BLANK Command Descriptor Block

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (A1h)							
1	Reserved			Immed	Reserved	Blanking Type		
2	(MSB)							
3	Start Address/Track Number							
4								
5								(LSB)
6	Reserved							
7	Reserved							
8	Reserved							
9	Reserved							
10	Reserved							
11	Reserved							

3.3.1.1 Description.

The BLANK command provides the ability to erase certain parts of a CD-RW disc.
Note: The erasing action performed in this command is a Logical Erase.

3.3.1.2 Parameters.

Byte 1:

Bit 4:
The Immed flag allows execution of the blank function as an immediate operation. If Immed is zero, then the requested blank operation is executed to completion prior to returning status. If Immed is one, then status is returned once the blank operation has begun.

Bit 0-2:
Blanking Type identifies the method and coverage of blanking. The allowed codes for Blanking Type are defined in Table 116: Blanking Types.

Byte 2-5:
Start Address/Track Number is the LBA at which a range for erasure begins:
a) When Blanking Type is Blank a Track Tail, this field indicates the start LBA.
b) When Blanking Type is Blank a Track, this field indicates the track.
c) When Blanking Type is Blank the Disc or Blank Minimally the Disc this field is not considered.

Table 116 : Blanking Types.

Code	Name	Description
000b	Blank the disc	The entire disc is to be erased. The Start Address parameter is ignored. This is used for clearing a complete disc. After completion of this command the disc is blank.
001b	Minimally blank the disc	Erases only the PMA, first session TOC and the pre-gap of the first track. The Start Address parameter is ignored. This is used for blanking a disc quickly. After completion of this command the disc is treated as a blank disc. Caution must be exercised when using this command as the program area still contains user data.
010b	Blank a Track	Erases the track specified in the Start Address/Track Number field. This command erases the track only, it does not erase the TOC or the PMA. The track to be erased shall be in the incomplete session.
100b	Blank a Track Tail	Erase the area between the LBA specified Start Address/Track Number field and the end of the track which includes the LBA specified. The LBA specified shall be the first user data block within a packet. This blank type is valid for only a Packet track. This may be used to prepare for writing a packet track to a CD-RW disc with the same write process as a CD-R. The track to be erased shall be in an incomplete session.
001b 011b 101b 111b	Reserved	

Table 117 : BLANK : Supported Sense Key, ASC and ASCQ Errors.

Sense Key	ASC (hex)	ASCQ (hex)	Description of Error
02	04	01	LOGICAL DRIVE NOT READY - IN PROGRESS OF BECOMING READY
02	04	04	NOT READY - WRITE IN PROGRESS
02	3A	01	MEDIUM NOT PRESENT, TRAY CLOSED
02	3A	02	MEDIUM NOT PRESENT, TRAY OPEN
03	02	00	NO SEEK COMPLETE
05	21	00	LOGICAL BLOCK ADDRESS OUT OF RANGE
05	24	00	INVALID FIELD IN COMMAND PACKET
05	64	00	ILLEGAL MODE FOR THIS TRACK OR INCOMPATIBLE MEDIUM
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON, RESET OR BUS DEVICE RESET OCCURRED

3.3.2 Close Track / Session.

Table 118 : CLOSE TRACK/SESSION Command Descriptor Block.

bit / byte	7	6	5	4	3	2	1	0
0	Operation Code (5Bh)							
1	Reserved							Immed
2	Reserved						Session	Track
3	Reserved							
4	Reserved							
5	Track Number							
6	Reserved							
7	Reserved							
8	Reserved							
9	Reserved							
10	Reserved							
11	Reserved							

3.3.2.1 Description.

The CLOSE TRACK/SESSION Command allows closure of either a track or a session.

3.3.2.2 Parameters.

Byte 1:

Bit 0:
The Immed flag allows execution of the close function as an immediate operation. If Immed is zero, then the requested close operation is executed to completion prior to returning status. If Immed is one, then status is returned once the close operation has begun.

Byte 2:

Bit 0-1:
The Session and Track flags have the following meanings:

Table 119: Session and Track Flags Definitions

Session	Track	Close Actions
0	0	Reserved, not valid
0	1	Close the track associated with the track number in the CDB. If this is the incomplete track, pad only to the minimum length of 4 seconds. No other padding is to be done. If this is the partially recorded or empty reserved track, the CDD3610 shall pad the track. In the case of an empty track, the CDD3610 shall write the track according to the write parameter page. If the write parameter page is inconsistant with the PMA, CHECK CONDITION shall be set to ILLEGAL MODE FOR THIS TRACK.
1	0	Close session: write a TOC and Lead-out information to the disc to complete the session If all tracks in the last session are not complete, generate Check Condition Status.
1	1	Reserved, not valid

If a session or track is to be closed that is already closed, no error shall be reported.

Byte 5:
If Session is zero and Track flag is one, byte 5 of the CDB contains the track number of the track to close. If the track number is FFh, then the incomplete track is to be closed. Byte 5 of the CDB shall be ignored if the session bit is set.
In order to close the incomplete track, the following steps are required:

1) If necessary, the track is padded to the minimum length of 4 seconds.
2) The PMA is consulted in order to locate the largest track number recorded, N.
3) The bounds of the track are determined and a PMA entry is written for track N+1.

Closing a session shall cause the lead-in and lead-out to be written for the incomplete session. Closing a session when the last session is closed shall not be considered an error. Closing a session when the last session is empty shall result in a CHECK CONDITION status and sense data set to 05/2C/04.
If partially recorded, empty, or incomplete tracks exist in the incomplete session, the drive shall issue CHECK CONDITION status, sense data set to 05/72/03.

Table 120 : CLOSE TRACK/SESSION : Supported Sense Key, ASC and ASCQ.

Sense Key	ASC (hex)	ASCQ (hex)	Description of Error
02	04	01	LOGICAL DRIVE NOT READY - IN PROGRESS OF BECOMING READY
02	04	04	NOT READY - WRITE IN PROGRESS
02	3A	01	MEDIUM NOT PRESENT, TRAY CLOSED
02	3A	02	MEDIUM NOT PRESENT,TRAY OPEN
03	02	00	NO SEEK COMPLETE
03	0C	0A	WRITE ERROR - PADDING BLOCKS ADDED
03	72	00	SESSION FIXATION ERROR
03	72	01	SESSION FIXATION ERROR WRITING LEAD-IN
03	72	02	SESSION FIXATION ERROR WRITING LEAD-OUT
03	73	04	PROGRAM MEMORY UPDATE FAILURE
05	24	00	INVALID FIELD IN COMMAND PACKET
05	2C	04	CURRENT PROGRAM AREA IS EMPTY
05	64	00	ILLEGAL MODE FOR THIS TRACK OR INCOMPATIBLE MEDIUM
05	72	03	SESSION FIXATION ERROR - INCOMPLETE TRACK IN SESSION
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON, RESET OR BUS DEVICE RESET OCCURRED

3.3.3 Format Unit.

Table 121 : Format Unit Command.

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (04h)							
1	Reserved			Fmt = 1	Cmp = 0	Format Code = 7h		
2	Reserved							
3	(MSB) Interleave Value							
4	(LSB)							
5	Reserved							
6	Reserved							
7	Reserved							
8	Reserved							
9	Reserved							
10	Reserved							
11	Reserved							

3.3.3.1 Description.

The FORMAT UNIT Command formats CD-RW medium into initiator addressable logical blocks per the initiator defined options.
A formatted CD-RW session shall consist of a single, fixed packet track. The packet size specified in the WRITE PARAMETERS mode page defines packet size for the format operation. If the WRITE TYPE field in the WRITE PARAMETERS mode page is not packet (00b), the FORMAT UNIT command shall terminate with a CHECK CONDITION and set sense to ILLEGAL REQUEST, COMMAND SEQUENCE ERROR. If the FP flag in the WRITE PARAMETERS mode page is not set to one (Fixed Packet), the FORMAT UNIT command shall terminate with a CHECK CONDITION and set sense to ILLEGAL REQUEST, COMMAND SEQUENCE ERROR.

3.3.3.2 Parameters.

Byte 1:

Bit 4:
The Fmt bit shall be set to one, indicating that a parameter list is available.

Bit 3:
The Cmp bit shall be set to zero, indicating that the parameter list provided is in addition to those already available to the CDD3610.

Bit 0-2:
The Format Code identifies the parameter list format. The Format Code shall be set to seven (111b).

Byte 3-4:
The Interleave Value identifies the interleave to be used when formatting: The Interleave Value shall be cleared to zero.

3.3.3.3 Parameter list.

The FORMAT UNIT Command parameter list (Table 122 : Format Unit Parameter List) consists of three descriptors: the Format List Header, the Initialization Pattern Descriptor, and the Format Descriptor.

Table 122 : Format Unit Parameter List.

Bit Byte	7	6	5	4	3	2	1	0
0	Format List Header							
4	Initialization Pattern Descriptor							
8	Format Descriptor							

Table 123 : Format List Header.

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved							
1	FOV =0	DPRY =0	DCRT =0	STPF =0	IP =0	DSP =0	IMM	VS =0
2	(MSB)	Format Descriptor Length						
3	=0008h							(LSB)

FOV is not used and shall be cleared to zero.
DPRY is not used and shall be cleared to zero.
DCRT is not usedand shall be cleared to zero.
STPF is not used and shall be cleared to zero.
IP is not used and shall be cleared to zero.
DSP is not used and shall be cleared to zero.
IMM set to 1 indicates that GOOD status shall be returned once the command has been decoded and the format operation has begun.
VS is not used and shall be cleared to zero.
The Format Descriptor Length shall be set to 8 when formatting CD-RW medium.

The Initialization Pattern Descriptor (Table 124: Initialization Pattern Descriptor) is not used for formatting CD-RW medium and shall be cleared to zeros.

Table 124 : Initialization Pattern Descriptor.

Bit Byte	7	6	5	4	3	2	1	0
4	0							
5	0							
6	0							
7	0							

Table 125 : CD-RW Format Descriptor.

Bit Byte	7	6	5	4	3	2	1	0
8	Sess	Grow	Reserved					
9	Reserved							
10	Reserved							
11	Reserved							
12	(MSB)							
13	Format Size							
14								
15								(LSB)

If both the Grow and Session flags are set to zero the format operation shall format (Format Size) user data blocks. Format Size must be integrally divisible by the Packet Size field in the WRITE PARAMETERS mode page. The first formatted user data block shall be LBA 0. Existing information on the disc may be overwritten. After the format, a single session containing a single, fixed packet track will exist on the medium.
If the Grow flag is set to zero and the Session flag is set to 1 the format operation shall create a new session that contains (Format Size) user data blocks. Format Size must be integrally divisible by the Packet Size field in the WRITE PARAMETERS mode page. If the last session on the disc is not complete when this command is issued, a CHECK CONDITION status shall be generated.
A Grow bit of 1 indicates that the final session shall be "grown" to (Format Size) from its original size. This is accomplished by appending packets to the existing session, writing a new lead-out, and updating the PMA and lead-in to change the track size to reflect the new size. Data in existing packets shall not be affected. If the Format Size is smaller than the existing size, a check condition status shall be returned. The order of updating the PMA, lead-in, lead-out, and data area is not specified.

The session bit shall be ignored when the Grow bit is set.
If the Multi Session Field (see Table 28: Multi-session Field Definition) in the Write Parameter Page is 11b, the drive shall erase the remaining area of the disc.

Table 126 : FORMAT UNIT : Supported Sense Key, ASC and ASCQ.

Sense Key	ASC (hex)	ASCQ (hex)	Description of Error
02	04	01	LOGICAL DRIVE NOT READY - IN PROGRESS OF BECOMING READY
02	04	04	NOT READY - WRITE IN PROGRESS
02	30	00	INCOMPATIBLE MEDIUM INSTALLED
02	3A	01	MEDIUM NOT PRESENT, TRAY CLOSED
02	3A	02	MEDIUM NOT PRESENT, TRAY OPEN
03	02	00	NO SEEK COMPLETE
05	24	00	INVALID FIELD IN COMMAND PACKET
05	26	00	INVALID FIELD IN PARAMETER LIST
05	64	00	ILLEGAL MODE FOR THIS TRACK OR INCOMPATIBLE MEDIUM
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON, RESET OR BUS DEVICE RESET OCCURRED

3.3.4 Read Disc Information.

Table 127 : READ DISC INFORMATION Command Descriptor Block

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

3.3.4.1 Description.

It is not possible to completely characterize some incomplete CD-R/E discs with the information from the READ TOC command. The READ DISC INFORMATION Command provides information about all discs: CD-ROM , CD-R, and CD-RW, including all incomplete CD-R/E discs.

3.3.4.2 Parameters.

Byte 7-8:
The number of Disc Information Block bytes returned is limited by the Allocation Length parameter of the CDB. An Allocation Length of zero is not to be considered an error.

The Disc Information Block has two parts; a static disc information area, as shown in Table 128: Disc Information Block, and an OPC response shown in Table 132: OPC Table Entry.

Table 128 : Disc Information Block

Bit / Byte	7	6	5	4	3	2	1	0
0	(MSB)			Data Length				
1								(LSB)
2	Reserved			Erasable	State 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 = 0	URU	Reserved				
8	Disc Type							
9	Reserved							
10	Reserved							
11	Reserved							
12	(MSB)							
13	Disc							
14	Identification							
15								(LSB)
16	(MSB)							
17	Last Session lead-in Start Time							
18	MSF							
19								(LSB)
20	(MSB)							
21	Last Possible Start Time for Start of lead-out							
22	MSF							
23								(LSB)
24	(MSB)							
...	Disc Bar Code							
31								(LSB)
32	Reserved							
33	Number of OPC Table Entries							
34 - n	OPC Table Entries							

Data Length is the number of bytes available in both the recording information area and the appended OPC table. Data Length excludes itself.
Disc Status field indicates the status of the disc and is shown in Table 129: Disc Status.

Table 129: Disc Status.

Status	Definition
00b	Empty
01b	Incomplete disc (Appendable)
10b	Complete (CDROM or last session is closed and has no next session pointer)
11b	Reserved

The State of Last Session field is defined in Table 130: State of Last Session.

Table 130 : State of Last Session.

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

The Erasable flag, when set to one, indicates that CD-RW medium is present. Otherwise, CD-RW medium is not present.
The Number of first Track identifies the first track number in the TOC or PMA. Valid track numbers are from 01h to 63h. The first track number is not required to be one. A disc may start with any valid track number. The track numbers between the first and last track number shall be in contiguous ascending order, except for lead-out areas.
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 is the track number of the first track in the last session. This is inclusive of the invisible track.
Last Track Number in Last Session is the track number of the last track in the last session. This is inclusive of the invisible track.
The DID_V (Disc ID Valid) flag, when set to one, indicates that the Disc Identification field is valid.
The DBC_V (Disc Bar Code Valid flag is always set to 0, indicating that the Disc Bar Code field (byte 24 trough 31) is not valid. The CDD3610 does not support Barcode Reading. 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.
The Disc Type field specifies the type of data on the whole disc. A disc has only one disc type. The disc type shall be obtained from the PMA or from the A0/PSEC field in the TOC of the first session in which there is at least one data track.
In the case of a session that contains no data track (only audio), A0/PSEC field in the TOC of the session is always 00h regardless of actual disc type.
The disc type shall be determined from the following sequences:

1) Disc ID (Disc Type) as written in PMA.

2) From the first Complete Session that includes at least one data track.

3) From the first session of a Complete Disc.

4) The Disc type is NOT decided, the Disc Type field of Disc Information shall contain FF. (undefined)

Table 131 : Disc Type Field - PMA.

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

The Last Session lead-in Start Time field is an address given in MSF format. This field shall specify the location of the next Lead-in to be recorded. If the disc is Empty as specified in the Disc Status field or has no Complete Session, then the Lead-in Start Time is returned as specified by ATIP. If the last session, which is second or greater, is Empty or Incomplete, this field shall specify the Lead-in Start Time of the Last Session. If the Disc Status is Complete, the Lead-in Start Time shall be FF/FF/FF MSF.

The Last Possible Start Time of Lead-out field is an address given in MSF. If the disc is a Complete disc, the Last Possible Start Time of Lead-out shall be FF/FF/FF MSF.

The Disc Bar Code : the CDD3610 is not able to read Disc Bar Code.

An OPC (Optimum Power Control) Table is attached only if the values are known for the disc. Since OPC values are likely to be different for different recording speeds, each table entry is associated with a recording speed. The Number of OPC Table Entries indicates that [8 x (Number of OPC Table Entries)] bytes follow the first part of the Disc Information. This number shall be the same for all values of Allocation Length. The Number of OPC Table Entries will be :

CD-ROM	0	
CD-R	2	1x and 2x
CD-RW	1	2x only

Table 132 : OPC Table Entry.

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

Speed is in kBytes per second. See also SEND OPC Command.

The OPC Value field is associated with the given speed and its content is specific for a disc and a drive.

An OPC Table entry will be returned for each write speed that valid OPC information is available. (refer to Send OPC command) CD-RW media will only return a single OPC Table entry at the 2X write speed.

Table 133 : READ DISC INFORMATION : Supported Sense Key, ASC and ASCQ.

Sense Key	ASC (hex)	ASCQ (hex)	Description of Error
02	04	01	LOGICAL DRIVE NOT READY - IN PROGRESS OF BECOMING READY
02	04	04	NOT READY , WRITE IN PROGRESS
02	3A	01	MEDIUM NOT PRESENT, TRAY CLOSED
02	3A	02	MEDIUM NOT PRESENT, TRAY OPEN
05	24	00	INVALID FIELD IN COMMAND PACKET
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON, RESET OR BUS DEVICE RESET OCCURRED

3.3.5 Read Track Information.

Table 134 : READ TRACK INFORMATION Command Descriptor Block.

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

3.3.5.1 Description.

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

3.3.5.2 Parameters.

Byte 1:

Bit 0:
The Track flag in byte 1 is used to specify the contents of bytes 2 through 5 of the CDB. If the Track flag is zero, then bytes 2 through 5 contain a Logical Block Address. If the Track flag is one, then bytes 2 through 5 contain a track number

Byte 2-5:
The Logical Block Address/Track Number field Bytes 2 through 5 are defined in Table 135: Track Number/LBA Field definition.

Table 135 : 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

Byte 7-8:
The number of Track Information Block bytes returned is limited by the Allocation Length parameter of the CDB.An Allocation Length of zero is not to be considered an error.

The format and content of the Track Information Block is shown in Table 136: Track Information Block.

Table 136 : Track Information Block.

Bit / Byte	7	6	5	4	3	2	1	0
0	(MSB) Data Length							
1								(LSB)
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	(MSB) Track Start Address							
9								
10								
11								(LSB)
12	(MSB) Next Writable Address							
13								
14								
15								(LSB)
16	(MSB) Free Blocks							
17								
18								
19								(LSB)
20	(MSB) Fixed Packet Size							
21								
22								
23								(LSB)
24	(MSB)							
25	Track Length							
26								
27								(LSB)

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 flag indicates that this track is a second or higher generation copy.
The Damage flag 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 drive when the

CLOSE TRACK/SESSION command is issued. If the repair is successful, the Damage flag 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 flag 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 flag, 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 flag is valid only when the RT flag is set to one or the track indicated is the incomplete track. The Packet flag, when set to one, indicates that this track is to be written only with packets.
The FP (Fixed Packet) flag is valid only when the Packet flag is set to one. When the Packet flag is set to one and the FP flag is also set to one, then the track is to be written only with fixed packets. When the Packet flag is set to one and the FP flag 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 137.

Table 137: Write Parameter Restrictions due to Track State.

RT	Blank	Packet	Write Parameter Restrictions
0	0	0	Can't write to stamped disc, or during track at once on invisible track, or writing disc at once mode
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 may be set to packet or TAO. All other parameters shall be changeable. If this track is the first track of a Session, then Disc at Once is allowed.
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 flags are set to one, FP flag of a Read Track Information result data is set to zero.
The Track Status Indications are defined in Table 138 : Track Status Indications.
Data Mode defines the track content. Data Mode is defined in Table 139: Data Mode

Table 138 : Track Status Indications.

RT	Blank	Packet	FP	Write Method	Track Status
0	0	0		Uninterrupted/TAO/SAO	Complete/During TAO/SAO
0	0	1	0	Variable	Incomplete
0	0	1	1	Fixed	Incomplete
0	1	0	0	TAO/Variable/Fixed(*)	Invisible
0	1	1	0	-	(invalid)
0	1	1	1	-	(invalid)
1	0	0		TAO	Complete/During TAO
1	0	1	0	Variable	Complete/Partially Recorded Reserve
1	0	1	1	Fixed	Complete/Partially Recorded Reserve
1	1	0	-	TAO	Empty Reserved
1	1	1	0	Variable/Fixed	Empty Reserved
1	1	1	1	-	(invalid)

* In case last session is empty, SAO is also valid.

Table 139 : Data Mode

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

If NWA_V is zero, then the next writable address field is not valid. Otherwise the next writable address field is valid. NWA_V shall be set to zero if the track is not writable for any reason.
The Track Start Address is the starting address for the track as is specified or would be specified in the PMA.
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 flags as defined in Table 140: Next Writable Address Definition. 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.

Table 140 : Next Writable Address Definition.

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

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

The Free Blocks field represents the maximum number of user data blocks available for recording in the track. This field shall be computed as follows: First, the Available Track Space (ATS) shall be computed. For the invisible track, $ATS = (StartTimeofLastPossibleLeadout) - NWA + 5$. For a reserved track, $ATS = (PMAStopTime) - NWA + 5$. If the track is reserved for, or written with, fixed packets, $FreeBlocks = IP\left(\frac{ATS}{PacketSize + 7}\right) \bullet PacketSize$. Otherwise, $FreeBlocks = ATS - 7$

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

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

$NWA_{Method\,2} = NWA_{Method\,1} - 7 \cdot IP\left(\frac{NWA_{Method\,1} - TrackStartAddress}{PacketSize + 7}\right)$. Method 1 is the physical address. Method 2 is used on fixed packet written tracks to hide the link areas from the host. The TrackStartAddress is always a physical address, even if prior tracks are recorded with Method 2. IP( ) is the integer part of the value.

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

NOTE: Read Track Information shall provide certain valid fields for a disc with the Unrecordable 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.

The track length is the sum of the written and unwritten user data blocks within that track. In case of packet writing the overhead will be part of the track length if variable packets are considered. In case of fixed packets, no overhead will be taken into account for the tracklength

Table 141 : READ TRACK INFORMATION : Supported Sense Key, ASC and ASCQ.

Sense Key	ASC (hex)	ASCQ (hex)	Description of Error
02	04	01	LOGICAL DRIVE NOT READY - IN PROGRESS OF BECOMING READY
02	3A	01	MEDIUM NOT PRESENT, TRAY CLOSED
02	3A	02	MEDIUM NOT PRESENT, TRAY OPEN
03	02	00	NO SEEK COMPLETE
05	21	00	LOGICAL BLOCK ADDRESS OUT OF RANGE
05	24	00	INVALID FIELD IN COMMAND PACKET
05	64	00	ILLEGAL MODE FOR THIS TRACK OR INCOMPATIBLE MEDIUM
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON, RESET OR BUS DEVICE RESET OCCURRED

3.3.6 Reserve Track.

Table 142 : RESERVE TRACK Command Descriptor Block

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (53h)							
1	Reserved							
2	Reserved							
3	Reserved							
4	Reserved							
5	(MSB)							
6	Reservation							
7	Size							
8								(LSB)
9	Reserved							
10	Reserved							
11	Reserved							

3.3.6.1 Description.

The RESERVE TRACK Command allows reservation of disc space for a track. A PMA entry for the track shall be cached for writing prior to disc removal.
Tracks can only be reserved in successive order. No pre-gap or user data will be written into the track (except for packet writing). The start and stop times (calculated by the drive) will be updated in the PMA. A pre-gap will be taken into account.
A reserve track compares the Disc Application code with the Host Application code. When the compare does not match, and it is not a 'disc for unrestricted use', nor a 'disc for restricted use - general purpose disc', a check condition state is returned.

3.3.6.2 Parameters.

Byte 5-8:
The Reservation Size field contains the number of user blocks desired for the track reservation. The actual number of user data blocks allocated shall be according to the Write Parameters Mode Page.

The PMA start time shall reflect the appropriate pre-gap, as determined by the previous track's mode and the settings of the Write Parameters mode page. Table 26 specifies the PMA stop time.

Table 143 : Track reservation sizing

Write Parameters Page Write Type Value	PMA Stop Time
Track-at-once	Reserves the number of user blocks specified. The PMA stop time shall be $PMAStart + ReservationSize + 2$
Variable Packet	Reserve behaves as in track-at-once.
Fixed Packet	Set $p = \frac{ReservationSize}{PacketSize}$ packets, where packet size is taken from the Write Parameters Mode Page. If p is an integer, then the reservation is performed and the PMA stop time shall be $PMAStart + (PacketSize + 7) \bullet p - 5$. Otherwise, the reservation is not performed, CHECK CONDITION status is returned, and sense is set to ILLEGAL REQUEST, INVALID FIELD IN COMMAND PACKET. Enough space for reservation size user data packets shall be reserved.

Reserved track is not allowed with the write method = RAW.

The invisible track is known to have track number N+1 only because the track number of the track immediately preceding it has track number N. Tracks shall only be reserved from the beginning of the invisible track. Each track prior to the invisible track has a track number defined in the PMA. After the reservation is done, the track number given to the new track is the current track number of the invisible track. The number of the invisible track is increased by one following a reservation.
If the Reservation Size is smaller than four seconds, excluding pre-gap length, the drive shall return CHECK CONDITION status and sense set to 05/24/00 Invalid Field in CDB.
Reserving shall be allowed when the track is invisible. Attempting to reserve an existing incomplete track shall cause a CHECK CONDITION status, ILLEGAL REQUEST, COMMAND SEQUENCE ERROR. Attempting to reserve a track when the invisible track is partially recorded shall cause a CHECK CONDITION status, ILLEGAL REQUEST, COMMAND SEQUENCE ERROR.
Reserving a track when the Write Type is set to packet (See Table 26) shall cause the TDB to be written.

Table 144 : RESERVE TRACK : Supported Sense Key, ASC and ASCQ.

Sense Key	ASC (hex)	ASCQ (hex)	Description of Error
02	04	01	LOGICAL DRIVE NOT READY - IN PROGRESS OF BECOMING READY
02	04	04	NOT READY , WRITE IN PROGRESS
02	3A	01	MEDIUM NOT PRESENT, TRAY CLOSED
02	3A	02	MEDIUM NOT PRESENT, TRAY OPEN
05	24	00	INVALID FIELD IN COMMAND PACKET
05	64	00	ILLEGAL MODE FOR THIS TRACK OR INCOMPATIBLE MEDIUM
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON, RESET OR BUS DEVICE RESET OCCURRED

3.3.7 Send OPC Information.

Table 145: SEND OPC INFORMATION Command Descriptor Block.

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (54h)							
1	Reserved			Reserved				DoOpc
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	(MSB) Parameter List Length							
8								(LSB)
9	Reserved							
10	Reserved							
11	Reserved							

3.3.7.1 Description.

This command is used to restore the Optimum Power Calibration (OPC) values to the drive for a specific disc. This is to limit writing to the power calibration area on the disc and not exceed the limit of 99 writes. A warning will be generated "Power Calibration Area Almost Full" when the 96th write occurs in the PCA. It is used in combination with the READ DISC INFORMATION command.

3.3.7.2 Parameters.

The Parameter List Length must be set to reflect the number of the parameter bytes to be transferred. The Parameter List Length can have three valid values : 0, 8 and 16. If any other value is given in, the following error is generated Invalid field in command packet. IF the DoOpc=1, the Parameter list length is ignored. The data is transferred, but not used.

When the Parameter List Length field is zero or one no parameter bytes will be transferred; this shall not be considered an error condition.
2 byte OPC Speed and 6 bytes of OPC value are transferred if the Parameter List Length is eight. This can be extended with a second OPC Speed and Value. In this case the length is 16.

The DoOpc flag, when is set to one, indicates the drive shall perform an OPC operation to set the OPC values for the Current Speed. These OPC values shall become current and the OPC value in the Parameter List will be ignored. When the flag is set to zero, the CDD3610 sets the OPC values to those sent in the Parameter List : the drive will accept them but a good writing performance is not guaranteed. Proper values can be obtained by setting the DoOpc flag to one or by issuing the READ DISC INFO command.

3.3.7.3 Response Data.

The format of the OPC Data to be transferred is shown in Table 146: SEND OPC INFORMATION Parameter List.

Table 146 : SEND OPC INFORMATION Parameter List.

Bit / Byte	7	6	5	4	3	2	1	0
0	(MSB)			OPC Speed in kBytes per Second				
1								(LSB)
2	(MSB)							
3								
4				OPC Value				
5								
6								
7								(LSB)

The OPC Speed can have two valid values for CDR media and one valid value for CDR/W media, as shown in Table 147 : Supported Speeds.

Table 147 : Supported Speeds.

	CDR	CD R/W
176 KBytes/second	Valid	Reserved
353 KBytes/second	Valid	Valid

The OPC values are Vendor Unique values, representing an optimum power calibration for a certain drive-disc-speed combination. It is the host's responsibility to check the disc ID and drive serial number in order to successfully use the OPC values.
A Parameter List may be sent to indicate an initial value of OPC .

Table 148 : SEND OPC INFORMATION : Supported Sense Key, ASC and ASCQ.

Sense Key	ASC (hex)	ASCQ (hex)	Description of Error
01	73	01	POWER CALIBRATION AREA ALMOST FULL
02	04	01	LOGICAL DRIVE NOT READY - IN PROGRESS OF BECOMING READY
02	04	04	NOT READY, WRITE IN PROGRESS
02	3A	01	MEDIUM NOT PRESENT, TRAY CLOSED
02	3A	02	MEDIUM NOT PRESENT, TRAY OPEN
03	02	00	NO SEEK COMPLETE
03	73	02	POWER CALIBRATION AREA IS FULL
03	73	03	POWER CALIBRATION ERROR
05	24	00	INVALID FIELD IN COMMAND PACKET
05	64	00	ILLEGAL MODE FOR THIS TRACK OR INCOMPATIBLE MEDIUM
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON, RESET OR BUS DEVICE RESET OCCURRED

3.3.8 Synchronize Cache.

Table 149 : SYNCHRONIZE CACHE Command.

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (35h)							
1	Reserved			Reserved			Immed	RELADR = 0
2	(MSB)							
3	Logical Block Address							
4								
5								(LSB)
6	Reserved							
7	(MSB)			Number of Blocks				
8								(LSB)
9	Reserved							
10	Reserved							
11	Reserved							

3.3.8.1 Description.

This command provides a normal sequence to terminate a Write process, and assures all remaining data in the data buffer has been written to the media.
If the data buffer is empty, issuing this command will result in no data being written to the physical media. This action will not be considered an error. Normal status shall be presented at the completion of the action.
The meaning of the synchronize cache command is dependent on the type of writing as described in Table 150 : Actions due to SYNCHRONIZE CACHE Command

Table 150 : Actions due to SYNCHRONIZE CACHE Command

Write type		Action
VP	Write Not In progress	initiate write of data in buffer
	Write In progress	generate runout and link blocks after current buffer data is written
FP		indicate end of fixed packet data, pad to end of packet if necessary
TAO		generate runout and link blocks after current buffer data is written
RAW		host generates runout and link blocks after current buffer data is written

3.3.8.2 Parameters.

An Immed (Immediate) bit of one indicates that the CDD3610 shall return status when the command descriptor block has been validated. An Immediate bit of zero indicates that the status shall not be returned until the operation has been completed.
The RELADR bit shall be set to zero.
The Logical Block Address field shall be ignored by the drive and is assumed to be zero.
The Number of Blocks field shall be ignored by the drive and is assumed to be zero.

Table 151 : SYNCHRONIZE CACHE : Supported Sense Key, ASC and ASCQ.

Sense Key	ASC (hex)	ASCQ (hex)	Description of Error
02	3A	01	MEDIUM NOT PRESENT, TRAY CLOSED
02	3A	02	MEDIUM NOT PRESENT, TRAY OPEN
02	04	01	LOGICAL DRIVE NOT READY - IN PROGRESS OF BECOMING READY
03	0C	0A	WRITE ERROR - PADDING BLOCKS ADDED
03	02	00	NO SEEK COMPLETE
03	73	04	PROGRAM MEMORY UPDATE FAILURE
05	24	00	INVALID FIELD IN COMMAND PACKET
05	64	00	ILLEGAL MODE FOR THIS TRACK OR INCOMPATIBLE MEDIUM
06	28	00	NOT READY TO READY TRANSITION
06	29	00	POWER ON, RESET OR BUS DEVICE RESET OCCURRED

3.3.9 Write (10).

Table 152 : WRITE command.

Bit / Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (2Ah)							
1	Reserved			DPO	FUA	Reserved		RELADR
2	(MSB)							
3	Logical Block Address							
4								
5								(LSB)
6	Reserved							
7	(MSB)			Transfer Length				
8								(LSB)
9	Reserved							
10	Reserved							
11	Reserved							

3.3.9.1 Description.

The write(10) command transfers data to the medium. The Write command shall use the WRITE Parameters mode page to determine its operating behavior.
Table 26: Write parameters Mode page identifies the fields and information necessary to perform the WRITE operation.

3.3.9.2 Parameters.

DPO : Disable Page Out shall be set to 0.
FUA : Force Unit Access shall be set to 0.

The Logical Block Address field specifies the logical block where the write operation shall begin. If the LBA is equal to the Next Writable Address in the same track as a previous Write, then writing should continue without interruption of streaming. If the LBA is equal to the NWA in another track, a synchronize cache may be performed before executing the write command. If the LBA is not any next writable address or a writable CD-R/W address, the status shall be set to CHECK CONDITION, ILLEGAL REQUEST, INVALID ADDRESS FOR WRITE.

The RELADR bit shall be set to zero.
The transfer length field specifies the number of contiguous logical blocks of data that shall be transferred. A transfer length of zero indicates that no logical blocks shall be transferred. This condition shall not be considered an error. Any other value indicates the number of logical blocks that shall be transferred. The block size shall be determined by the write parameters mode page (if in track at once, packet, or raw mode).
Once actual writing to the media has started, the data stream must be uninterrupted until the recording is done. Interruptions of data are called “underruns.” The underrun condition may also be

forced with the “Synchronize Cache” command. The drive shall behave as follows in an underrun condition.

1) Disc at Once functionality , RAW mode.

   The host shall generate leadin, user data and lead out data. No PMA will be written to the disc. The disc is final closed. All data must be supplied raw with subchannel P an Q. Any under run results in a unusable disc.

2) Track at Once mode:

   The drive shall pad the track (if reserved or not minimum length) and update the PMA.

3) Variable Packet:

   The drive shall write run-out and link blocks.

4) Fixed Packet:

   The drive shall pad the packet.

Note: “Update the PMA” means to update the PMA on the disc or to update the PMA Cache, which shall be written to the PMA on the disc prior to the removing the disc from the drive.

If the block number specified by the LBA field is already written on CD-R media, the drive shall return a CHECK CONDITION status, ILLEGAL REQUEST, INVALID ADDRESS FOR WRITE. This error will indicate that an underrun may have occurred, as the run-out and link blocks occupy logical addresses. On CD-RW media, the LBA shall specify an address that is an appendable point (according to CD-R rules) or is the first user data block of an existing packet or track.
While writing is occurring, the drive may not be able to process all commands. The following is a list of commands that shall function during writing without causing a synchronize cache.

1) TEST UNIT READY
2) REQUEST SENSE
3) INQUIRY
4) READ TRACK INFO (for current track). If the LBA or track number specified is not within the current track, the drive may return CHECK CONDITION status, ILLEGAL COMMAND, Invalid Field in CDB.
5) MEDIA STATUS
6) WRITE (10)

All other commands will return a check condition with the sense code “LOGICAL UNIT NOT READY - WRITE IN PROGRESS”, and will not force a synchronize cache.

Table 153 : WRITE : Supported Sense Key, ASC and ASCQ.

Sense Key	ASC (hex)	ASCQ (hex)	Description of Error
02	04	01	LOGICAL DRIVE NOT READY - IN PROGRESS OF BECOMING READY
02	04	04	NOT READY - WRITE IN PROGRESS
02	3A	01	MEDIUM NOT PRESENT, TRAY CLOSED
02	3A	02	MEDIUM NOT PRESENT, TRAY OPEN
03	02	00	NO SEEK COMPLETE
03	0C	0A	WRITE ERROR - PADDING BLOCKS ADDED
03	0C	09	WRITE ERROR - LOSS OF STREAMING
03	73	04	PROGRAM MEMORY UPDATE FAILURE
05	21	00	LOGICAL BLOCK ADDRESS OUT OF RANGE
05	24	00	INVALID FIELD IN COMMAND PACKET
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, RESET OR BUS DEVICE RESET OCCURRED

4. Command Sequences For Writing CD-R/W

4.1 Disc At Once

Disc At Once writing is way of writing a complete disc (Lead-in, Data/Audio tracks, and lead-out) without recording linking blocks between tracks. This is particularly useful for recording CD-DA discs as well as discs for use as source to a CD-ROM mastering house. The CDD3610 allows for writing Disc at Once via a Raw Data writing method. This method of writing requires the host application to provide most of the data and sub-code information, this includes the user-data and P-Q sub-code for the Lead-in, all data tracks, and the Lead-out. The CDD3610 will generate the R-W sub-code, and will use the data from the host application to write the disc.

4.1.1.1 Outline for Raw DAO

The following describes in more details how a host application should write Raw Disc At Once, and some key responsibilities of the CDD3610:

1. Setup Write Parameters Page of Mode Select 10
   - Issue a Mode Sense 10 with page code 05h and disable block descriptor to get current settings
   - Clear Sense Data Length field in Mode Sense 10 Header
   - Set fields of Write Parameters Page (page code 05h):

```
Write Type                = 03h, Raw
Test Write                = 0, normal mode
                          = 1, test mode
Track Mode                = NOP
Copy                      = NOP
FP                        = NOP
Multi-Session             = NOP
Data Block Type           = 01h, Raw w/ P-Q, blksize = 2368
Host Application Code     = must be valid
Session Format            = NOP
Packet Size               = NOP
Audio Pause Length        = NOP
MCN                       = NOP
ISRC                      = NOP
Sub Header Byte 0         = NOP
Sub Header Byte 1         = NOP
Sub Header Byte 2         = NOP
Sub Header Byte 3         = NOP
```

   - Issue Mode Select 10 with modified Sense data

2. The host application is responsible for generating a Raw TOC that should contain the following special tracks or ‘points’:

```
A0h, First Track in Program Area
A1h, Last Track in Program Area (optional, regenerated)
A2h, Start Location of Lead-out (optional, regenerated)
B1h, Number of Skip Interval Pointers
01-40h (adr=1), Skip Interval Pointers
B2-B4h, Skip Track Assignment Pointers
C0h, Start Time of First Leadin, including Disc App. Code
C1h, Copy of Info. from Additional Area 1 in ATIP (CD-RW)
```

The host application is also responsible for generating the ISRC for any audio tracks, and the MCN for an audio track.

3. Determine address to begin writing
    - Use ReadDiscInfo to find disc type, start time of Lead-in and Lead-out.

4. Stream raw data to the disc (stream contains data and sub-code for Lead-in, all tracks, and Lead-out).
    - Use sequence of Write (10) commands with proper LBA, starting at first LBA, drive will validate Host Application Code with Disc Application code upon first write.
    - Issue SyncCache command after final Write (10) (optional).

4.1.1.2 Issues for Raw DAO

There are a number of issues with the Raw Disc At Once method. First, since the CDD3610 relies on the host application to provide most of the data, the drive cannot validate that disc/session just created is within the Color-Book specifications. It is possible to create a disc that cannot be read by this drive or by other CD-ROM drives.

Second, this method places a great deal of the processing requirements on the host application. The host application must generate correct Lead-in data with P-Q sub-code, which includes the TOC (part of the Q sub-code). The host application must also generate the C3 block level ECC for data sectors. The TOC creation can be involved, while the ECC generation can be quite time intensive and may prevent 'on-the-fly' writing.

A third issue is that the host application is responsible for scrambling the data sectors per the Yellow book specification.

The host will be required to generate runout and link blocks at the end of the data stream. This is due to :

1. Scrambling of data,
2. Not knowing the mode of the sectors.

The drive will stop the write on the last data block (assumed to be link).

Another issue involves recovering from a failed write stream. In the event of an under-run condition, the drive will complete the write stream and this disc will no longer be useable!!!

4.2 Track At Once

Track At Once writing is way of writing individual tracks to a disc, one at a time. This results in a linking area inserted between tracks that should be ignored by CD-ROM drives and Audio players. The MMC standard allows for writing Track At Once with and without reserved tracks.

4.2.1 Track At Once with Reserved Tracks

It is possible to reserve tracks for future use, and then later record those tracks. As in all methods of writing, the Write Parameters Page of Mode Select 10, must be setup, and in this case it must match the state of that page when the track to be written was first reserved.

4.2.1.1 Outline for TAO with Reserved Tracks

1. Setup Write Parameters Page of Mode Select 10 (must match previously reserved track that is to be written).

2.

- Issue a Mode Sense 10 with page code 05h to get current settings
- Clear Sense Data Length field in Mode Sense 10 Header
- Set fields of Write Parameters Page (page code 05h):

```
Write Type          = 01h, Track at once
Test Write          = 0, normal mode
                    = 1, test mode
Track Mode          = Cnt nibble for Q channel,
                      set as appropriate
Copy                = 0, Serial Copy Mgmt off
                    = 1, Serial Copy Mgmt on
FP                  = 0
Multi-Session       = 00b, No B0 pntr, Next Ses. not allowed
                    = 01b, B0=FF:FF:FF, Next Ses. not allowed
                    = 11b, Next Session Allowed, B0 set = NPA
                      (field used at Close Session)
Data Block Type     = 00h, Raw w/o P-Q, blksize = 2352
                    = 01h, Raw w/ P-Q, blksize = 2368
                    = 08h, Mode1, blksize = 2048
                    = 09h, Mode2, blksize = 2336
                    = 10h, Mode2-Form1, blksize = 2048
                    = 11h, Mode2-Form1 w/SubHdr,blksize=2056
                    = 12h, Mode2-Form2, blksize = 2324
                    = 13h, Mode2-mixed form /w SubHdr,
                           blksize = 2332

Host Application Code = must be valid
Session Format      = 00h, CD-DA or CD-ROM Disc
                    = 01h, CD-I Disc
                    = CD-ROM XA Disc
                      (must match Data Block Type)
Packet Size         = 0
Audio Pause Length  = set as appropriate (Audio tracks only)
MCN                 = set as appropriate
ISRC                = set as appropriate
Sub Header Byte 0   = XA SubHdr File Number, typically 0
Sub Header Byte 1   = XA SubHdr Channel Number, typically 0
Sub Header Byte 2   = XA SubHdr Sub Mode, typically
                             00h for Mode 2 - Form 1
                             20h for Mode 2 - Form 2
Sub Header Byte 3   = XA SubHdr Coding Info, typically 0
                      (drive will validate with data block
                       type)
```

- Issue Mode Select 10 with modified Sense data

2. Reserve any new tracks
3. Determine address to begin writing
   - Use ReadDiscInfo to find disc type
   - Use ReadTrackInfo, track = reserved track to get start address

4. Stream data to the disc
   - Use sequence of Write 10 commands with proper LBA, starting at first LBA, the CDD3610 will validate Host Application Code with Disc Application code upon first write.
   - Upon the end of the data stream or a SyncCache, the CDD3610 will complete the track. If the data stream ends or a SyncCache occurs before reaching the reserve length, the track will be filled to the reserved length with dummy blocks.
5. The CDD3610 updates the PMA upon reserving any new tracks.

4.2.1.2 Issues for TAO with Reserved Tracks

It is recommended that Data Block Types 10h and 12h are used over types 11h and 13h, although all are supported. This will result in a less data transferred from the host, and thus is less prone to under-runs.

The CDD3610 will validate the Sub-Header Byte 2, bit 5 (the form bit) against Data Block Types of 10h and 12h. In the event of a mismatch, the Byte and Bit pointers of the returned sense data will point to the Sub-Header Byte 2. Validation occurs prior to start of write.

The CDD3610 will not scramble the data if the Write Type is 01h, Track at once, and the Data Block Type is 00h, or Raw (Audio data).

The use of SyncCache is optional if the host application sends the exact amount of data to fill the reserved track. SyncCache allows the host application to wait for all data to be written from the buffer, without polling the drive.

If the host application sends less data than the reserved length of the track, a buffer under-run condition has occurred, and the CDD3610 will complete the rest of the reserved track. If the host application issues another write command for what should have been the next LBA before the under-run, the CDD3610 will report a LBA invalid error. If the host issues another command, an error indicating Dummy Blocks Added will be returned.

The Close Track/Session for a reserved track may be issued, but the CDD3610 will not do anything in most cases. In the case that a track was reserved, but never written, the CDD3610 will complete writing that track.

Track At Once with Reserved Track cannot be used for Audio data.

It is recommended that the Close Track/Session command be sent using the Immed bit = 1. This helps avoid time-out problems on the IDE/ATAPI bus.

4.2.2 Track At Once without Reserved Tracks

It is often easier or more convenient to write a Track At Once without reserving a track. This method requires writing to what is known as the “invisible” track. The invisible track is a way to describe the remaining record-able area on the disc as a single track.

4.2.2.1 Outline for TAO without Reserved Tracks

1. Setup Write Parameters Page of Mode Select 10
   - Issue a Mode Sense 10 with page code 05h to get current settings
   - Clear Sense Data Length field in Mode Sense 10 Header
   - Set fields of Write Parameters Page (page code 05h):

```
Write Type          = 01h, Track at once
Test Write          = 0, normal mode
                    = 1, test mode
Track Mode          = Cnt nibble for Q channel,
                      set as appropriate
Copy                = 0, Serial Copy Mgmt off
                    = 1, Serial Copy Mgmt on
FP                  = 0
Multi-Session       = 00b, No B0 pntr, Next Ses. not allowed
                    = 01b, B0=FF:FF:FF, Next Ses. not allowed
```

```
                        = 11b, Next Session Allowed, B0 set = NPA
                          (field used at Close Session)
Data Block Type         = 00h, Raw w/o P-Q, blksize = 2352
                        = 01h, Raw w/ P-Q, blksize = 2368
                        = 08h, Mode1, blksize = 2048
                        = 09h, Mode2, blksize = 2336
                        = 10h, Mode2-Form1, blksize = 2048
                        = 11h, Mode2-Form1 w/SubHdr,blksize=2056
                        = 12h, Mode2-Form2, blksize = 2324
                        = 13h, Mode2- mixed form /w SubHdr,
                               blksize = 2332

Host Application Code = must be valid
Session Format          = 00h, CD-DA or CD-ROM Disc
                        = 01h, CD-I Disc
                        = CD-ROM XA Disc
                          (must match Data Block Type)
Packet Size             = 0
Audio Pause Length      = set as appropriate (Audio tracks only)
MCN                     = set as appropriate
ISRC                    = set as appropriate
Sub Header Byte 0       = XA SubHdr File Number, typically 0
Sub Header Byte 1       = XA SubHdr Channel Number, typically 0
Sub Header Byte 2       = XA SubHdr Sub Mode, typically
                                 00h for Mode 2 - Form 1
                                 20h for Mode 2 - Form 2
Sub Header Byte 3       = XA SubHdr Coding Info, typically 0
                          (drive will validate with data block
                           type)
```

- Issue Mode Select 10 with modified Sense data

2. Determine address to begin writing
   - Use ReadDiscInfo to find disc type and number of invisible track
   - Use ReadTrackInfo, track = invisible track to get start address

3. Stream data to the disc
   - Use sequence of Write 10 commands with proper LBA, starting at first LBA, the CDD3610 will validate Host Application Code with Disc Application code upon first write. The stream of data must be greater than the minimal track length of 300 blocks. If not, the CDD3610 will fill to the minimum track length with dummy blocks.
   - Upon the end of the data stream (buffer under-runs), the CDD3610 will complete the track. this is not considered as an error if the host lets the buffer under-run. Optionally, the host can issue a SyncCache command to proactively indicate the end of the track.
4. Drive updates the PMA upon track completion and either a CloseSession command or a Physical Eject Request.

4.2.2.2 Issues for TAO without Reserved Tracks

It is recommended that Data Block Types 10h and 12h are used over types 11h and 13h, although all are supported. This will result in a less data transferred from the host, and thus is less prone to under-runs.

The drive will validate the Sub-Header Byte 2, bit 5 (the form bit) against Data Block Types of 10h and 12h. In the event of a mismatch, the Byte and Bit pointers of the returned sense data will point to the Sub-Header Byte 2. Validation occurs prior to start of write.

The CDD3610 will not scramble the data if the Write Type is 01h, Track At Once, and the Data Block Type is 00h, or Raw (Audio data).

The use of SyncCache is optional. SyncCache allows the host application to wait for all data to be written from the buffer, without polling the CDD3610.

It is possible for a buffer under-run condition to occur. Since the CDD3610 cannot tell if the under-run was intentional, it is expected that a host will learn of the under-run when it issues the next Write 10 command with an LBA equal to the next LBA before the under-run occurred. The CDD3610 will then report an LBA invalid error.

To end a track using this method, it is necessary to send a Close Track/Session for the invisible track. The CDD3610 will then complete the track, and note its PMA entry (the PMA information may be cached until a Close Session, Start/Stop Unit, or Physical Eject Request).

It is recommended that the Close Track/Session command be sent using the Immed bit = 1. This helps avoid time-out problems on the IDE/ATAPI bus.

4.3 Packet Writing

The smallest unit of writing is a packet. Each packet physically consists 1 link block, 4 run-in blocks, x user blocks, and 2 run-out blocks. Thus for each packet there are 7 blocks of overhead. There are two types of packets defined: variable and fixed. Variable means that for each packet of a track, the user block length (x from above) is variable. Variable packet tracks also expose the overhead blocks in the address space. In other words, if the last user block of the first packet is n, the first user block of the second packet is n+8. This is called 'Method 1' addressing.

Fixed packet tracks consist of packets that have the same user block length per packet. Fixed packet tracks hide the packet overhead blocks (the overhead is still there). In other words, if the last user block of the first packet is n, the first user block of the second packet is n+1. This is called 'Method 2' addressing. Note that the physical to logical addressing of Method 2 addressing is done by the drive. (Exception is for READ CD MSF.)

4.3.1 Variable Packet Writing with Reserved Tracks

This method involves writing to a track that was previously reserved. The Write Parameters page must match the state of that page when the track to be written was first reserved.

4.3.1.1 Outline for VP with Reserved Tracks

1. Setup Write Parameters Page of Mode Select 10 (must match previously reserved track that is to be written)
    - Issue a Mode Sense 10 with page code 05h to get current settings
    - Clear Sense Data Length field in Mode Sense 10 Header
    - Set fields of Write Parameters Page (page code 05h):

```
Write Type          = 00h, Packet
Test Write          = 0, normal mode
                    = 1, test mode
Track Mode          = Cnt nibble for Q channel,
                      set as appropriate
Copy                = 0, Serial Copy Mgmt off
                    = 1, Serial Copy Mgmt on
FP                  = 0
Multi-Session       = 00b, No B0 pntr, Next Ses. not allowed
                    = 01b, B0=FF:FF:FF, Next Ses. not allowed
                    = 11b, Next Session Allowed, B0 set = NPA
                      (field used at Close Session)
Data Block Type     = 08h, Mode1, blksize = 2048
                    = 09h, Mode2, blksize = 2336
```

```
                        = 10h, Mode2-Form1, blksize = 2048
                        = 11h, Mode2-Form1 w/SubHdr,blksize=2056
                        = 12h, Mode2-Form2, blksize = 2324
                        = 13h, Mode2- mixed form /w SubHdr,
                               blksize = 2332
Host Application Code = must be valid
Session Format      = 00h, CD-DA or CD-ROM Disc
                    = 01h, CD-I Disc
                    = CD-ROM XA Disc
                      (must match Data Block Type)
Packet Size         = 0
Audio Pause Length  = NOP
MCN                 = set as appropriate
ISRC                = set as appropriate
Sub Header Byte 0   = XA SubHdr File Number, typically 0
Sub Header Byte 1   = XA SubHdr Channel Number, typically 0
Sub Header Byte 2   = XA SubHdr Sub Mode, typically
                             00h for Mode 2 - Form 1
                             20h for Mode 2 - Form 2
Sub Header Byte 3   = XA SubHdr Coding Info, typically 0
                      (drive will validate with data block
                       type)
```

- Issue Mode Select 10 with modified Sense data

2. Reserve any new tracks
   - Use Reserve Track with length accounting for expected packet overhead. Drive cannot determine this ahead of time since packets are variable.

3. Determine address to begin writing
   - Use ReadDiscInfo to find disc type
   - Use ReadTrackInfo, track = reserved track to get start address

4. Stream data to the disc
   - Use sequence of Write 10 commands with proper LBA, starting at first LBA, the CDD3610 will validate Host Application Code with Disc Application code upon first write.
   - Upon the end of the data stream (buffer under-runs), the CDD3610 will complete the packet, this is not considered an error if the host provides the proper amount of data and completes writing the reserved track. Optionally, the host can issue a SyncCache command to proactively indicate the end of a packet.
   - ReadTrackInfo can be used during writing to determine the next writable address. If the stream is still going, that address will be the next expected LBA, if the stream under-ran, that address will be the first user block of the next variable packet.
5. The CDD3610 updates the PMA upon reserving any new tracks.

4.3.1.2 Issues for VP with Reserved Tracks

It is recommended that Data Block Types 10h and 12h are used over types 11h and 13h, although all are supported. This will result in a less data transferred from the host, and thus is less prone to under-runs.

The drive will validate the Sub-Header Byte 2, bit 5 (the form bit) against Data Block Types of 10h and 12h. In the event of a mismatch, the Byte and Bit pointers of the returned sense data will point to the Sub-Header Byte 2. Validation occurs prior to start of write.

The use of SyncCache is optional if the host application sends the exact amount of data to fill the reserved track including packet overhead. SyncCache allows the host application to wait for all data to be written from the buffer, without polling the drive.

The CDD3610 will look for the condition where a variable packet ends too close to the end of a reserved track, not allowing a minimal packet (1 link block, 4 run-in blocks, 1 user block, and 2 run-out blocks) to be written. In this case, the CDD3610 will pad the preceding variable packet such that it completes the track, and then close the track. An error indicating Dummy Blocks Added will be returned upon the next command.

The Close Track/Session for a reserved track may be issued, but the CDD3610 will not do anything in most cases. In the case that a track was reserved, but never written, the CDD3610 will complete writing that track. In the case of a partially written track, the CDD3610 will complete that track with a single variable packet.

It is recommended that the Close Track/Session command be sent using the Immed bit = 1. This helps avoid time-out problems on the IDE/ATAPI bus.

4.3.2 Variable Packet Writing without Reserved Tracks

The most typical use of Variable Packet writing is to the invisible track. This allows open ended appending to the end of the disc.

4.3.2.1 Outline for VP without Reserved Tracks

1. Setup Write Parameters Page of Mode Select 10
    - Issue a Mode Sense 10 with page code 05h to get current settings
    - Clear Sense Data Length field in Mode Sense 10 Header
    - Set fields of Write Parameters Page (page code 05h):

```
Write Type          = 00h, Packet
Test Write          = 0, normal mode
                    = 1, test mode
Track Mode          = Cnt nibble for Q channel,
                      set as appropriate
Copy                = 0, Serial Copy Mgmt off
                    = 1, Serial Copy Mgmt on
FP                  = 0
Multi-Session       = 00b, No B0 pntr, Next Ses. not allowed
                    = 01b, B0=FF:FF:FF, Next Ses. not allowed
                    = 11b, Next Session Allowed, B0 set = NPA
                      (field used at Close Session)
Data Block Type     = 08h, Mode1, blksize = 2048
                    = 09h, Mode2, blksize = 2336
                    = 10h, Mode2-Form1, blksize = 2048
                    = 11h, Mode2-Form1 w/SubHdr,blksize=2056
                    = 12h, Mode2-Form2, blksize = 2324
                    = 13h, Mode2- mixed form /w SubHdr,
                           blksize = 2332
Host Application Code = must be valid
Session Format      = 00h, CD-DA or CD-ROM Disc
                    = 01h, CD-I Disc
                    = CD-ROM XA Disc
                      (must match Data Block Type)
Packet Size         = 0
Audio Pause Length  = NOP
MCN                 = set as appropriate
ISRC                = set as appropriate
Sub Header Byte 0   = XA SubHdr File Number, typically 0
Sub Header Byte 1   = XA SubHdr Channel Number, typically 0
Sub Header Byte 2   = XA SubHdr Sub Mode, typically
                             00h for Mode 2 - Form 1
                             20h for Mode 2 - Form 2
Sub Header Byte 3   = XA SubHdr Coding Info, typically 0
                      (drive will validate with data block
                       type)
```

- Issue Mode Select 10 with modified Sense data

2. Determine address to begin writing
   - Use ReadDiscInfo to find disc type and number of invisible track
   - Use ReadTrackInfo, track = invisible track to get start address

3. Stream data to the disc
   - Use sequence of Write 10 commands with proper LBA, starting at first LBA, the CDD3610 will validate Host Application Code with Disc Application code upon first write.
   - Upon the end of the data stream (buffer under-runs), the CDD3610 will complete the packet, this is not considered an error. Optionally, the host can issue a SyncCache command to proactively indicate the end of a packet.
   - ReadTrackInfo can be used during writing to determine the next writable address. If the stream is still going, that address will be the next expected LBA, if the stream under-ran, that address will be the first user block of the next variable packet.
4. The CDD3610 updates the PMA upon track completion (Close Track command).

4.3.2.2 Issues for VP without Reserved Tracks

It is recommended that Data Block Types 10h and 12h are used over types 11h and 13h, although all are supported. This will result in a less data transferred from the host, and thus is less prone to under-runs.

The CDD3610 will validate the Sub-Header Byte 2, bit 5 (the form bit) against Data Block Types of 10h and 12h. In the event of a mismatch, the Byte and Bit pointers of the returned sense data will point to the Sub-Header Byte 2. Validation occurs prior to start of write.

The use of SyncCache is optional. SyncCache allows the host application to wait for all data to be written from the buffer, without polling the drive.

It is possible for a buffer under-run condition to occur. Since the CDD3610 cannot tell if the under-run was intentional, it is expected that a host will learn of the under-run when it issues the next Write 10 command with an LBA equal to the next LBA before the under-run occurred. The CDD3610 will then report an LBA invalid error.

To end a track using this method, it is necessary to send a Close Track/Session for the invisible track. The CDD3610 will then complete the track, and note its PMA entry (the PMA information may be cached until a Close Session, Start/Stop Unit, or Physical Eject Request).

It is recommended that the Close Track/Session command be sent using the Immed bit = 1. This helps avoid time-out problems on the IDE/ATAPI bus.

4.3.3 Fixed Packet Writing with Reserved Tracks

4.3.3.1 Outline for FP with Reserved Tracks

1. Setup Write Parameters Page of Mode Select 10 (must match previously reserved track that is to be written)
   - Issue a Mode Sense 10 with page code 05h and disable block descriptor to get current settings
   - Clear Sense Data Length field in Mode Sense 10 Header
   - Set fields of Write Parameters Page (page code 05h):

```
Write Type          = 00h, Packet
Test Write          = 0, normal mode
                    = 1, test mode
Track Mode          = Cnt nibble for Q channel,
                      set as appropriate
Copy                = 0, Serial Copy Mgmt off
                    = 1, Serial Copy Mgmt on
FP                  = 1
Multi-Session       = 00b, No B0 pntr, Next Ses. not allowed
                    = 01b, B0=FF:FF:FF, Next Ses. not allowed
                    = 11b, Next Session Allowed, B0 set = NPA
                      (field used at Close Session)
Data Block Type     = 08h, Mode1, blksize = 2048
                    = 09h, Mode2, blksize = 2336
                    = 10h, Mode2-Form1, blksize = 2048
                    = 11h, Mode2-Form1 w/SubHdr,blksize=2056



Host Application Code = must be valid
Session Format      = 00h, CD-DA or CD-ROM Disc
                    = 01h, CD-I Disc
                    = CD-ROM XA Disc
                      (must match Data Block Type)
Packet Size         = set appropriately (CD-UDF expects 32d)
Audio Pause Length  = NOP
MCN                 = set as appropriate
ISRC                = set as appropriate
Sub Header Byte 0   = XA SubHdr File Number, typically 0
Sub Header Byte 1   = XA SubHdr Channel Number, typically 0
Sub Header Byte 2   = XA SubHdr Sub Mode, typically
                            00h for Mode 2 - Form 1
                            20h for Mode 2 - Form 2
Sub Header Byte 3   = XA SubHdr Coding Info, typically 0
                      (drive will validate with data block
                       type)
```

- Issue Mode Select 10 with modified Sense data

2. Reserve any new tracks
   - Use Reserve Track expected user length. The CDD3610 will calculate true length accounting for packet overhead, based on the values in the Write Parameters page of Mode Select 10.

3. Determine address to begin writing
   - Use ReadDiscInfo to find disc type
   - Use ReadTrackInfo, track = reserved track to get start address

4. Stream data to the disc
   - Use sequence of Write 10 commands with proper LBA, starting at first LBA, the CDD3610 will validate Host Application Code with Disc Application code upon first write.
   - The CDD3610 is expected to insert packet overhead between the fixed packets. Optionally, the host can issue a SyncCache command to proactively indicate the end of a packet.
   - ReadTrackInfo can be used during writing to determine the next writable addres, that address will be the next expected LBA.
5. The CDD3610 updates the PMA upon reserving any new tracks.

4.3.3.2 Issues for FP with Reserved Tracks

It is recommended that Data Block Types 10h and 12h are used over types 11h and 13h, although all are supported. This will result in a less data transferred from the host, and thus is less prone to under-runs.

The drive will validate the Sub-Header Byte 2, bit 5 (the form bit) against Data Block Types of 10h and 12h. In the event of a mismatch, the Byte and Bit pointers of the returned sense data will point to the Sub-Header Byte 2. Validation occurs prior to start of write.

The use of SyncCache is optional between Fixed Packets. The CDD3610 will provide packet breaks automatically. If a SyncCache is issued midway through the recording of a Fixed Packet, the drive should pad that packet. If the data stream stops midway through a Fixed Packet, that packet will not start recording (if the Fixed Packet size is less than the buffer size) until all of the data for that packet is given, or another command is received that flushes the cache.

The Close Track/Session for a reserved track may be issued, but the CDD3610 will not do anything in most cases. In the case that a track was reserved, but never written, the CDD3610 will complete writing that track with the appropriate number of fixed packets. In the case of a partially written track, the CDD3610 will complete that track with the appropriate number of fixed packets.

It is recommended that the Close Track/Session command be sent using the Immed bit = 1. This helps avoid time-out problems on the IDE/ATAPI bus.

4.3.4 Fixed Packet Writing without Reserved Tracks

4.3.4.1 Outline for FP without Reserved Tracks

1. Setup Write Parameters Page of Mode Select
   - Issue a Mode Sense 10 with page code 05h and disable block descriptor to get current settings
   - Clear Sense Data Length field in Mode Sense 10 Header
   - Set fields of Write Parameters Page (page code 05h):

```
Write Type          = 00h, Packet
Test Write          = 0, normal mode
                    = 1, test mode
Track Mode          = Cnt nibble for Q channel,
                      set as appropriate
Copy                = 0, Serial Copy Mgmt off
                    = 1, Serial Copy Mgmt on
FP                  = 1
Multi-Session       = 00b, No B0 pntr, Next Ses. not allowed
                    = 01b, B0=FF:FF:FF, Next Ses. not allowed
                    = 11b, Next Session Allowed, B0 set = NPA
                      (field used at Close Session)
Data Block Type     = 08h, Mode1, blksize = 2048
                    = 09h, Mode2, blksize = 2336
                    = 10h, Mode2-Form1, blksize = 2048
                    = 11h, Mode2-Form1 w/SubHdr,blksize=2056


Host Application Code = must be valid
Session Format      = 00h, CD-DA or CD-ROM Disc
                    = 01h, CD-I Disc
                    = CD-ROM XA Disc
                      (must match Data Block Type)
Packet Size         = set appropriately (CD-UDF expects 32d)
Audio Pause Length  = NOP
```

```
MCN                 = set as appropriate
ISRC                = set as appropriate
Sub Header Byte 0   = XA SubHdr File Number, typically 0
Sub Header Byte 1   = XA SubHdr Channel Number, typically 0
Sub Header Byte 2   = XA SubHdr Sub Mode, typically
                            00h for Mode 2 - Form 1
                            20h for Mode 2 - Form 2
Sub Header Byte 3   = XA SubHdr Coding Info, typically 0
                      (drive will validate with data block
                       type)
```

- Issue Mode Select 10 with modified Sense data

2. Determine address to begin writing
   - Use ReadDiscInfo to find disc type and number of invisible track
   - Use ReadTrackInfo, track = invisible track to get start address

3. Stream data to the disc
   - Use sequence of Write 10 commands with proper LBA, starting at first LBA, the CDD3610 will validate Host Application Code with Disc Application code upon first write.
   - The CDD3610 is expected to insert packet overhead between the fixed packets. Optionally, the host can issue a SyncCache command to proactively indicate the end of a packet.
   - ReadTrackInfo can be used during writing to determine the next writable address, that address will be the next expected LBA.
4. The CDD3610 updates the PMA upon track completion (Close Track).

4.3.4.2 Issues for FP without Reserved Tracks

It is recommended that Data Block Types 10h and 12h are used over types 11h and 13h, although all are supported. This will result in a less data transferred from the host, and thus is less prone to under-runs.

The CDD3610 will validate the Sub-Header Byte 2, bit 5 (the form bit) against Data Block Types of 10h and 12h. In the event of a mismatch, the Byte and Bit pointers of the returned sense data will point to the Sub-Header Byte 2. Validation occurs prior to start of write.

The use of SyncCache is optional between Fixed Packets. The CDD3610 will provide packet breaks automatically. If a SyncCache is issued midway through the recording of a Fixed Packet, the CDD3610 will pad that packet. If the data stream stops midway through a Fixed Packet, that packet will not start recording (if the Fixed Packet size is less than the buffer size) until all of the data for that packet is given, or another command is received that flushes the cache.

To end a track using this method, it is necessary to send a Close Track/Session for the invisible track. The drive will then complete the track, and note its PMA entry (the PMA information may be cached until a Close Session, Start/Stop Unit, or Physical Eject Request).

It is recommended that the Close Track/Session command be sent using the Immed bit = 1. This helps avoid time-out problems on the IDE/ATAPI bus.

4.4 CD-RW Specific Issues

4.4.1 Two Models for CD-RW

There are two distinct models for using CD-RW discs. The first is to use it like a CD-R disc with the option to blank part or all of the disc. This allows existing CD-R applications to function normally,

and add error recovery or utility features to back out the last changes made, or completely blank/erase the disc.

The second model is a random read/write model, similar to a HD or MO drive. This is the model to be used with the CD-UDF file system. In this model the disc is completely formatted as a single Fixed Packet Track, in a single session. Then individual packets can be overwritten. If less than a full packet is to be updated, the file system is responsible for the Read/Modify/Write sequence.

4.4.2 Overwriting Rules

There are only certain conditions that allow overwriting on a CD-RW disc.

- Fixed Packets
- A complete Track At Once track

In all cases the drive must make sure that the whole entity is overwritten or padded to completion. This means that the CDD3610 must determine the packet (or track) range before starting the overwrite. In the case of Fixed Packets the drive can get the packet size from the track descriptor block. In the case of tracks, the CDD3610 will get the length from the PMA.

The first write of the overwrite must start at the beginning of the fixed packet or track. If the data stream ends before the end of the fixed packet or track, the CDD3610 will pad.

4.4.3 Using the Blank Command

The Blank command is used to blank or erase various portions of a CD-RW disc. It is intended to be used primarily in the CD-R model for CD-RW. The following describes the parameters for the Blank Command:

```
   Blanking Type    = 000b, "Blank the Disc" - Mandatory
                          (Erase the entire disc)
                    = 001b, "Minimally Blank the Disc" - Mandatory
                                (Erase PMA, first TOC, and 1st pre-gap)
                    = 010b, "Blank a Track"
                          (Erase data of given track in incomplete area)
                    = 100b, "Blank a Track Tail" - Mandatory
                          (Erase data of a packet track from
                                 give LBA to end of track)

Start Addr/Trk      = appropriate address/track
                      (used only with Blanking Types 010b and 100b)
```

Due to the physical characteristics of CD-RW media, an erase operation does not return the media to its original state. Instead, an invalid data pattern in overwritten to the disc. This means that the Blank command can be a fairly lengthy operation.

First of all we have the total blank. This takes about 35 minutes to execute. The time is equal to the time needed to write a full disc. For a totally blank disc there are no constraints in using it afterwards.

.The other method to blank a disc is minimal blank. The big advantage is that it takes about half the time required to close a first session on a disk. (close to 2 minutes) However, a minimally blanked disc has some remainders left from previous write actions, and so it will have some limitations in using it.

Limitations for minimal blanked discs.

- no limitations for writing track at once tracks.

- packet oriented tracks shall not be written to these discs.
- reserving tracks can confuse the drive. When a track has been reserved, and the disc is reinserted again, then it is not always possible to avoid conflicts for that track due to the presence of previous data.

The drive is designed to work with the conflicting situations as much as possible. Therefore following rules are implemented.

After a blank, following write preconditions exists :

PMA exists for invisible track	Invisible area	Write Condition
NO	ERASED	Packet writing allowed (blank track)
NO	HAS DATA	Packet writing disallowed (result of quick erase)
YES	ERASED	Packet writing allowed (blank track)
YES	HAS DATA	Packet writing allowed (packets exist)

Defining the state of the invisible area can be done on 2 different ways :

- scan the remaining part of the disc, and make sure that it is erased or new media (versus contains data) for the total remaining part of the disc. This is a safe way, but it can take up to 35 minutes in worst case for a 74 minutes disc. The drive is not implemented this way. If a user wants the safe way, use the total blank.
- look only in the beginning of the invisible track, and accept that status for the remaining part of the disc. This is rather fast, but can be wrong depending on the data content from earlier actions. (e.g. before the blank action, that part of the disc was reserved, and further on the disc, some data was written). This can lead to unreadable discs.

To avoid confusion that can arise for reserving tracks on minimally blanked discs, the drive can decide to fully blank the reserved area in the program area of the disc. The user should be aware that this can take the same time as required for writing the reserved track.

Implementor's note : In case of a minimally blanked disc, we strongly advise to use only track at once or disc at once writing. For other application areas we strongly advise the use of the full blank.

4.4.4 Using the Format Unit Command

The Format Unit command is used to prepare a CD-RW disc for the random read/write use model of CD-UDF. The Format Unit command can write a single track within a single session over the entire recordable area of a CD-RW disc. The Write Parameters page of Mode Select 10 should be set up as follows:

- Issue a Mode Sense 10 with page code 05h and disable block descriptor to get current settings
- Clear Sense Data Length field in Mode Sense 10 Header
- Set fields of Write Parameters Page (page code 05h):

```
Write Type          = 00h, Packet
Test Write          = 0, normal mode
                    = 1, test mode
Track Mode          = Cnt nibble for Q channel,
                      set as appropriate
Copy                = 0, Serial Copy Mgmt off
```

```
                        = 1, Serial Copy Mgmt on
FP                      = 1
Multi-Session           = 00b, No B0 pntr, Next Ses. not allowed
                        = 01b, B0=FF:FF:FF, Next Ses. not allowed
                        = 11b, Next Session Allowed, B0 set = NPA
                          (field used at Close Session)
Data Block Type         = 08h, Mode1, blksize = 2048
                        = 09h, Mode2, blksize = 2336
                        = 10h, Mode2-Form1, blksize = 2048
                        = 11h, Mode2-Form1 w/SubHdr,blksize=2056
                        = 12h, Mode2-Form2, blksize = 2324
                        = 13h, Mode2- mixed form /w SubHdr,
                               blksize = 2332
Host Application Code = must be valid
Session Format          = 00h, CD-DA or CD-ROM Disc
                        = 01h, CD-I Disc
                        = CD-ROM XA Disc
                          (must match Data Block Type)
Packet Size             = set appropriately
Audio Pause Length      = NOP
MCN                     = set as appropriate
ISRC                    = set as appropriate
Sub Header Byte 0       = XA SubHdr File Number, typically 0
Sub Header Byte 1       = XA SubHdr Channel Number, typically 0
Sub Header Byte 2       = XA SubHdr Sub Mode, typically
                                 00h for Mode 2 - Form 1
                                 20h for Mode 2 - Form 2
Sub Header Byte 3       = XA SubHdr Coding Info, typically 0
                          (drive will validate with data block
                           type)
```

- Issue Mode Select 10 with modified Sense data

The Format Unit command will write the entire disc, and will take upwards of 30 minutes to complete.

General rules :

Format session 0, grow 0 :

preconditions : none
post condition is : 1 leadin, 1 fixed packet track, 1 leadout.
If the new session is smaller than the old, the remaining old data gives this disc the appearance of a minimally blanked disk.

Format session 1, grow 0 :

precondition : last session must be empty (no incomplete sessions)
post condition : 1 more session added to the disc.

Format session x (don't care), grow 1 :

precondition : last session must be closed or empty.
only 1 track in that session,
that track must be fixed packet
it can only grow, not become smaller.
post condition : last session became bigger.

4.4.5 Defect Management

Defect management is to be handled by the CD-UDF file system that is used with CD-RW. The drive will report recovered errors on Reads and Verifies. Those errors will be used as an indication by the file system to relocate the data from those packets to other packets.