PIONEER®

The Art of Entertainment

CD-ROM
SCSI-2 Command Set

Reference Manual

Version 3.1

(OB-U0077C)

June 26, 1997

Pioneer Electronic Corporation

Pioneer New Media Technologies, Inc.

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FCC INFORMATION

The equipment described in this manual has been tested and found to comply with the limits for a Class B digital device in accordance with the specifications in Part 15 of FCC rules. These specifications are designed to provide reasonable protection against radio and television reception interference in a residential installation. There is no guarantee that interference will not occur in a particular installation.

To determine if your CD-ROM drive is causing interference, turn the drive off. If the interference stops, it was most likely caused by the drive. To eliminate the interference, you may try one or more of the following corrective measures:

- verify the cables and connectors between components are shielded.
- increase separation between the drive and components.
- connect the drive into an outlet or circuit different from that which the components are connected.
- consult dealer or experienced radio/television technician for help.

The Federal Communications Commission offers a handbook that may help you with eliminating interference. The handbook is titled *Interference Handbook* (stock number 004-000-00493-1) and may be ordered from the U.S. Government Printing Office, Washington, D.C. 20402.

WARNING: Any changes or modifications to this product that are not authorized by Pioneer could void the FCC Certification and negate the user's authority to operate the equipment.

DOC CLASS B COMPLIANCE

This digital apparatus does not exceed the Class B limits for radio noise emissions from digital apparatus set out in the radio interference regulations of the Canadian Department of Communications.

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REVISION HISTORY

Version	Date	Section/Page	Description
1.0	09.07.93	N/A	Initial release
2.0	07.20.94	Title Sections 1.1 - 1.2 Section 1.4 Sections 2.46 - 2.49	Addition of DRM-602X Vendor Unique Commands
3.0	02.08.95	Sections 1.1 - 1.2 Section 1.4 Section 2.1 Section 2.9.7 Sections 2.22 - 2.23 Section 2.37 Section 2.40 Sections 2.46 - 2.49	Addition of models DR-124X and DRM-624X Addition of Appendix D
3.1	06.26.97	Sections 1.0 - 1.2 Section 1.4 Sections 2.46 - 2.49	Addition of models DR-A10X, DR-411, DR-U10X, DR-433, DR-A12X, DR-444, DR-U12X, DR-466, DR-A24X, DR-511, DR-U24X, DR-533

1. PREFACE

These specifications define the SCSI command set that defines the interface between a host computer and such primary devices as CD-ROM drives and CD-R writers.

These are the control functions for the Pioneer DRM/DR-U series CD-ROM drives. For specific models, refer to Section 1.1 below.

For details of the common standard of SCSI, refer to *ANSI SCSI-2 working draft X3T9.2 revision 10K*.

For details regarding the use of the compact disc as a SCSI CD-ROM device, refer to the proposal made after the *ANSI SCSI-2 working draft X3T9.2 revision 10K*.

For Compact Disc, CD-ROM disc, and CD-R disc specifications, refer to the *Red Book*, *Yellow Book* and *Orange Book Part2*.

For file system specifications, refer to *ISO 9660*.

For details about the use of SCSI Bus, refer to the installation manuals of the particular drives.

For more information on player control commands (mnemonic commands), refer to Appendix B of this document and/or Pioneer Industrial LaserDisc Player (any model) User's Manuals.

THESE SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

1.1 DRM/DR-U Series

The six-disc DRM series drives are SCSI-2[1] CD-ROM minichangers using a single movable optical assembly and a removable Pioneer-developed 6-disc CD magazine. Six discs may be stored in individual trays in the magazine. Each tray swings out of the magazine into the drive assembly. Only one disc may be read at a time. The minichanger appears on the SCSI bus as one SCSI ID with six (6) logical units (0-5), one logical unit assigned per disc. The assignment of logical units to discs may be changed at any time.

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[1] DRM-604X is the only minichanger that supports both the SCSI-1 and SCSI-2 command sets. Please refer to Pioneer's *DRM-600 Series SCSI Command Reference Manual* for details on the SCSI-1 command set.

TABLE 1-0   MODELS OF DRM/DR-U SERIES SUPPORTING SCS-2 COMMAND SET

Model Number	Voltage Requirements
DRM-602X	100 v ~ 230 v
DRM-604X	100 v ~ 230 v
DRM-624X	100 v ~ 230 v
DRM-1804X	100 v ~ 230 v
DR-D504X	DRM-5004X 500-disc Autochanger built-in use
DR-U124X	+5 v. +12 v
DR-UA124X	+5 v. +12 v ATA BUS mode1
DR-A10X	+5 v. +12 v ATA BUS mode1
DR-U10X	+5 v. +12 v
DR-411	+5 v. +12 v OEM version of DR-A10X
DR-433	+5 v. +12 v OEM version of DR-U10X
DR-A12X	+5 v. +12 v ATA BUS mode1
DR-U12X	+5 v. +12 v
DR-444	+5 v. +12 v OEM version of DR-A12X
DR-466	+5 v. +12 v OEM version of DR-U12X
DR-A24X	+5 v. +12 v ATA BUS mode1
DR-U24X	+5 v. +12 v
DR-511	+5 v. +12 v OEM version of DR-A24X
DR-533	+5 v. +12 v OEM version of DR-U24X

TABLE 1-2   DRIVE VERSIONS SUPPORTED BY THIS MANUAL

Model Number	Vendor	Product Data	Revision Number
DRM-602X	Pioneer	CD-ROM DRM-602X	2901 or greater
DRM-604X	Pioneer	CD-ROM DRM-604X	2403 or greater
DRM-624X	Pioneer	CD-ROM DRM-624X	0100 or greater
DRM-1804X	Pioneer	CD-ROM DRM-1804X	0100 or greater
DR-D504X	Pioneer	CD-ROM DR-D504X	2405 or greater
DR-U124X	Pioneer	CD-ROM DR-U124X	0100 or greater
DR-UA124X	Pioneer	CD-ROM DR-UA124X	0100 or greater
DR-A10X	Pioneer	CD-ROM DR-A10X	0100 or greater
DR-U10X	Pioneer	CD-ROM DR-U10X	0100 or greater
DR-411	Pioneer	CD-ROM DR-A10X	0100 or greater
DR-433	Pioneer	CD-ROM DR-U10X	0100 or greater
DR-A12X	Pioneer	CD-ROM DR-A12X	0100 or greater
DR-U12X	Pioneer	CD-ROM DR-U12X	0100 or greater
DR-444	Pioneer	CD-ROM DR-A12X	0100 or greater
DR-466	Pioneer	CD-ROM DR-A12X	0100 or greater
DR-A24X	Pioneer	CD-ROM DR-A24X	0100 or greater
DR-U24X	Pioneer	CD-ROM DR-U24X	0100 or greater
DR-511	Pioneer	CD-ROM DR-A24X	0100 or greater
DR-533	Pioneer	CD-ROM DR-U24X	0100 or greater

The DRM-1804X is an 18-disc single drive SCSI-2 CD-ROM changer. It appears on the SCSI bus as one SCSI ID with two (2) logical units. The single CD-ROM reader is logical unit 0 and the changer is logical unit 1. For detail information, refer to Pioneer's *DRM-1804X CD-ROM Jukebox Changer Mechanism Controller SCSI Specifications*, document number OB-U0084-B.

The DRM series includes two jukebox changers - the DRM-1004X 100-disc CD-ROM changer and the DRM-5004X 500-disc CD-ROM changer. For detail information, refer to Pioneer publications *DRM-1004X Series 100-Disc CD-ROM Changer Mechanism Controller Specifications*, document number DSE-S035C and *DRM-5004X Series 500-Disc CD-ROM Changer Mechanism Controller SCSI Specifications*, document number OB-U0091-B, respectively.

The DR-U series are SCSI-2 single disc CD-ROM drives. They appear on the SCSI bus as one SCSI ID with logical unit 0.

The DR-D504X is a SCSI-2 single drive unit that is mounted into the DRM-5004X 500-disc jukebox changer. It is assigned one SCSI ID and logical unit 0. Refer to Pioneer's *DRM-5004X Series 500-Disc CD-ROM Changer Mechanism Controller SCSI Specifications*, document number OB-U0091-B, for further details.

Implementing Pioneer's LaserDisc player technology, vendor unique SCSI commands support the alphanumeric player command set allowing CD audio control through use of simple mnemonic commands. Refer to Appendices A and B for further information.

Table 1.1 on the opposite page lists the models supporting the SCSI-2 command set.

1.2   Drives Supported by this Manual

Refer to Table 1-2 on the opposite page for drive versions that are supported by this manual. To determine what version your drive is, issue an IQUIRY command, reference Section 2.4. The drive's response to the command will be to return the following information about the drive:

    Model Number;
    Vendor;
    Product Data; and
    Revision Number.

1.3   SCSI Protocol

The SCSI Protocol outlined in this section applies only to SCSI bus models. It does not support ATA bus models.

1.3.1   Command Link/Control Field

The Control Field inside the Command Block is defined as:

Bit	7	6	5	4	3	2	1	0
	Vendor Unique		Reserved				Flag	Link

The Command Link function is not supported by the DRM/DR-U Series. Set Flag and Link bits to "0" (FALSE).

Set the RelAdr (Relative Address) bit, bit 0 of byte 1, inside the Command Block to "0" (FALSE).

1.3.2   Disconnect/Reselect

Selection time-out period is 250 ms.

If the initiator does not respond to reselection within the time-out period, the drive will release the bus for a minimum of 200 ms. The drive will then repeat the arbitration/reselection sequence until the initiator responds, issues BUS DEVICE RESET, or until the SCSI bus is reset. During a reselection retry, the drive will return BUSY to selection requests from any initiator.

During execution of audio commands, if the disconnect/reselect function is selected, the drive disconnects from the initiator before execution a SEEK or other operation that requires head movement. When the selected address is located, the drive reselects the initiator and begins audio playback. The time needed for the reselection procedure is dependent upon the status of the SCSI bus. Audio playback may begin before the reselection is complete. Refer to Appendix A for more information.

1.3.3 Status Phase

Four status conditions are supported. They are

GOOD	00h
CHECK CONDITION	02h
BUSY	08h
RESERVATION CONFLICT	18h

When the IMMED bit is set to "1" (TRUE) in a command block, the drive returns GOOD when the command is first interpreted. As the command is being executed, the drive returns BUSY to successive commands until operation of the first command is complete and the drive is ready to receive a new command.

Refer to Section 2.31 REQUEST SENSE for details on deferred error reporting.

1.3.4 In-Phase/Out-Phase Messages

The DRM/DR-U Series supports only those In-Phase and Out-Phase Messages that are listed below and on the following page. The drive will return a MESSAGE REJECT for any messages received other than those listed.

Message **Msg 05h + 09h** will cause the drive to go to BUS FREE PHASE without a retry.

Message In-Phase (issued by drive)

COMMAND COMPLETE	00h
SAVE DATA POINTER	02h
DISCONNECT	04h
MESSAGE REJECT	07h
IDENTIFY	80h - FFh
SYNCHRONOUS DATA TRANSFER REQUEST[2]	01h

---

[2] From EXTEND MESSAGE (01h)

TABLE 1-5   SAMPLE COMMAND

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Operation Code (XXh)							
1	Logical Number			Reserved				
2	Logical Block Address (MSB)							
3	Logical Block Address							
4	Logical Block Address							
5	Logical Block Address (LSB)							
6	Reserved							
7	Allocation Length (MSB)							
8	Allocation Length (LSB)							
9	Reserved							

Operation Code : XXh

Logical Unit Number specifies which Logical Unit the command applies to.

Logical Block Address specifies which Logical Block Address (LBA) the operation is to start.

Allocation Length is (depending on the command) the number of Logical Blocks or the number of bytes that the initiator is expecting to receive from the drive.

Message Out-Phase (issued by host computer)

INITIATED DEFECTED ERROR	05h
ABORT	06h
NO OPERATION	08h
MESSAGE PARITY ERROR	09h
BUS DEVICE DRIVER[3]	0Ch
TERMINATE IO PROCESS	11h
IDENTIFY	80h - FFh
SYNCHRONOUS DATA TRANSFER REQUEST[4]	01h

1.4   Address Format for Answering Occasion (MSF bit)

With some commands, it is possible to choose either Logical Block Address or MSF Format with Address Field of answering data.

MSF bit

if "0" (FALSE), use Logical Block Address as CD-ROM Absolute Address or Track Relative Address. If Track Relative Address, the MSF bit is indicated by 2s sequences.

if "1" (TRUE), MSF Format is used. Within the shift area, number declines by a positive number.

1.5   Sample Command

The table on the opposite page outlines the command structure. Some commands apply to the entire drive. For these commands only, the LUN will be ignored.

Commands with Logical Blocks, e.g. READ, VERIFY, have Allocation Length in Blocks. All others have Allocation Length in bytes. Some commands use Transfer Length instead of Allocation Length to specify the number of bytes that the initiator will transfer to the drive.

---

[3] For equipment supporting Change Definition Command, the DRM/DR-U Series drives have a Hardware Reset Option. In this case, the Change Definition chosen by the SCSI action definition would not be changed or initialized by either the SCSI BUS RESET or BUS DEVICE RESET message.

[4] From EXTEND MESSAGE (01h).

The drive terminates the DATA IN phase when the specified number of bytes have been transferred or, in the case when the bytes exceed the number of bytes the drive wishes to transfer, the DATA IN phase is terminated when the number of bytes prepared have been transferred.

Table 2-0   SCSI-2 COMMAND LIST (by Name)

| Command Name | Code | Applied Model | | | Sense Data |
		I	II	III	Contents of Information Bytes
Audio Scan (1)	BAh	---	---	7	Logical Block Address
Audio Scan (2)	CDh	yes	yes	7	Logical Block Address
Change Definition	40h	1	---	---	
Inquiry	12h	yes	yes	yes	
Mode Select(6)	15h	2	2	yes	
Mode Select(10)	55h	2	2	yes	
Mode Sense(6)	1Ah	2	2	yes	
Mode Sense(10)	5Ah	2	2	yes	
Pause/Resume	4Bh	yes	yes	yes	Logical Block Address
Play Audio (10)	45h	yes	yes	yes	Logical Block Address
Play Audio (12)	A5h	yes	yes	yes	Logical Block Address
Play Audio MSF	47h	yes	yes	yes	Logical Block Address
Play Audio Track/Index	48h	yes	yes	yes	Logical Block Address
Play Track Relative (10)	49h	yes	yes	yes	Logical Block Address
Play Track Relative (12)	A9h	yes	yes	yes	Logical Block Address
Prevent/Allow Medium Removal	1Eh	yes	yes	yes	
Read (6)	08h	yes	yes	yes	Logical Block Address
Read (10)	28h	yes	yes	yes	Logical Block Address
Read (12)	A8h	yes	yes	yes	Logical Block Address
Read Buffer	3Ch	yes	yes	yes	
Read CD	BEh	---	---	3	Logical Block Address
Read CD-DD	D8h	---	yes	3	Logical Block Address
Read CD MSF	B9h	---	---	3	Logical Block Address
Read CD-DA MSF	D9h	---	yes	3	Logical Block Address
Read CD-XA	DBh	---	yes	yes	Logical Block Address
Read All Subcode	DFh	---	yes	7	Logical Block Address
Read CD-ROM Capacity	25h	yes	yes	yes	Logical Block Address
Read Header	44h	yes	yes	yes	Logical Block Address
Read Sub-Channel	42h	yes	yes	yes	
Read TOC	43h	4	yes	yes	
Receive Diagnostic Results	1Ch	yes	yes	yes	
Release	17h	yes	yes	5	
Request Sense	03h	yes	yes	yes	
Reserve	16h	yes	yes	5	
Rezero Unit	01h	yes	yes	yes	
Seek (6)	0Bh	yes	yes	yes	Logical Block Address
Seek (10)	2Bh	yes	yes	yes	Logical Block Address
Send Diagnostic	1Dh	yes	yes	yes	
Set CD-ROM Speed (1)	BBh	---	---	yes	
Set CD-ROM Speed (2)	DAh	yes	yes	yes	
Start/Stop Unit	1Bh	yes	yes	yes	
Stop Play/Scan	4Eh	---	---	yes	
Test Unit Ready	00h	yes	yes	yes	
Verify (10)	2Fh	yes	yes	---	Logical Block Address
Verify (12)	AFh	yes	yes	---	Logical Block Address
Write Buffer	3Bh	yes	yes	5	
Read CDP	E4h	yes	yes	yes	
Read Drive Status	E0h	yes	yes	yes	
Write CDP	E3h	yes	yes	yes	

2. COMMANDS

The table on the opposite page lists the commands in the SCSI-2 command set and their corresponding code, applied model and sense data when applicable.

Applied Model

Applied Model has three values. Each model code corresponds to particular drive models.

I :   product models DRM-604X; DRM-1804X; and DR-D504X

II :   product model DRM-602X

III :   product models DRM-624X; DR-U124X; DR-UA124X; DR-A10X; DR-U10X; DR-A12X; DR-411; DR-U12X; DR-433; DR-A24X; DR-511; DR-U24X; and DR-533

Each command is either supported by a drive, indicated by "yes", not supported by a drive, "---", or is supported but with restrictions and/or conditions, "N" where N is a numeric value 1-7.

yes :   is supported by all drives corresponding to this Applied Model code.

--- :   is not supported by any of the drives corresponding to this Applied Model code.

1 :   is not supported by DRM-1804X.

2 :   does not support the media type code 4h, 8h, 70h, 71h and 72h. There is limited action in the CD-ROM Audio Controller Parameter Page (0Eh).

3 :   random access is possible with CD-DA data. Buffer Over Flow Error would not occur. For SUB-CHANNEL READ OUT, support is only when the Beginning Logical Block Address is FFFFFFFFh and Sub-Channel data. It is unable to choose the Beginning Logical Block Address or to read out along with other data.

4 :   is not supported by Format Field = 2 (all of Q Sub-Code information).

5 :   is not supported by DR-UA124X.

6 :   is unable to reassign disc of single type drive.

7 :   is not supported by DR-A10X, DR-U10X, DR-411, DR-433, DR-A12X, DR-U12X, DR-444, DR-466, DR-A24X, DR-U24X, DR-511 and DR-533.

Upon execution of some commands, a Page Code is returned. The table on the next page lists the various CD-ROM Mode Page Codes.

NOTE: The Applied Model values and the support codes listed above apply to the CD-ROM Mode Page Code List on the next page. (The values are listed opposite the table for your convenience.)

TABLE 2-0A   CD-ROM MODE PAGE CODE LIST

Page Code	Description	Section	Applied Model		
			I	**II**	**III**
00h	Only Block Descriptor		yes	yes	yes
01h	Read Error Recovery Page	2.9.1	yes	yes	yes
07h	Verify Error Recover page	2.9.2	yes	yes	---
0Bh	Peripheral Device page	2.9.3	yes	yes	yes
0Dh	CD-ROM Parameters page	2.9.5	yes	yes	yes
0Eh	CD-ROM Audio Control page	2.9.6	yes	yes	yes
2Ah	CD-ROM Capabilities & Mechanical Status page	2.9.7	---	---	yes
31h	Drive Speed page	2.9.8	yes	yes	yes
3Eh	Logical Unit Assignment page	2.9.9	6	6	6
3Fh	Return all pages[5]		yes	yes	yes

---

[5] Valid only for the MODE SENSE command.

Applied Model

Applied Model has three values. Each model code corresponds to particular drive models.

I :   product models DRM-604X; DRM-1804X; and DR-D504X

II :   product model DRM-602X

III :   product models DRM-624X; DR-U124X; DR-UA124X; DR-A10X; DR-U10X; DR-A12X; DR-411; DR-U12X; DR-433; DR-A24X; DR-511; DR-U24X; and DR-533

Each command is either supported by a drive, indicated by "yes", not supported by a drive, "---", or is supported but with restrictions and/or conditions, "N" where N is a numeric value 1-7.

yes :   is supported by all drives corresponding to this Applied Model code.

--- :   is not supported by any of the drives corresponding to this Applied Model code.

1 :   is not supported by DRM-1804X.

2 :   does not support the media type code 4h, 8h, 70h, 71h and 72h. There is limited action in the CD-ROM Audio Controller Parameter Page (0Eh).

3 :   random access is possible with CD-DA data. Buffer Over Flow Error would not occur. For SUB-CHANNEL READ OUT, support is only when the Beginning Logical Block Address is FFFFFFFFh and Sub-Channel data. It is unable to choose the Beginning Logical Block Address or to read out along with other data.

4 :   is not supported by Format Field = 2 (all of Q Sub-Code information).

5 :   is not supported by DR-UA124X.

6 :   is unable to reassign disc of single type drive.

7 :   is not supported by DR-A10X, DR-U10X, DR-411, DR-433, DR-A12X, DR-U12X, DR-444, DR-466, DR-A24X, DR-U24X, DR-511 and DR-533.

TABLE 2-1   AUDIO SCAN (1)

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Operation Code (CDh)							
1	Logical Unit Number		. Direct		Reserved			
2	Scan Start Address (MSB)							
3	Scan Start Address							
4	Scan Start Address							
5	Scan Start Address (LSB)							
6	Reserved							
7	Reserved							
8	Reserved							
9	Type		.	Reserved				

TABLE 2-1A   LOGICAL BLOCK ADDRESS FORMAT (TYPE = 00B)

Byte	Bit							
	7	6	5	4	3	2	1	0
2	Logical Block Address (MSB)							
3	Logical Block Address							
4	Logical Block Address							
5	Logical Block Address (LSB)							

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2.1   Audio Scan (1) (CDh)

When AUDIO SCAN (1) is executed, the drive begins a high-speed scan from the Scan Start Address. The drive plays a block as it crosses each track. Each scan is approximately 15 seconds.

When the specified search address is found, GOOD status is returned.

If the drive is not ready or if the Scan Start Address is not on an audio track, Check Condition status is returned.

During an audio scan, the drive can receive and execute the following SCSI commands without scan termination:

> AUDIO PLAY (StpAdr=1), AUDIO STATUS, AUDIO STOP
> INQUIRY
> MODE SELECT, MODE SENSE
> READ BUFFER, WRITE BUFFER
> READ CD-ROM CAPACITY, READ SUB CHANNEL, READ TOC
> RECEIVE DIAGNOSTIC RESULTS, REQUEST SENSE, TEST UNIT READY
> RELEASE, RESERVE

There are several commands that when received by the drive during an audio scan, the drive will terminate the scan and execute the received command. The commands are:

> PLAY AUDIO (StpAdr=0), AUDIO SCAN, PLAY AUDIO TRACK
> PAUSE/RESUME
> READ, SEEK, VERIFY
> READ HEADER
> START/STOP UNIT, REZERO UNIT
> SEND DIAGNSTICS
> PREVENT/ALLOW MEDIA REMOVAL

Operation Code is (CDh).

Direct
is "0" (FALSE) when the drive scans forward.
is "1" (TRUE) when the drive scans backwards.

Scan Start Address contains the address at which the audio scan is to begin.

TABLE 2-1B   AMIN, ASEC AND AFRAME ADDRESS FORMAT (TYPE = 01B)

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

AMIN, ASEC and AFRAME show the absolute time for the beginning of the disc in BCD. The values must be in the ranges 0~99 (AMIN), 0~59 (ASEC) and 0~74 (AFRAME).

TABLE 2-1C   TRACK NUMBER ADDRESS FORMAT (TYPE = 10B)

Byte	Bit							
	7	6	5	4	3	2	1	0
2	Reserved							
3	Reserved							
4	Reserved							
5	Track number (TNO) (01-99)							

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Type defines the format of the Scan Start address field. Type has four parameters.

The four (4) parameters are
      00b : Logical Block Address format   (reference Table 2-1A)
      01b : AMIN, ASEC and AFRAME format   (reference Table 2-1B)
      10b : Track Number Address format   (reference Table 2-1C)
      11b : Reserved

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TABLE 2-2   AUDIO SCAN (2)

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Operation Code (BAh)							
1	Reserved			Direct		Reserved		
2	Scan Starting Address (MSB)							
3	Scan Starting Address							
4	Scan Starting Address							
5	Scan Starting Address (LSB)							
6	Reserved							
7	Reserved							
8	Reserved							
9	Type		Reserved					
10	Reserved							
11	Reserved							

2.2   Audio Scan (2) (BAh)

Operation Code is (BAh).

Direct

    If "0" (FALSE), the drive scans forward.

    If "1" (TRUE), the drive scans backwards.

Scan Start Address is the address at which the audio scan begins operation.

Type defines the format of the Scan Start address field. Type has four parameters.

The four (4) parameters are

    00b : Logical Block Address format   (reference Table 2-1A)

    01b : AMIN, ASEC and AFRAME format   (reference Table 2-1B)

    10b : Track Number Address format   (reference Table 2-1C)

    11b : Reserved

TABLE 2-3   CHANGE DEFINITION

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Operation Code (40h)							
1	Logical Unit Number			Reserved				
2	Reserved							SCB=0
3	Reserved	Definition Parameter						
4	Reserved							
5	Reserved							
6	Reserved							
7	Reserved							
8	Parameter Data Length (0)							
9	Reserved							

2.3   Change Definition (40h)

When executed, the CHANGE DEFINITION command modifies the operating definition of the drive regardless of the specified logical unit number.

A SCSI reset or BUS DEVICE RESET will not affect the definition changed by the CHANGE DEFINITION command.

Cycling the power to the drive OFF and ON will cause the operating definition to revert to the default setting.

If the CHANGE DEFINITION command did not execute successfully, the operating definition will remain in the same status it was prior to the attempted execution of the CHANGE DEFINITION command.

Operation Code is (40h).

Save Control Bit (SCB)
>   Must be set to "0" (FALSE).
>   The drive will not save the operating definition. A power reset will set the drive to its initial operating definition.

Definition Parameter specifies the operating definition. The Definition Parameter field supports the following field values:

00h	:	Use current operating definition
01h	:	SCSI-1 operating definition
02h	:	SCSI-1 operating definition
03h	:	SCSI-2 operating definition
04h~7Fh	:	Reserved

DRIVE NOTES:
>   This command is used by the DRM-604X.
>   Drives that are SCSI-2 only and will reject the CHANGE DEFINITION command are:
>>   DRM-602X, DRM-624X, DRM-1804X and the DR-U Series drives

TABLE 2-4   INQUIRY

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Operation Code (12h)							
1	Logical Unit Number			Reserved				EVPD (0)
2	Reserved							
3	Reserved							
4	Allocation Length : 47 (2Fh)							
5	Reserved							

TABLE 2-4A   INQUIRY DATA FORMAT

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type (05h)				
1	RMB	Reserve						
2	0			0		ANSI Version (2)		
3	0	TIOP	Reserve		Response Format (2)			
4	Additional Length : 42 (2Ah)							
5	Reserve							
6	Reserve							
7	0	0	0	SYNC	0	Reserve	0	0
8~15	Vendor Name (8-byte ASCII code) (PIONEER)							
16~31	Product Inquiry Data (16-byte ASCII code)							
32~35	Revision Number (ASCII code) ("XXXX")							
36	Release Version (20h)							
37~46	Revision Date (10-byte ASCII code) ("YYYY/MM/DD")							

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2.4   Inquiry (12h)

The INQUIRY command supports standard 47 Bytes Inquiry data. If byte length in Allocation Length is less than 47 bytes, the requested length is transferred. If byte length is 47 bytes or more, only 47 bytes will be transferred.

The INQUIRY command returns Check Condition if data transfer to the Initiator was not properly received.

Whenever a Check Condition is returned against any command, inquiry data is returned providing the initiator with system information.

Operation Code is (12h).

Enable Vital Product Data (EVPD)

Must be set to "0" (ZERO) for the drive to return the standard Inquiry data.

If the Page Code field is not set to "0" (ZERO), the drive will return Check Condition Status (Sense Key: Illegal Request) and sense code INVALID FIELD IN CDB.

Table 2-4A on the opposite page illustrates the standard Inquiry data format.

RMB

If "1" (TRUE), the media is removable.

TIOP

If "1" (TRUE), the drive will support the Terminate I/O Process message.

SYNC

If "1" (TRUE), the drive supports synchronous data transfers.

Table 2-4B on the next page outlines the drive specific values for bytes 16~31, Product Inquiry Data; and bytes 32~35, Revision Number.

TABLE 2-4B   DRIVE SPECIFIC STRINGS

Drives	Bytes	
	16 ~ 31 (Product Data)	32 ~ 35 (Revision Number)
DRM-602X	CD-ROM DRM-602X	29XX[6]
DRM-604X	CD-ROM DRM-604X	24XX
DRM-624X	CD-ROM DRM-624X	01XX
DRM-1804X	CD-ROM DRM-1804X	01XX
DR-D504X	CD-ROM DR-D504X	24XX
DR-A10X	CD-ROM DR-A10X	01XX
DR-U10X	CD-ROM DR-U10X	01XX
DR-411	CD-ROM DR-A10X	01XX
DR-433	CD-ROM DR-U10X	01XX
DR-A12X	CD-ROM DR-A12X	01XX
DR-U12X	CD-ROM DR-U12X	01XX
DR-444	CD-ROM DR-A12X	01XX
DR-466	CD-ROM DR-U12X	01XX
DR-A24X	CD-ROM DR-A24X	01XX
DR-U24X	CD-ROM DR-U24X	01XX
DR-511	CD-ROM DR-A24X	01XX
DR-533	CD-ROM DR-U24X	01XX

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[6] Where X denotes a whole number, 0-9.

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TABLE 2-5 MODE SELECT(6) (15H)

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Operation Code (15h)							
1	Logical Unit Number			PF	Reserved			SP
2	Reserved							
3	Reserved							
4	Parameter List Length							
5	Reserved							

TABLE 2-5A   MODE SELECT(6) HEADER AND PARAMETER LIST

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Reserved							
1	Media Type (0)							
2	Reserved							
3	Block Descriptor Length (0 or 8)							

Block Header

Byte	
4	Block Descriptor / Page Descriptor(s)
:	
:	
:	
N	Block Length (LSB) / Ending Element Address (LSB)

Block Descriptor and/or Page Code
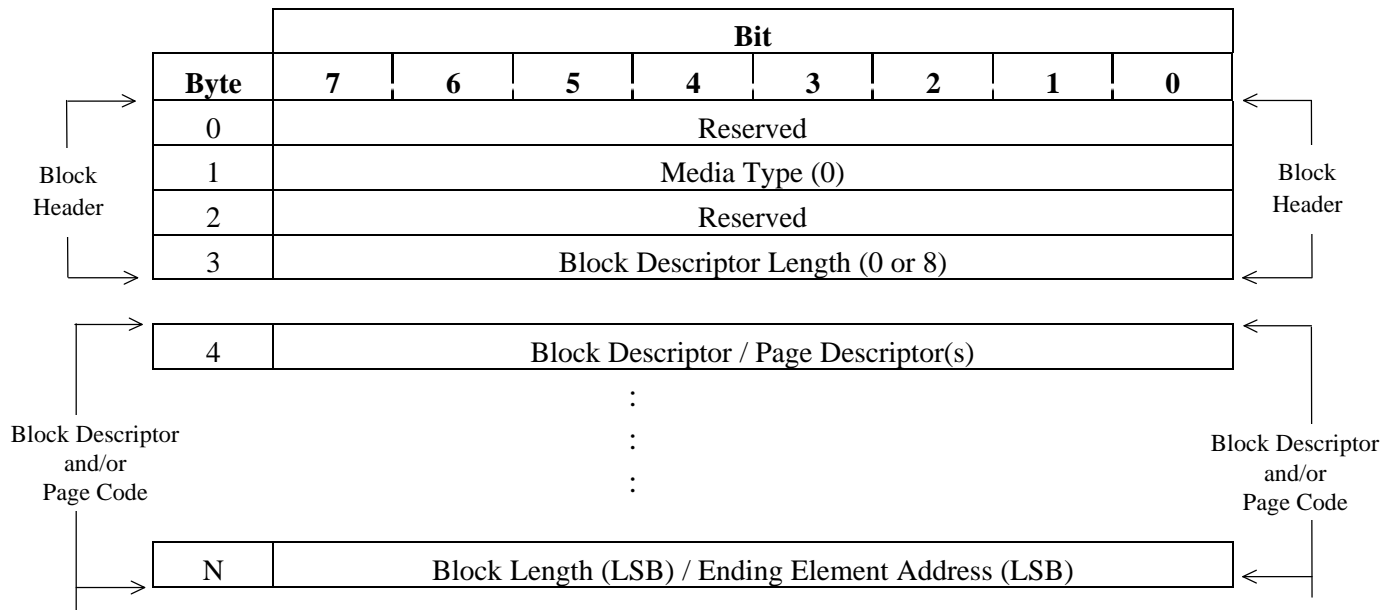
2.5 Mode Select(6) (15h)

The MODE SELECT(6) command provides a range for the initiator specifying specific operating parameters, e.g., medium, logical unit and peripheral device parameters.

IMPORTANT: Initiators should issue the MODE SENSE command (reference Section 2.7) prior to each execution of the MODE SELECT command to determine supported pages, page lengths and other parameters.

Operating Code is (15h).

PF (Page Format)

Must be set to "1" (TRUE). The drive does not check the value of the Page Format bit.

SP (Save Parameters)

Must be set to "0" (FALSE). Parameter saving is not supported.

Parameter List Length

If "0" (ZERO), no data will be transferred.

The Parameter List Length is the number of bytes of the Mode Select Parameter List that is to be transferred in the Data Out phase. A parameter list length that results in the truncation of any descriptor, header or page parameters will cause the target to terminate the command. In this case Check Condition Status (Sense Key : Illegal Request) is returned and Sense Code is set to Parameter List Length Error.

Using the MODE SELECT command, the initiator can assign or alter parameters for the logical units. The Parameter List includes a 4-byte header, followed by 0-1 block descriptors and 0-N, where N is a whole number, page descriptions. Refer to Table 2-5A on the opposite page. The drive keeps parameters, the block descriptor and parts of page descriptors for each logical unit in its controller memory. When the drive is reset, the default parameter values are restored.

Refer to Table 2-5B on the next page for details on the Block Descriptor format.

Refer to Table 2-5C on the next page for details on the Page Descriptor format.

After the MODE SELECT command is received, the drive returns Check Condition Status (Sense Key : Unit Attention) and sets sense key to Mode Select Parameter Changed for the first command received (except for INQUIRY or REQUEST SENSE) from any other initiator. The Sense Key Unit Attention is returned even if the parameters have not actually changed with the MODE SELECT command.

TABLE 2-5B   BLOCK DESCRIPTOR

Byte	_ Bit _							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Density Code							
1	Number of Blocks (MSB)							
2	Number of Blocks							
3	Number of Blocks (LSB)							
4	Reserved							
5	Block Length (MSB)							
6	Block Length							
7	Block Length (LSB)							

TABLE 2-5C   PAGE DESCRIPTOR

Byte	_ Bit _							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Reserve	Reserve	Page Code					
1	Page Length							
2	Mode Parameter Page Definition							
	:							
	:							
N	Mode Parameter Page Definition							

BLOCK DESCRIPTOR

Media Type
>   Set to "0" (ZERO).

Block Descriptor Length
>   If "0" (ZERO), there is no block description included in the parameter list.
>   Set to "0" or "8".

Density Code specifies data type to be transferred. Five (5) parameters are supported. They are

01h	:	User data only (2048 bytes/physical sector) [default]
02h	:	User data plus auxiliary data (2336 bytes/physical sector)
03h	:	Header, user data plus auxiliary data (2340 bytes/physical sector)
04h	:	Audio data only (1/75th of a second per logical block)
05h~FFh	:	Reserved

Number of Blocks
>   Set to "0" (ZERO).

Logical Block Length specifies logical block size in number of bytes. In the current version, 256, 512, 1024, 2048(default), 2052, 2056, 2336, 2340 and 2352 byte are supported. An external switch on the back of the DRM-602X, DRM-604X and DRM-1804X drives allows the power-on default value to be switched to either 512 or 2048.

PAGE DESCRIPTOR

Page Code indicates the meaning of the data contained in the page.

Page Length is the number of bytes supported for each page. It does not include the page length byte.

The drive will return Check Condition if ECC is enabled and the initiator accesses a Mode 1 or Mode 2 form1 data block and has specified 2336-, 2340-, or 2352 byte length.

When the initiator accesses a Mode 2 form2 data block and has specified 2336-, 2340- or 2352-byte lengths, the ECC must be disabled. The drive will return Check Condition.

The first two bytes of the page descriptor comprise the header which consists of the Page Code and Page Length. Following the header are the page definitions.

TABLE 2-6   MODE SELECT(10) (55H)

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Operation Code (55h)							
1	Logical Unit Number			PF	Reserved			SP
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	Parameter List Length (MSB)							
8	Parameter List Length (LSB)							
9	Reserved							

2.6   Mode Select(10) (55h)

The MODE SELECT(10) command provides a range for the initiator specifying specific operating parameters. Refer to MODE SELECT(6) Command, Section 2.5 for details of the command fields.

IMPORTANT: Initiators should issue the MODE SENSE command (reference Sections 2.7 and 2.8) prior to each execution of the MODE SELECT command to determine supported pages, page lengths and other parameters.

TABLE 2-7   MODE SENSE(6) (1AH)

Byte	Bit							
	7	**6**	**5**		**4**	**3**	**2**	**1**
0	Operation Code (1Ah)							
1	Logical Unit Number			Reserved	DVD	Reserved		
2	PCF		Page Code					
3	Reserved							
4	Allocation Length							
5	Reserved							

TABLE 2-7A   MODE SENSE DATA HEADER

Byte	**Bit**							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Reserved							
1	Media Type							
2	Reserved							
3	Block Descriptor Length (0 or 8)							

TABLE 2-7B   BLOCK DESCRIPTOR

Byte	**Bit**							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Density Code							
1	Number of Blocks (MSB)							
2	Number of Blocks							
3	Number of Blocks (LSB)							
4	Reserved							
5	Block Length (MSB)							
6	Block Length							
7	Block Length (LSB)							

2.7   Mode Sense(6) (1Ah)

Operation Code is (1Ah)

DBD (Disable Block Descriptor)

    If "0" (ZERO), the block descriptors are returned in the MODE SENSE data.

    If "1" (TRUE), no block descriptors are returned.

PCF (Page Control Field) specifies the Page Parameter Type to be returned.

Page Code specifies the Page(s) to be returned.

The MODE SENSE command requests the drive to report parameters for each logical unit. An Allocation Length of "0" means that no data is returned. If other than "0", the drive terminates the DATA IN phase when Allocation Length bytes or all the Sense data have been transferred.

The following PCF codes are supported:

00b	:	Current value:	The drive returns the values specified by the latest MODE SELECT command. If no MODE SELECT command has been issued, the default values are returned.
01b	:	Alterable value:	The drive returns the alterable parameters set to one in the requested page. Even if all parameter values are unalterable, the requested page(s) is returned.
10b	:	Default value:	The default values of the drive are returned. The fields and bits that are not supported are set to 0.
11b	:	Reserved	

Mode Sense Data Format

    The Mode Sense Data consists of a 4-byte header; an 8-byte block descriptor; and no, one, or more page descriptor(s).

Sense Data Length

    Shows the length in bytes of the following Sense data. This length does not include itself (byte 0).

Media Type

    The default value is 0.

Block Descriptor Length

    The value 8 is always returned.

TABLE 2-7C   MEDIA TYPE CODE

Media Type Code	Type of Media
00h	Default
01h	120mm CD-ROM Data
02h	120mm CD-DA Audio
03h	120mm CD-ROM Data/Audio
04h	Reserved
05h	80mm CD-ROM Data
06h	80mm CD-ROM Audio
07h	80mm CD-ROM Data/Audio
08h ~ FFh	Reserved

TABLE 2-7D   PAGE DESCRIPTOR FORMAT

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Reserve	Reserve	Page Code					
1	Page Length							
:								
:								
N	Page Definition							

Number of blocks

    The value 0 means that the length of all blocks is same as the Logical Block Length shown in the block descriptor.

Logical Block Length

    Indicates the logical block size in bytes. In the current version, 256, 512, 1024, 2048(default), 2052, 2336, 2340 and 2352 byte are supported. The default values for the CD-ROM drives (512 or 2048) are selectable with an external switch.

Density Code

01h	:	User data only (2048 bytes/physical sector)(default)
02h	:	User data plus auxiliary data (2336 bytes/physical sector)
03h	:	Header, user data plus auxiliary data (2340 bytes/physical sector)
04h	:	Audio data only (1/75th of a second per logical block)
05h~FFh	:	Reserved

The drive will return Allocation Length bytes or the complete sense data.

Each page descriptor starts with a 2-byte header consisting of the page code and page length, and the specified page data follow the header.

Page code indicates the meaning of the data contained in the page.

Page length does not include the page length byte itself. The page length indicates the number of bytes supported for each page.

TABLE 2-8   MODE SENSE(10) (5Ah)

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Operation Code (5Ah)							
1	Logical Unit Number			Reserved	DVD	Reserved		
2	PCF		Page Code					
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	Allocation Length (MSB)							
8	Allocation Length (LSB)							
9	Reserved							

2.8　Mode Sense(10) (5Ah)

Operation Code is (5Ah)

The MODE SENSE(10) command provides a means for a target to report parameters to the initiator. It is the complementary command to the MODE SELECT(10) command. See MODE SENSE(6) command (reference Section 2.7) for a complete description of the fields in this command.

TABLE 2-9   MODE SELECT/SENSE PARAMETERS

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0 ~ N	Mode Parameter Header							
0 ~ N	Page(s)							

TABLE 2-9A   MODE PAGE CODES FOR CD-ROM

Page Code	Description
00h	Only Block Descriptor
01h	Read Error Recover Page
07h	Verify Error Recovery Page
0Bh	Peripheral Device Page
0Dh	CD-ROM Parameters Page
0Eh	CD-ROM Audio Control Page
2Ah	CD-ROM Capabilities & Mechanical Status Page
31h	Drive Speed Page
3Eh	Logical Unit Assignment Page
3Fh	Return all pages (valid only for the MODE SENSE command)

TABLE 2-9B   MODE PAGE FORMAT

Byte	Bit							
	7	6	5	4	3	2	1	0
0	PS/Resr	Reserve	Page Code					
1	Page Length (N-1)							
2	Mode Parameters							
	:							
	:							
N	Mode Parameters							

2.9 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.

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

TABLE 2-9-1   PAGE CODE 01H - ERROR RECOVERY PARAMETERS

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Reserve	Reserve	Page Code (01h)					
1	Page Length (06h)							
2	Reserve	Reserve	TB	RC	EEC	PER	DTE	CDR
3	Retry Number							
4	Reserve							
5	Reserve							
6	Reserve							
7	Reserve							

TABLE 2-9-1A   VALID COMBINATIONS OF THE ERROR RECOVERY PARAMETERS

Code	Reserve		TB	RC	EEC	PER	DTE	DCR
00h	0	0	00	0	0	0	0	0
01h	0	0	0	0	0	0	0	1
04h	0	0	0	0	0	1	0	0
05h	0	0	0	0	0	1	0	1
06h	0	0	0	0	0	1	1	0
07h	0	0	0	0	0	1	1	1
10h	0	0	0	1	0	0	0	0
11h	0	0	0	1	0	0	0	1
14h	0	0	0	1	0	1	0	0
15h	0	0	0	1	0	1	0	1
20h	0	0	1	0	0	0	0	0
21h	0	0	1	0	0	0	0	1
24h	0	0	1	0	0	1	0	0
25h	0	0	1	0	0	1	0	1
26h	0	0	1	0	0	1	1	0
27h	0	0	1	0	0	1	1	1

2.9.1　　Error Recovery Parameters

NOTE: When the bit definition of this error recovery parameter and the error recovery procedure (described later) are not in agreement, the error recovery procedure takes priority.

DCR (Disable Correction)
    If "1", data is transferred without Layered ECC (L-ECC) error correction.
    If "0", L-ECC error correction is performed. The default value is 0.

DTE (Disable Transfer on Error)
    If "0", transfer of recovered data is allowed. The default value is 0.
    When both the **DTE** and **PER** bit are 1, the target stops the data transfer immediately if the error is detected, and then returns Check Condition status.

NOTE: The **TB** bit controls whether data from the bad block is transferred.

PER (Post Error)
    If "1", the drive returns a Check Condition status for a recovered error.
    If "0", no Check Condition status is returned for the recovered error.
    The default value is 0.

EEC (Enable Early Correction)
    This bit must be 0: The defined retry procedure is performed prior to the error correction.

RC (Read Continuous)
    Set to 0. A delay in the data transfer may occur due to an error recovery action.

TB (Transfer Block)
    If "1", uncorrected data blocks will be transferred to the initiator.
    If "0", uncorrected data blocks are not transferred. The default value is 0.

NOTE: in either case, the block address returned to the REQUEST SENSE command is not of the preceding good block but of the error block.

Retry Number specifies how many times the drive re-tries a physical read operation when it finds an uncorrectable block. The default value is 4.

TABLE 2-9-1B   ERROR RECOVERY DESCRIPTIONS

Value	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 which 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 (layer 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 five 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 sued. 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 was detected. if a data error occurs which 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 (layer 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 not transferred. The sense key is set to Recovered Error. The information bytes five 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.

TABLE 2-9-1B   ERROR RECOVERY DESCRIPTIONS (*CONTINUED*)

Value	Description
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 which 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 corrections 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 lock 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.

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TABLE 2-9-1B   ERROR RECOVERY DESCRIPTIONS (*CONTINUED*)

Value	Description
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 an 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 which 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 an 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 which 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 (layer 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 an 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.

The CD-ROM errors are:

1) Recovered CIRC (Cross Interleaved Reed-Solomon Code) Error:

An error in a block had been detected by the EDC (Error Detection Code) but the error was recovered by read retry. Number of read retries to perform is specified with the Read Retry Number (the third byte of the Error Recovery Parameter page in the Mode Select command.). In this case, L-ECC (Layered Error Correction Code) is not used.

2) Uncorrectable CIRC Error:

L-ECC was not used, error could not be corrected by the CIRC after the specified number of read retries were attempted.

3) Recovered L-ECC Error:

Uncorrectable CIRC Error was found, but the error was corrected by the L-ECC during read retries.

4) Uncorrectable L-ECC Error:

Error could not be corrected by the L-ECC after the specified number of read retries were attempted.

TABLE 2-9-2   PAGE CODE 07H - VERIFY ERROR RECOVERY PAGE FORMAT

Byte	Bit							
	7	6	5	4	3	2	1	0
0	PS	Reserve	Page Code (07h)					
1	Page Length (06h)							
2	Error Recovery Parameter							
3	Verify Retry Count							
4	Reserved							
5	Reserved							
6	Reserved							
7	Reserved							

2.9.2   Verify Error Recovery Page

PS (Parameters Savable)

The Parameters Savable bit is only used with the MODE SENSE command. This bit is reserved with the MODE SELECT command. A PS bit of one indicates that the target is capable of saving the page in a non-volatile vendor specific location.

Error Recovery Parameter

The error recovery parameters for verify operations are as defined by the read error recovery parameters.

The verify error recovery parameters page specifies the error recovery parameter the target shall use during verify operations.

TABLE 2-9-3   PAGE CODE 09H - PERIPHERAL DEVICE PAGE FORMAT

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Reserved		Page Code (09h)					
1	Page Length (06h)							
2	Interface Identifier (MSB)							
3	Interface Identifier (LSB)							
4	Reserved							
5	Reserved							
6	Reserved							
7	Reserved							

TABLE 2-9-3A   INTERFACE IDENTIFIER CODES

Value	Interface
0000h	Small Computer System Interface
0001h	Storage Module Interface
0002h	Enhanced Small Device Interface
0003h	IPI-2
0004h	IPI-4
0005h ~ FFFFh	Reserved

2.9.3 Peripheral Device Page

Interface Identifier Codes are in Table 2-9-3A on the opposite page.

The peripheral device page is used to pass vendor-specific information between an initiator and a peripheral interface below the target.

TABLE 2.9.4   PAGE CODE 0BH - MEDIUM TYPES SUPPORTED PAGE FORMAT

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	PS	Reserve	Page Code (0Bh)					
1	Page Length (06h)							
2	Reserved							
3	Reserved							
4	Medium Type One Supported							
5	Medium Type Two Supported							
6	Medium Type Three Supported							
7	Medium Type Four Supported							

2.9.4   Medium Types Supported Page

PS (Parameters Savable)

The Parameters Savable bit is only used with the MODE SENSE command. This bit is reserved with the MODE SELECT command. A PS bit of one indicates that the target is capable of saving the page in a non-volatile vendor specific location.

The code values for each medium type supported by the target (up to four maximum), as defined in the MODE SELECT command are reported in ascending order. If only the default medium type is supported zero is reported. If less than four medium types are supported the unused entries shall be returned as zero.

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TABLE 2-9-5   PAGE CODE 0DH - CD-ROM PARAMETERS PAGE FORMAT

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Reserve	Reserve	Page Code (0Dh)					
1	Parameter Length (06h)							
2	Reserved							
3	Reserved				Inactivity Timer Multiplier			
4								
5	Number of MSF-S Units per MSF-M Unit (3Ch)							
6								
7	Number of MSF-F Units per MSF-S Unit (4Bh)							

TABLE 2-9-5A   INACTIVITY TIMER MULTIPLIER VALUE

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

2.9.5 CD-ROM Parameters Page

Inactivity Timer Multiplier

The inactivity timer multiplier specifies the length of time that the drive will remain in the hold track state after completion of a SEEK or READ operation. The default value is 0Dh. (i.e. 8 minutes). Table 2-6-14 gives a complete listing of the Inactivity Timer Multiplier.

Number of S per M units

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 standard, this value is 60 (3Ch).

Number of F per S units

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 standard, this value is 75(4Bh).

TABLE 2-9-6   PAGE CODE 0EH - CD-ROM AUDIO CONTROL PARAMETERS STATUS FORMAT

Byte	Bit

	Bit							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Reserved		Page Code (0Eh)					
1	Page Length (0Eh)							
2	Reserved					Immed	SOTC	Reserve
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	Reserved							
8	Reserved				Out Port 0 Channel Select (1h)			
9	Output Port 0 Volume (FFh)							
10	Reserved				Out Port 1 Channel Select (2h)			
11	Output Port 1 Volume (FFh)							
12	Reserved							
13	Reserved							
14	Reserved							
15	Reserved							

TABLE 2-9-6A   OUT PORT CHANNEL SELECT PARAMETERS

Output	Out Port 0 Channel Select	Out Port 1 Channel Select
muted	0000	0000
Left Audio	0001	0001
Right Audio	0010	0010
Stereo	0001	0010

2.9.6 CD-ROM Audio Control Parameters

Immed (Immediate)

An Immediate, Immed ,bit of one indicates the target will send completion status as soon as the playback operation has been started. An Immed bit of zero indicates that the drive will not send completion status until the audio playback operation is completed or an error occurs.

SOTC (Stop On Track Crossing)

A stop on track crossing, SOTC, bit of zero indicates the drive will terminate the audio playback operation when the transfer length is satisfied. A stop on track crossing bit of one indicates that the drive will terminate audio playback when the beginning of a following track is encountered.

Out Port Channel Select

Refer to Table 2-9-6A on the opposite page for out port channel select options.

Output Port Volume

The channel volume control indicates the relative volume level for this audio port. A value of zero indicates the output is muted, a value of FFh indicates the maximum level. The output volume is defined by averaging port 0 and port 1.

The CD-ROM audio control parameter page sets the playback modes and output controls of subsequent Play Audio commands and any current audio playback operation.

TABLE 2-9-7   PAGE CODE 2AH - CD-ROM CAPABILITIES AND MECHANICAL STATUS PAGE FORMAT

Byte	Bit 7	6	5	4	3	2	1	0
0	Reserve	Reserve	Page Code (2Ah)					
1	Page Length (0Eh)							
2	Reserved							
3	Reserved							
4 ~ 7 32-bit field of Capability Bits	Reserve	Multi-Session	Mode 2 From2	Mode 2 Form1	Reserve	Reserve	0	Audio Play
	Reserve	ISRC	UPC	C2 Pointer are supported	R-W De-interleaved & corrected	R-W supported	CD-DA Stream is Accurate	CD-DA Command Supported
	Loading Mechanism Type			Reserve	Eject	Prevent Jumper	Lock State	Lock
	Reserved						Separate Channel Mute-Supported	Separate Volume Levels per Channel
8	(MSB) Maximum Speed Supported (in KBps)							
9	(LSB)							
10	(MSB) Maximum Speed Supported (in KBps)							
11	(LSB)							
12	(MSB) Buffer Size Supported by Drive (in Kbytes)							
13	(LSB)							
14	(MSB) Current Speed Selected (in KBps)							
15	(LBS)							
16	Reserved for number of ADPCM Decoders							
17 ~ 20	Reserved							

2.9.7 CD-ROM Capabilities and Mechanical Status Page

IMPORTANT: This command applies only to models DRM-602X, DRM-624X, DR-U124X, DR-UA124X

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.

TABLE 2-9-7A   PARAMETER DESCRIPTION

Bit	Parameter	Description	
0	Audio Play	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.	
1	XA Commands Supported	This bit has been reserved for future support of CD-ROM XA commands. Drives which set this bit shall support all CD-ROM XA commands.	
4	Mode 2 Form1	The drive is capable of reading sectors in Mode 2 Form 1(XA) format.	
5	Mode 2 Form2	The drive is capable of reading sectors in Mode 2 Form 2 format.	
6	Multi-Session	The drive is capable of reading multiple session or Photo-CD discs.	
8	READ CD-DA	Red Book audio can be read using the READ-CD command.	
9	CD-DA Stream is Accurate	This bit indicates 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.	
		0	The drive is incapable of accurately restarting the CD-DA read operation , and a BUFFER OVERFLOW error **shall** be reported whenever a loss of streaming occurs, This error will be fatal and the command will have to be repeated from the beginning.
		1	The drive can continue from a loss of streaming condition and no error will be generated.
10	R-W Supported	The commands that return Sub-channel data can return the combined R-W information.	
11	R-W De-Interleaved & Correction	This indicates that the R-W sub-channel data will be returned de-interleaved and error corrected.	
12	C2 Pointers are Supported	This indicates that the drive supports 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.	
13	UPC	The drive can return the Media Catalog Number (UPC).	
14	ISRC	The drive can return the International Standard Recording Code Information.	
16	Lock	The PREVENT/ALLOW command is capable of actually locking the media into the drive.	
17	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.
18	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
		1	Jumper is not present. Drive will power up to the Prevent State (Locked). The drive will not accept new media or allow the ejection of media already loaded until an allow command is issued.

TABLE 2-9-7A   PARAMETER DESCRIPTION (*CONTINUED*)

Bit	Parameter	Description			
19	Eject Command	The drive can eject the disc via the normal START/STOP command with the LoEj bit set.			
23 ~ 21	Loading Mechanism Type	This field specifies the type of disc loading the drive supports.			
		23	22	21	
		0	0	0	Caddy type loading mechanism
		0	0	1	Tray type loading mechanism
		0	1	0	Pop-up type loading mechanism
		0	1	1	Reserved
		1	X	X	Reserved
24	Separate Volume Levels	The audio level for each channel can be controlled independently.			
24	Separate Channel Mute	The mute capability for each channel can be controlled independently.			

TABLE 2-9-7B   EXAMPLE DATA RATES

Speed	Data Rate
X1	176 Kbytes / second
X2	353 Kbytes / second
X2.2	387 Kbytes / second
X3	528 Kbytes / second
X4	706 Kbytes/second

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.

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 Number of Volume Levels Supported field returns the number of discrete levels. If the drive only supports turning audio on and off, the Number of Volume Levels field **shall** be set to 2.

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(this page has been left intentionally blank)

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). If the drive does not have a buffer cache, the value returned **shall** be zero.

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.

TABLE 2-9-8   PAGE CODE 31H - DRIVE SPEED PAGE

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Reserved		Page code (31h)					
1	Parameter Length (02h)							
2	Speed							
3	Reserved							

TABLE 2-9-8A   SPEED FIELD VALUES

Value	Description
00h	Normal Speed
01h	2X Speed
03h	4X Speed
FFh	Maximum Speed
Other Value	Maximum Speed

2.9.8 Drive Speed Page

The speed field provides a means for the initiator to set and retrieve the spindle speed when accessing data areas. The speed field values are listed in Table 2-9-8A on the opposite page.

The speed setting is only applicable when reading data areas. The target will automatically switch to normal speed when playing audio tracks and will switch back to the speed setting when accessing data.

DRIVE NOTES:

DRM-602x

The DRM-602x does not support 4x speed. A speed setting value of 03h will not cause an error, but set the drive to 2x speed.

DRM-624x, DRM-604X, DR-U124X, DR-UA124X, DR-D504X

These drives do not support 2x Speed. A speed setting value of 01h will not cause an error.

However, the drive will automatically be set to 4x speed.

TABLE 2-9-9   PAGE CODE 3EH - LOGICAL UNIT ASSIGNMENT LIST

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Reserve	Reserve	Page Code (3Eh)					
1	Page Length : (06h)							
2	0	Number of supported discs (MSB) : (00h)						
3	Number of supported discs (LSB) : (06h)							
4	Disc number for logical unit0							
5	Disc number for logical unit1							
6	Disc number for logical unit2							
7	Disc number for logical unit3							
8	Disc number for logical unit4							
9	Disc number for logical unit5							

2.9.9   Logical Unit Assignment Page

Number of supported discs

The drive supports 6 discs. 0006h is always returned, and 124x will return 1 .

Disc numbers

Shows the disk number assigned to each logical unit. Disc number 0 means that the associated logical unit cannot be used. Disc numbers in defaults are 1 through 6 for logical units 0 through 5, respectively.

Accessing, with other SCSI commands, a logical unit to which disc number 0 has been assigned results in a Check Condition status with the sense data of "Illegal logical unit number."

This page shows the parameters of the drive. The logical unit number specified in the command descriptor block is ignored.

TABLE 2-10 PAUSE/RESUME (4BH)

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Operation Code (4Bh)							
1	Logical Unit No.				Reserved			
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	Reserved							
8	Reserved							Resume
9	Reserved							

2.10 Pause/Resume (4Bh)

Operation Code is (4Bh)

Resume

A Resume of zero indicates that the drive enter the hold track state with the audio output muted. A Resume bit of one indicates that the drive release the pause and begin play at the block following the last block played.

The PAUSE/RESUME command requests that the drive start or stop the current audio play operation. This command is used with PLAY AUDIO commands, issued while the immediate bit(Immed) of MODE SELECT PAGE CODE E is set to one.

This command is terminated with Check Condition status if the resume bit is zero and the audio play operation cannot be paused (i.e. an audio play operation has not been requested, or the requested audio play operation has been completed).

It will 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 2-11 PLAY AUDIO(10) (45H)

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Operation Code (45h)							
1	Logical Unit No.			Reserved				
2	Starting Logical Block Address (MSB)							
3	Starting Logical Block Address							
4	Starting Logical Block Address							
5	Starting Logical Block Address (LSB)							
6	Reserved							
7	Transfer Length (MSB)							
8	Transfer Length (LSB)							
9	Reserved							

2.11   Play Audio(10) (45h)

Operation Code is (45h).

Logical Block Address

> The logical block address field specifies the logical block at which the audio play back operation will begin. If all bytes in the logical block address field are set to FFh, it means to start at the current optical head location. This feature allows the host to modify the audio ending address without interrupting the current audio playback operation.

Transfer Length

> Specifies the number of contiguous logical blocks that will be played. A transfer length field of zero indicates that no audio operation will occur. This condition will not be considered an error. Any other value indicates the number of logical blocks that will be played.

The PLAY AUDIO(10) command requests that the target play audio starting at the specified logical block address for the specified transfer length. The command function (Immed bit) and the output of audio signals will be as specified by the settings of the audio control parameters in the MODE SELECT PAGE CODE E.

The status returning condition depends on the Immed bit of MODE SELECT page code E. The Immed bit in MODE SELECT page code E of one requests that this command return the status byte as soon as the audio playback operation has been started. The Immed bit in MODE SELECT page code E of zero requests that this command return the status byte when audio playback operation is completed, or an error occurs.

If any commands related to audio operations are implemented then the PLAY AUDIO command will be implemented to allow a method for the initiator to determine if audio operations are supported. A target responding to a PLAY AUDIO command which has transfer length of zero with Check Condition status and setting the sense key to ILLEGAL REQUEST does not support audio play operations.

TABLE 2-12 PLAY AUDIO(12) (A5H)

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Operation Code (A5h)							
1	Logical Unit No.			Reserved				
2	Logical Block Address (MSB)							
3	Logical Block Address							
4	Logical Block Address							
5	Logical Block Address (LSB)							
6	Transfer Length (MSB)							
7	Transfer Length							
8	Transfer Length							
9	Transfer Length (LSB)							
10	Reserved							
11	Reserved							

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2.12   Play Audio(12) (A5h)

Operation Code is (A5h).

The PLAY AUDIO(12) command requests that the drive begin an audio playback operation. The command function (Immed and SOTC bits) and the output of audio signals shall be specified by the settings of the mode parameters. See the PLAY AUDIO(10) command for a description of the fields in this command.

TABLE 2-13 PLAY AUDIO MSF (47H)

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Operation Code (47h)							
1	Logical Unit No.			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							

2.13 Play Audio MSF (47h)

Operation Code is (47h)

Starting M/S/F Field
>   Specifies absolute starting address in minutes, seconds, frame number.

Ending M/S/F Field
>   Specifies absolute ending address in minutes, seconds, frame number.

The PLAY AUDIO MSF command requests the target to begin an audio playback operation. The command function (Immed) and the output of audio signals shall be as specified by the settings of the mode parameters page code 0Eh.

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 at which the audio play operation shall end.

All contiguous audio sectors between the starting and the ending MSF address shall be played.

A starting MSF address equal to an ending MSF address causes no audio play operation to occur. This is not considered an error. If the starting MSF address is less 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 the address is not within an audio track, or if a not ready condition exists, the drive will terminate with a Check Condition status. If the SOTC bit parameter in the MODE SELECT command page code 0Eh is one, the drive will stop if during the specified starting and ending addresses, a track crossing occurs.

TABLE 2-14 PLAY AUDIO TRACK INDEX (48H)

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Operation Code(48h)							
1	Logical Unit No.			Reserved				
2	Reserved							
3	Reserved							
4	Starting Track							
5	Starting Index							
6	Reserved							
7	Ending Track							
8	Ending Index							
9	Reserved							

2.14   Play Audio Track Index (48h)

Operation Code is (48h).

Starting Track/Index

> The starting track field specifies the track number of the starting audio track. The starting index field specifies the index number within the track at which the audio play operation shall begin.

Ending Track/Index

> The ending track field specifies the track number of the ending audio track. The ending index field specifies the index number within the track after which the audio play operation shall stop. The audio play operation shall terminate at the last block with an index number equal to the ending index. All contiguous audio sectors between the starting and ending address shall be played.

The PLAY AUDIO TRACK INDEX command requests the drive begin an audio play operation. The command function (Immed) and the output of audio signals shall be specified by the settings of the mode parameters page code 0Eh.

If the starting address is less than the ending address, the command will be terminated with Check Condition sense key set to ILLEGAL REQUEST.

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. Valid values for the track and index fields are 1 to 99.

If the ending track is greater than the last information track on the media, the playback will continue until the last track is complete. If the ending index is greater than the largest index value on the ending track, the playback shall continue until this track is complete then terminate. These conditions are not considered errors.

If the starting index is greater than the largest index value on the starting track, and the stop on track crossing (SOTC) bit of the audio control MODE SELECT parameters page code 0Eh is zero, the playback operation will start at the beginning of the next track.

If the starting index is greater than the largest index value on the starting track, and the stop on track crossing (SOTC) bit of the audio control MODE SELECT parameters page is one, the playback shall not begin. The target shall return Check Condition, and the sense key set to ILLEGAL REQUEST.

TABLE 2-15 PLAY AUDIO TRACK RELATIVE(10) (49H)

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Operation Code (49h)							
1	Logical Unit No.			Reserved				
2	Track Relative Logical Block Address (MSB)							
3	Track Relative Logical Block Address							
4	Track Relative Logical Block Address							
5	Track Relative Logical Block Address (LSB)							
6	Starting Track							
7	Transfer Length (MSB)							
8	Transfer Length (LSB)							
9	Reserved							

2.15   Play Audio Track Relative(10) (49h)

Operation Code is (49h).

TRLBA

The Track Relative Logical Block Address field specifies the two's complement starting logical block address relative to the beginning of the first sector on the track with an index value of one. Negative values indicate a starting location within the audio pause area at the beginning of the requested track.

Starting Track

Specifies the track number of the starting audio track.

Transfer Length

The Transfer Length Field specifies the number of contiguous logical blocks that shall be output as audio data. A length of zero indicates that no audio playback operation shall occur. This condition is not an error. Any other value indicates the number of logical blocks that shall be output.

The PLAY AUDIO TRACK RELATIVE(10) command requests that the drive begin an audio playback operation. The starting address is specified as a track relative logical block address within the specified starting track. The command function (Immed and SOTC bits) and the output of audio signals shall be as specified by the settings of the mode parameters.

If the logical block length is not equal to the sector size the drive will adjust the starting logical block address and the transfer length. The drive will start the audio play operation with the beginning of a sector whenever the starting logical address falls within that sector (MSF unit). If the requested transfer length causes the end of an audio play operation to fall within a sector the drive will continue the play operation through the end of that sector.

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 is terminated with Check Condition status.

TABLE 2-16 PLAY AUDIO TRACK RELATIVE(12) (A9H)

Byte				Bit				
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Operation Code(A9h)							
1	Logical Unit No.			Reserved				
2	Track Relative Logical Block Address (MSB)							
3	Track Relative Logical Block Address							
4	Track Relative Logical Block Address							
5	Track Relative Logical Block Address (LSB)							
6	Transfer Length (MSB)							
7	Transfer Length							
8	Transfer Length							
9	Transfer Length (LSB)							
10	Starting Track							
11	Reserved							

2.16 Play Audio Track Relative(12) (A9h)

Operation Code is (A9h).

The PLAY AUDIO TRACK RELATIVE(12) command requests that the device begin an audio playback operation. The command function (Immed and SOTC bits) and the output of audio signals shall be as specified by the settings of the mode parameters. See the PLAY AUDIO TRACK RELATIVE(10) command for a description of the fields in this command.

TABLE 2-17 PREVENT/ALLOW MEDIA REMOVAL (1EH)

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Operation Code (1Eh)							
1	Logical Unit No.			Reserved				
2	Reserved							
3	Reserved							
4	Reserved							Prev
5	Reserved							

2.17   Prevent/Allow Media Removal (1Eh)

Operation code is (1Eh).

Prev (Prevent bit)

> When this bit is set to 1, EJECT DISK commands (C0h) and the Eject Button on the drive are ignored. When it is 0, media removal is allowed.

This command is used to prevent or allow media removal from the drive. If an EJECT DISK command is received when media removal is prevented, a Check Condition is returned with the sense key "Illegal request" and the extended sense code of 80h (Medium Change Prohibited).

The prevented condition is released when a BUS DEVICE RESET message is received or a hardware reset occurs.

TABLE 2-18 READ(6) (08H)

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Operation Code (08h)							
1	Logical Unit No.			Logical block address (MSB)				
2	Logical block address							
3	Logical block address (LSB)							
4	Transfer Length							
5	Reserved							

2.18   Read(6) (08h)

Operation Code is (08h).

This six-byte READ command only allows reads of up to 255 blocks.

The logical blocks will have the length set by MODE SELECT or the power-on default.   For longer reads, use the ten-byte READ(10) command.

After a read operation, the drive holds the head at the last read track until an inactivity time-out occurs.

TABLE 2-19 READ(10)

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Operation Code (28h)							
1	Logical Unit No.			.		Reserved		
2	Logical block address (MSB)							
3	Logical block address							
4	Logical block address							
5	Logical block address (LSB)							
6	Reserved							
7	Logical block length (MSB)							
8	Logical block length (LSB)							
9	Reserved							

2.19   Read(10)

Operation code is (28h).

This ten byte READ command allows reads of up to 64K blocks. The logical blocks will have the length set by MODE SELECT or the power-on default.

After a read operation, the drive holds the head at the last read track until an inactivity time-out occurs.

NOTE: The **DPO**, **FUA** and **RelAdr** bits (not shown) in byte 1 are not supported, and must be set to 0.

TABLE 2-20 READ BUFFER (3CH)

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Operation Code (3Ch)							
1	Logical Unit No.			Reserved			Mode	
2	Buffer ID : (00h)							
3	Buffer offset (MSB)							
4	Buffer offset							
5	Buffer offset (LSB)							
6	Allocation length (MSB)							
7	Allocation length							
8	Allocation length (LSB)							
9	Control/Reserved							

TABLE 2-20A   READ BUFFER HEADER

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Reserved							
1	Effective length (MSB)							
2	Effective length							
3	Effective length (LSB)							

2.20   Read Buffer (3Ch)

Operation Code is (3Ch).

Mode specifies meaning of the Buffer Offset field.

Buffer ID is not supported. This byte is always 00h.

Buffer Offset

The byte offset in the buffer at which the read shall begin. This must be between 0 and 15.

Allocation Length must include 4 byte header.

This command is used with the WRITE BUFFER command to test the reliability of the drive command buffer memory and of the SCSI bus. This command does not cause a disc access. The drive terminates the DATA IN phase when it has transferred the header and data specified in **Allocation Length**, or the header and the remainder of the buffer.

Mode field	Definition
00b	The header, data, and buffer offset are 0s.
01b	The buffer offset indicates the offset from the start of the buffer at which the data are to be read.
10b	Reserved
11b	Reserved

The 4-byte header and the following data are transferred to the initiator in the DATA IN phase. If **Allocation Length** is 0, neither the header nor data are transferred.

The header is defined as follows:

- Effective Length

The number of bytes of valid data in the buffer.

The effective length does not depend on the actual number of data written by a WRITE BUFFER command. The sum of the buffer offset plus the effective data length is always 16. The number of data to be transferred following the header is the smaller one, either the allocated length minus 4 bytes, or the effective length.

When the drive cannot accept the specified buffer offset, a Check Condition is returned with the sense key "ILLEGAL REQUEST." If **Buffer Offset** is not 0 when **Mode** is set to 00h, Check Condition is returned.

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TABLE 2-21 READ CD-ROM CAPACITY (25H)

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Operation Code (25h)							
1	Logical Unit No.			Reserved			RelAdr (0)	
2	Logical block address (MSB) (00h)							
3	Logical block address (00h)							
4	Logical block address (00h)							
5	Logical block address (LSB) (00h)							
6	Reserved							
7	Reserved							
8	Reserved							PMI (0)
9	Reserved							

TABLE 2-21A   READ CAPACITY DATA

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Logical block address (MSB)							
1	Logical block address							
2	Logical block address							
3	Logical block address (LSB)							
4	Logical block length (MSB)							
5	Logical block length							
6	Logical block length							
7	Logical block length (LSB)							

2.21 Read CD-ROM Capacity (25h)

Operation code is (25h).

This command requests the drive to return physical parameters of the CD-ROM disc currently loaded. The **Logical Block Address**, **RelAdr** (Byte 1, bit 0), and **PMI** (Byte 8, bit 0) parameters are not supported and must be set to 0.

The drive sends the initiator the 8-byte data as shown in Table 2-3 in the data transfer phase.

Logical block address is the last logical block address on the disc.

Logical block length is the size of logical blocks in bytes.

The value of **Logical Block Length** returned depends on the block length set with a MODE SELECT command. The default value of the block length is 2048 bytes. The CD-ROM drives allow values of 2048 or 512 bytes to be set with an external switch on the drive.

T ABLE 2-22 READ CD (BEh)

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

T ABLE 2-22A   READ-CD, E XPECTED S ECTOR T YPE F IELD D EFINITION

Expected Sector Type	Definition	Description
000b	Any Type	Checking of the Sector Type is not performed. Device will terminate command at sector where transition between CD-ROM and CD-DA occurs.
001b	CD-DA	Only Red Book (CD-DA) sectors allowed. Attempt to read any other format results in error report.
010b	Mode 1 Form 1	Only Yellow Book sectors having "user" data field of 2048 bytes allowed. Attempt to read any other format results in an error report.
011b	Mode 1 Form 2	Only Yellow Book sectors having "user" data field of 2336 bytes allowed. Attempt to read any other format results in an error report.
100b	Mode 2 Form 1	Only Green Book sectors having "user" data field of 2048 bytes allowed. Attempt to read any other format results in an error report.
101b	Mode 2 Form 2	Only Green Book sectors having "user" data field of 2324 bytes allowed. Attempt to read any other format results in an error report. Note: the spare data is included in the user data making the size 2324+4 =2328 bytes.
110b~111b		Reserved

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2.22   Read CD (BEh)

IMPORTANT: This command applies only to models DRM-602X, DRM-624X, DR-U124X, DR-UA124X

Operation code is (BEh).

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 TOR THIS TRACK.

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

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

The **User Data Flag**, when set to one, indicates that the Data part of a CD Sector shall be returned in the data stream. When set to 1, the whole user data will be returned to the host. Note that the setting of the Mode Select Density Code does not apply to this command, and the physical user data will be returned . If the current track is an Audio Track then the Audio Data will be returned, else the normal CD-ROM data will be returned. The possible data lengths are 2048,2336,2328 and 2352.

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

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

The **Sub-Channel Data Selection** bits indicate which CD Sub-Channel information is to be included in the data stream., the "}Raw"} Sub-Channel information (All eight channels , on 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 2-22B   READ CD, HEADER 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 mode 1 or Form 1 4-byte header will be returned in the data stream.
10b	Sub-header Only	Only the Mode 2 Form 1 of 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.

TABLE 2-22C   READ CD, ERROR FLAG FIELD DEFINITION

Error Flags	Definition	Description
00b	None	No Error information will be included in the data stream.
01b	C2 Error Flag data	The C2 Error flag (Pointer) bits (2352 bits or 294 bytes) will be included in the data stream. When the C2 Error pointer bits are included in the data stream, there will be one bit for each byte in error in the sector (2352 total). The bit ordering is from the most significant bit to the least significant bit in each byte . The first bytes in the sector will be the first bits/bytes in the data stream.
10b	C2 & Block Error Flags	Both the C2 Error Flags (2352 bits or 294 bytes) and the Block Error Byte will be included in the data stream. The Block Error byte is just the longitudinal parity of all the C2 Error Flag bytes, So that the data stream will always be an even number of bytes, the Block Error byte will be padded with a 0 byte. The Block Error byte will be first in the data stream followed by the pad byte.
11b	Reserved	Reserved for future enhancement.

Support of Sub-channel data is optional. In the case of R-W the drive may return data de-interleaved and error-corrected, RAW or padded with zeros depending on the R-W Supported and R-W de-interleaved and error-corrected bits in the CD-ROM capabilities and mechanical status page.

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 Audio play).

The number of bytes returned is based on which bits are set in the Data Selection Field.

The table on the opposite page allows you to calculate the number of bytes returned based on which Data Selection field bits are set.

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

TABLE 2-22D   READ CD, SUB CHANNEL DATA SELECTION FIELD DEFINITION

Sub-channel	Definition	Description
000b	No Sub channel Data	No Sub-channel data will be transferred
001b	RAW	Raw Sub-channel data will be transferred
010b	Q	Not Supported
011b	Reserved	
100b	R - W	R-W data will be transferred
101b-111b	Reserved	

TABLE 2-22E   NUMBER OF BYTES RETURNED BASED ON DATA SELECTION FIELD

	Flag Bits	CD-DA	Mode 1 Form 1	Mode 1 Form 2	Mode 2 Form1	Mode 2 Form1
Sync	80h	0	12	12	12	12
Header	20h	0	4	4	4	4
Sync & Header	A0h	0	16	16	16	16
Sub Header	40h	0	0	0	8	8
All Header	60h	0	4	4	12	12
Sync & Headers	E0h	0	16	16	24	24
User Data	10h	2352	2048	2336	2048	2328
Sub Header & User Data	50h	2352	2048	2336	2056	2336
Header & User Data	30h	2352	2052	2340	2052	2332
All Headers & User Data	70h	2352	2052	2340	2060	2340
Sync & All Headers & User Data	F0h	2352	2064	2352	2072	2352
Repeat All Above and Add EDC/ ECC	08h	0	288	0	280	0
Repeat All Above and Add Error Flags	02h	294	294	294	294	294
Repeat All Above and Add Block & Error Flags	04h	296	296	296	296	296

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TABLE 2-23 READ CD MSF (B9H)

Byte	Bit 7	6	5	4	3	2	1	0
0	Operation Code (B9h)							
1	Reserved			Expected User data 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	Reserved for Error Type		Reserve
	Reserved					Sub-Channel Data Selection Bits		
	Sub Q	Raw	Reserved					
11	Reserved							

2.23   Read CD MSF (B9h)

IMPORTANT: This command applies only to models DRM-602X, DRM-624X, DR-U124X, DR-UA124X

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.

TABLE 2-24 READ CDP (E4H)

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Operation Code (E4h)							
1	Logical Unit No.			Reserved				
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	Reserved							
8	Allocation length (MSB)							
9	Allocation length (LSB)							
10	Reserved							
11	Reserved							

2.24   Read CDP (E4h)

Operation Code is (E4h)

This command requests the drive to return the status data resulting from the previous WRITE CDP command. The drive terminates the data phase when Allocation Length bytes or all the relevant data have been transferred.

The last status data returned from the Drive Controller is buffered in the drive SCSI controller. Because the next return data from the next WRITE CDP command will overwrite the buffer, the READ CDP command should immediately follow a WRITE CDP command.

The buffered status data is cleared after executing a READ CDP command. If a READ CDP command is issued after the buffer is cleared, the drive does not go to the data phase, but returns a GOOD status.

If a READ CDP command is issued during the execution of a player operation, a BUSY status is returned. Any command other than the READ CDP is accepted. If the drive receives a SCSI command (except the INQUIRY or REQUEST SENSE commands) the action initiated by the WRITE CDP command will be terminated. In this case, the player status returned by the READ CDP command will be "E16" (Input From Other Device). Such a player interrupt does not cause any SCSI errors.

See Appendix B for information on the CDP return codes.

TABLE 2-25 READ DRIVE STATUS (E0H)

Byte	**Bit**							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Operation Code (E0h)							
1	Logical Unit No.			Reserved				
2	PCF		Page Code					
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	Reserved							
8	Allocation Length (MSB)							
9	Allocation Length (LSB)							
10	Reserved							
11	Reserved							

TABLE 2-25A   PAGE HEADER

Byte	**Bit**							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Reserved		Page Code					
1	Page Length (MSB)							
2	Page Length (LSB)							

2.25   Read Drive Status (E0h)

Operation Code is (E0h)

PCF (Page Control Field) indicates the type of Page Parameter to be returned.

00b	:	Current Value
01b	:	Reserved
10b	:	Reserved
11b	:	Reserved

Page Code indicates contents of the Page Parameters.

01h	:	Drive Status
02h	:	Audio Play Status
Others	:	Reserved

The READ DRIVE STATUS command requests the drive to report its specific drive status to the initiator.

The drive terminates the DATA IN phase when Allocation Length bytes have been transferred or when all available Drive Status data has been transferred to the initiator. When **Allocation Length** is set to 0, no data is returned. This does not cause a Check Condition.

Page Parameters

Each Page Parameter data is preceded by a header of 3 bytes defining the Page Code and Page Length of the page.

Page Length is the number of bytes of status data following the Header

Page Code 01h

The drive will return 16 bits of Drive Status data. Bit 0 is the least significant bit.

TABLE 2-25B   DRIVE STATUS DATA FORMAT

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Reserved		Page Code : (01h)					
1	Page Length (MSB) (00h)							
2	Page Length (LSB) (02h)							
3	Drive Status (MSB)							
4	Drive Status(LSB)							

TABLE 2-25C   AUDIO PLAY STATUS FORMAT

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Reserved		Page Code : (02h)					
1	Page Length (MSB) (00h)							
2	Page Length (LSB) (01h)							
3	Audio Play Status							

Drive Status

Bit 15-12	0:	Reserved (all 0)
Bit 11	0:	Disc is present in Logical unit
	1:	No disc present in Logical Unit
Bit 10	1:	Supports Mode2 form1and form2.(XA)
	0:	Does not support Mode2 form1 and form2.(XA)
Bit 9	0:	Supports HSG addressing mode
	1:	Supports HSG and Red Book addressing modes
Bit 8	0:	No audio channel manipulation
	1:	Supports audio channel manipulation
Bit 7	0:	No Look-Ahead Read function
	1:	Supports Look-Ahead Read function
Bit 6		0: Reserved
Bit 5		0: Does not support interleaving
	1:	Supports ISO-9660 interleaving read
Bit 4		0: Data track reads only
	1:	Data track reads and play audio/video tracks
Bit 3		0: Read only
	1:	Supports Read and Write commands
Bit 2		0: Supports only 2048-byte block size
	1:	Supports 2048 and 2353-bytes block size
Bit 1		0: Magazine locked
	1:	Magazine unlocked
Bit 0		0: Magazine inserted
	1:	No magazine inserted

Page Code: 02h

The drive returns a 1-byte Audio Play Status.

Audio Play Status is a bit set to 1 indicates that the corresponding Logical Unit is playing an audio track.

Bit 0	:	Logical Unit 0
Bit 1	:	Logical Unit 1
Bit 2	:	Logical Unit 2
Bit 3	:	Logical Unit 3
Bit 4	:	Logical Unit 4
Bit 5	:	Logical Unit 5
Bit 6 and 7	:	Reserved

The Audio Play Status refers only to audio playback operations initiated by AUDIO PLAY commands.

TABLE 2-26 READ HEADER (44H)

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Operation Code (44h)							
1	Logical Unit No.			Reserved			MSF	Reserve
2	Logical block address (MSB)							
3	Logical block address							
4	Logical block address							
5	Logical block address (LSB)							
6	Reserved							
7	Allocation Length (MSB)							
8	Allocation Length (LSB)							
9	Reserved							

TABLE 2-26A   HEADER DATA FORMAT

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	CD-ROM Data Mode							
1	Reserved							
2	Reserved							
3	Reserved							
4	Absolute CD-ROM Address (MSB)							
5	Absolute CD-ROM Address							
6	Absolute CD-ROM Address							
7	Absolute CD-ROM Address (LSB)							

TABLE 2-26B   CD-ROM DATA MODE CODES

CD-ROM Mode	User Data Field Contents (2048 Bytes)	Auxiliary Field Contents (288 Bytes)
00	all bytes zero	all bytes zero
01	user data	EDC, L-EC bytes
02	user data	user data
03h ~ FFh	reserved	reserved

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2.26   Read Header (44h)

Operation Code is (44h)

MSF

> Set to 1 indicates that the absolute CD-ROM address field of the returned header data will indicate the MSF address where the specified logical block is found.

> If MSF bit is equal to 0, the absolute CD-ROM Address field of the returned header data gives the logical block address of the first logical block in the physical sector where the specified logical block is found. Note: This address may be different from the specified logical block address in CDB if the block length is either 512 or 1024 bytes.

Logical Block Address

> Specifies the logical block at which the read header operation will begin. A logical block size smaller than 2048 bytes, will be mapped into the appropriate physical block from which the data would have been read.

Allocation Length is the length of header data to be returned (08h).

This command requests the drive to return the header data of the specified logical block to allow the system or applications to determine the mode of the specified block.

If the specified block is on an audio track, a Check Condition status is returned.

CD-ROM Data Mode

> The CD-ROM Data Mode field will return CD-ROM Data Mode of the specified logical block.

TABLE 2-27 READ SUB-CHANNEL (42H)

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Operation Code (42h)							
1	Logical Unit No.			Reserved			MSF	Reserved
2	Reserved	SubQ	Reserved					
3	Sub Channel Data Format							
4	Reserved							
5	Reserved							
6	Track Number							
7	Allocation Length (MSB)							
8	Allocation Length (LSB)							
9	Reserved							

TABLE 2-27A   SUB CHANNEL DATA HEADER

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

2.27 Read Sub-Channel (42h)

Operation Code is (42h).

MSF

> If "1", the CD-ROM address field of the returned sub-channel data is in MSF format. The returned M,S and F fields are specified in hex. If "0", the CD-ROM address field of the returned sub-channel data is in logical address format.

Sub Q

> The Sub Q bit set to one requests the target return the Q sub-Channel data. Set to zero requests that no sub-channel data will be returned.

Sub Channel Data Format

> The Sub Channel Data Format Field specifies the returned Sub Channel Data. The format codes are listed below.

Track Number

> The track number field specifies the track number from which the ISRC Code is transferred. This field must have the value between 01h and 63h (99 bcd), and is valid only when the Sub Channel Data Format field is 03h. In this case, the target returns the ISRC Code of the track if it is detected. In other cases (i.e. Sub Channel Data Format Field not equal to 03h), the drive will return Check Condition status if the Track Number Field is not equal to 00h. The sense key and additional sense code are set to ILLEGAL REQUEST/INVALID FIELD in CDB.

Allocation Length

The READ SUB-CHANNEL command requests that the target return the requested sub-channel data of the current block plus the status of an audio play operation.

Format Code		Sub-Channel Data Block
00h	:	Q Sub-code Data
01h	:	CD-ROM Current Position
02h	:	Media Catalog Number (UPC/Bar Code)
03h	:	Track International Standard Recording Code (ISRC)
04h-FFh	:	Reserved

The returned sub-channel data consists of a four-byte header followed by a sub-channel data block. The header contains the audio status byte and the sub-channel data length field. If the Sub-Q bit in byte 2 of the CDB is zero, the target will not return the sub-channel data block. In this case the sub-channel data length is 0.

TABLE 2-27B   SUB-CHANNEL Q MODE INFORMATION

Byte	7	6	5	4	3	2	1	0
				Bit				
4	Sub Channel Data Format code (00h)							
5	ADR				Control			
6	Track Number							
7	Index Number							
8	Absolute CD-ROM Address (MSB)							
9	Absolute CD-ROM Address							
10	Absolute CD-ROM Address							
11	Absolute CD-ROM Address (LSB)							
12	Track Relative CD-ROM Address (MSB)							
13	Track Relative CD-ROM Address							
14	Track Relative CD-ROM Address							
15	Track Relative CD-ROM Address (LSB)							
16	MCV	Reserved						
17	(MSB)							
31	media catalog number(UPC/Bar Code) (LSB)							
32	TCV	Reserved						
33	(MSB)							
47	ISRC (LSB)							

TABLE 2-27C   AUDIO STATUS

Status	Description
00h	audio status byte not supported or invalid
11h	audio play operation in progress
12h	audio play operation paused
13h	audio play operation successfully completed
14h	audio play operation stopped due to error
15h	no current audio status to return

Audio Status indicates the status of an audio play operation. The status of audio commands are listed in Table 2-23C on the opposite page.

Sub Channel Data Length should be set 0, 12, 20, 28 or 44 bytes and does not include the Sub Channel Header.

ADR codes are defined in Table 2-23D

Control bits are defined in Table 2-23E

Track Number specifies the current Track Number

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

Absolute CD-ROM Address returns the current location relative to the logical beginning of the media. If the MSF bit in the CDB is zero, this field is a logical block address. If the MSF bit in the CDB is one, this field is an Absolute MSF address.

Track Relative CD-ROM Add returns 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 address will be a negative value, expressed as a two's complement number. If the MSF bit is one, this field is an absolute MSF address.

MCV

> If the MCV bit is one, the media catalog number field is valid.

> There are identify numbers according to the UPC/EAN cording in the media catalog number field. If all data in this field is ASCII 0, there is no media catalog number in the field.

TCV

> If the TCV bit is one, the ISRC field is valid. In this field, there are identify numbers according to the ISRC standard. (DIN-31-621)

When the **Sub-Q bit** in the CDB is set to zero, the drive returns the Sub Channel Header with no other data.

Audio status values 13h and 14h return information on previous audio operations; they are returned only once after the condition has occurred. If another audio play operation is not requested, the audio status returned for subsequent READ SUB-CHANNEL commands is 15h.

TABLE 2-27D   ADR SUB-CHANNEL Q FIELD

ADR Code	Description
0h	sub-channel Q mode information not supplied
1h	sub-channel Q encodes current position data
2h	sub-channel Q encodes media catalog number
3h	sub-channel Q encodes ISRC
4h ~ Fh	reserved

TABLE 2-27E   SUB-CHANNEL Q CONTROL FIELD

Bit	Set to "0" (ZERO)	Set to "1" (ONE)
0	audio without pre-emphasis	audio with pre-emphasis
1	digital copy prohibited	digital copy prohibited
2	audio track	data track
3	two channel audio	four channel audio

TABLE 2-27F   CD-ROM CURRENT POSITION DATA BLOCK

Byte	Bit 7	6	5	4	3	2	1	0
4	Sub Channel Data Format code (01h)							
5	ADR				Control			
6	Track Number							
7	Index Number							
8	Absolute CD-ROM Address (MSB)							
9	Absolute CD-ROM Address							
10	Absolute CD-ROM Address							
11	Absolute CD-ROM Address (LSB)							
12	Track Relative CD-ROM Address (MSB)							
13	Track Relative CD-ROM Address							
14	Track Relative CD-ROM Address							
15	Track Relative CD-ROM Address (LSB)							

The **ADR** field shows the type of information encoded in the Q sub-Channel of this block as defined in the CD standard.

MCV

If the MCV bit is one, the media catalog number field is valid.

There are identify numbers according to the UPC/EAN cording in the media catalog number field. If all data in this field is ASCII 0, there is no media catalog number in the field.

TCV

If the TCV bit is one, the ISRC field is valid. In this field, there are identify numbers according to the ISRC standard. (DIN-31-621)

TABLE 2-27G   MEDIA CATALOG NUMBER DATA BLOCK

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
4	Sub Channel Data Format code (02h)							
5	Reserved							
6	Reserved							
7	Reserved							
8	MCV	Reserved						
9	(MSB)							
23	Media catalog number (UPC/Bar Code) (LSB)							

TABLE 2-27H   TRACK INTERNATIONAL STANDARD RECORDING CODE(ISRC)   DATA
BLOCK

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
4	Sub Channel Data Format code (03h)							
5	ADR				Control			
6	Track Number							
7	Reserved							
8	TCV	Reserved						
9	(MSB)							
	Track International Standard Recording Code(ISRC)							
23								(LSB)

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TABLE 2-28 READ TOC (43H)

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Operation Code (43h)							
1	Logical Unit No.			Reserved			MSF	Reserve
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							
6	Start Track							
7	Allocation Length (MSB)							
8	Allocation Length (LSB)							
9	Format		Control					

TABLE 2-28A   **TOC** DATA WITH **FORMAT=00B**

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

TABLE 2-28B   TRACK DESCRIPTORS

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Reserved							
1	ADR			Control				
2	Track Number							
3	Reserved							
4	Absolute CD-ROM Address (MSB)							
5	Absolute CD-ROM Address							
6	Absolute CD-ROM Address							
7	Absolute CD-ROM Address (LSB)							

2.28 Read TOC (43h)

Operation Code is (43h).

The **READ TOC** command requests the target transfers data from the table of contents to the initiator.

This command has been modified from the SCSI-2 **READ TOC** command with the addition of the **Format** field to support multi-session discs.

Format field	Definition
00b	Same as SCSI-2. The **Start Track** Field specifies the starting track number for which the data will be returned. For multi-session discs, this command will return the **TOC** data for all sessions.
01b	This format returns the first session number, last session number and the starting address of the last session. The **Start Track** field is reserved and should be set to zero.
10b	All Sub-Channel Q code information.(DRM-602X only)
11b	Reserved.

The **Start Track** field specifies the starting track number for which the data shall be returned. If this value is zero, the table of contents data shall begin with the first track on the medium. The data is returned in contiguous ascending track number order.

If the **Start Track** 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.

IMPLEMENTORS NOTE: The maximum **TOC** data length possible on currently available CD-ROM media is 804 bytes, or 100 **TOC** track descriptors.

The TOC data block contains a four byte header followed by zero or more TOC track descriptors.

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.

The first track number field indicates the first track number in the table of contents. The last track number field indicates the last track number in the table of contents before the lead-out track number.

TABLE 2-28C **TOC** DATA WITH **FORMAT=01B**

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

TABLE 2-28D TRACK DESCRIPTORS

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Reserved							
1	ADR				Control			
2	First Track Number in Last Session							
3	Reserved							
4 ~ 7	Absolute CD-ROM Address of the First Track in the Last Session							

TABLE 2-28E TOC DATA WITH FORMAT=10B (DRM-602X ONLY)

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

IMPLEMENTORS NOTE:

The first track number is not required to be one. A disc may start at any valid track number. The track numbers between the first track number and the last track number are required to be in contiguous ascending order, except for the lead-out track.

The ADR field gives the type of information encoded in the Q sub-channel of the block where this TOC entry was found. The control field indicates the attributes of the track.

The track number field indicates the track number for which the data in the TOC track descriptor is valid. A track number of 0AAh indicates the track descriptor is for the start of the lead-out area.

The absolute CD-ROM 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 absolute CD-ROM address field contains a logical block address. An MSF bit of one indicates the absolute CD-ROM address field contains an MSF address.

IMPLEMENTORS NOTE:

The starting logical block address value recovered from the TOC has a tolerance of zero for data tracks and plus or minus 75 CD sectors for audio tracks. This tolerance is multiplied by a factor dependent of the logical block length.

TABLE 2-28F   TRACK DESCRIPTORS

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Reserved							
1	ADR				Control			
2	Byte1 or TNO							
3	Byte2 or Point							
4	Byte3 or Min							
5	Byte4 or Sec							
6	Byte5 or Frame							
7	Byte6 or Zero							
8	Byte7 or Pmin							
9	Byte8 or Psec							
10	Byte9 or PFrame							

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TABLE 2-29 RECEIVE DIAGNOSTIC RESULTS (1CH)

Byte	Bit

	Bit							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Operation Code (1Ch)							
1	Logical Unit No.			Reserved				
2	Reserved							
3	Allocation length (MSB)							
4	Allocation length (LSB)							
5	Reserved							

TABLE 2-29A   DIAGNOSTIC RESULTS DATA FORMAT

	Bit							
Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Reserved							
1	Parameter Length (06h)							
2	ROM Diagnostic							
3	RAM Diagnostic							
4	Data Buffer Diagnostic							
5	Reserved							
6	Reserved							

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2.29   Read Diagnostic Results (1Ch)

Operation code is (1Ch).

This command requests the drive to return the results of the power-on self test.

The Diagnostic Results data consists of 8-byte parameters as shown in Table 2-28B on the opposite page.

Parameter Length

    The number of bytes of the RECEIVE DIAGNOSTIC parameter excluding itself. This is fixed to 06h.

ROM Diagnostic

    Bit 0 = 1, failure of the SCSI controller ROM.

    Bit 1 = 1, failure of the drive controller ROM.

RAM Diagnostic

    Bit 0 = 1, failure of the SCSI controller RAM.

    Bit 1 = 1, failure of the drive controller RAM.

Data Buffer Diagnostic

    Bit 0 = 1, failure of the SCSI controller data buffer.

    Bit 1 = 1, failure of the drive controller data buffer.

    Bit 2 = 1, failure of the ECC RAM in the drive controller.

Interface Diagnostic

    Bit 0 = 1, interface failure between the SCSI controller and the drive controller.

    Bit 1 = 1, interface failure between the drive controller and the mechanism.

T<small>ABLE</small> 2-30 RELEASE (17H)

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Operation Code (17h)							
1	Logical Unit Number			3rdPty	3rd Party device ID			Ext (0)
2	Reservation ID : 00h							
3	Reserved							
4	Reserved							
5	Reserved							

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2.30   Release (17h)

Operation Code is (17h).

3rdPty

Set to one if the initiator requests third-party reservation.

3rd Party device ID

The SCSI ID of another initiator for which the logical unit shall be reserved.

Ext. (Extent)

Not supported. This bit must be 0.

Reservation ID

Not supported. This byte must be 00h.

This command is used by the reserving initiator to release the previous reservation of the logical unit. If an initiator attempts to release a reservation that is not currently active, no error is generated; the drive returns a GOOD status.

When the **3rd Party** bit is 1, the **3rd-Party Device ID** must be the same ID reserved by the original initiator.

TABLE 2-31 REQUEST SENSE (03H)

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Operation Code (03h)							
1	Logical Unit Number			Reserved				
2	Reserved							
3	Reserved							
4	Allocation Length (12h)							
5	Reserved							

TABLE 2-31A   EXTENDED SENSE DATA FORMAT

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Valid	Error code (70h / 71h)						
1	Segment number (00h)							
2	FileMk	EOM	ILI	Reserve	Sense Key			
3	Information byte (MSB)							
4	Information byte							
5	Information byte							
6	Information byte (LSB)							
7	Additional Sense Data Length							
8	Command-Specific Information (MSB)							
9	Command-Specific Information							
10	Command-Specific Information							
11	Command-Specific Information (LSB)							
12	Additional Sense Codes							
13	Additional Sense Code Qualifier							
14	Field Replaceable Unit Code							
15	SKSV	Sense-Key Specific (MSB)						
16	Sense-Key Specific							
17	Sense-Key Specific (LSB)							
18 ~ N	Additional Sense Bytes							

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2.31   Request Sense (03h)

Operation Code is (03h).

The REQUEST SENSE command requests the drive to transfer extended sense data to the initiator. The drive supports the first 18 bytes of the extended sense data format. The drive will transfer Allocation Length bytes or 18 bytes, whichever is smaller.

Valid

A valid bit of zero indicates that the information field is not as defined in the SCSI-2 standard. A valid bit of one indicates the information field contains valid information as defined in the SCSI-2 specifications.

FileMk (File mark) if one indicates that the current command has read a file mark.

EOM (End of Medium) if one indicates that an end-of-medium condition exists.

ILI (Incorrect Length Indicator)

An incorrect length indicator bit set to one indicates that the requested logical block length did not match the logical block length of the data on the medium.

Sense Key

Provides generic categories in which error and exception conditions can be reported. Table 2-31B lists the supported sense keys.

ASC / ASCQ (Additional Sense Codes)/(Additional Sense Code Qualifier)

Additional sense codes and additional sense code qualifier provides further detail describing the sense key. These codes are listed in Table 2-31C.

Additional Sense Length

Indicates the number of additional sense bytes to follow. If the allocation length of the command descriptor block is to small to transfer all of the additional sense bytes, the additional sense length is not adjusted to reflect the truncation.

Command Specific Info

The field contains information that depends on the command which was executed. Further definition for this field is contained within the command description.

SKSV

(Sense Key Specific Valid) The sense-key specific field is defined when the sense-key specific valid (SKSV) bit is one. A SKSV value of zero indicates that this field is not defined.

TABLE 2-31B   SUPPORTED SENSE KEYS

Sense Key	Name	Comments
0h	no sense	There is no specific sense key information to be reported for the designated logical unit.
1h	recovered error	The last command completed successfully with some recovery action performed by the target.
2h	not ready	The logical unit addressed can not be accessed.
3h	medium error	Command terminated, unrecovered error, probably caused by a flaw in the medium or an error in the recorded data.
4h	hardware error	The target detected a non-recoverable hardware failure while performing the command or during a self-test.
5h	illegal request	An illegal parameter in the command descriptor block or in the additional parameters supplied as data for commands.
6h	unit attention	Removable medium changed or target was reset.
7h	data protect	Execution of a read or write to medium command was attempted on a protected block.
8h	blank check	Write-once device encountered blank medium or format defined end of data indication while reading.
Bh	aborted command	Target aborted command.
Others	---	not supported

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TABLE 2-31C   SUPPORTED ADDITIONAL SENSE CODES AND ADDITIONAL SENSE CODE
    QUALIFIERS

ASC	ASCQ	DESCRIPTION
00	00	no additional sense information
00	06	I/O process terminated
00	11	audio play operation in progress
00	12	audio play operation pause
00	13	audio play operation successfully completed
00	14	audio play operation stopped due to error
00	15	no current audio status to return
02	00	no seek complete
04	00	logical unit not ready, cause not reportable
04	01	logical unit is in process of becoming ready
04	02	logical unit not ready, initializing command required
04	03	logical unit not ready, manual intervention required
05	00	logical unit does not respond to selection
06	00	no reference position found
07	00	multiple peripheral devices selected
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 error
09	02	focus servo failure
09	03	spindle servo failure
0A	00	error log overflow
11	00	unrecovered read error
11	05	L-EC uncorrectable error
11	06	CIRC unrecovered error
14	00	recorded entity not found
14	01	record not found
15	00	random positioning error
15	01	mechanical positioning 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 error correction applied
18	01	recovered data error correction and retries applied
18	02	recovered data - data auto - reallocated
18	03	recovered data with CIRC
18	04	recovered data with L-EC
18	05	recovered data - recommend reassignment
1A	00	parameter list length error
1B	00	synchronous data transfer error
20	00	invalid command operation code

CONTINUED

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Table 2-31C Supported additional sense codes and additional sense code qualifiers (*continued*)

ASC	ASCQ	DESCRIPTION
21	00	logical block address out of range
24	00	invalid field in CDB
25	00	logical unit not supported
26	00	invalid field in parameter list
26	01	parameter not supported
26	02	parameter value invalid
26	03	threshold parameters not supported
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
2A	02	log parameters changed
2B	00	copy can not execute since host can not disconnect
2C	00	command sequence error
2F	00	commands cleared by another initiator
30	00	incompatible medium installed
30	01	can not read medium - unknown format
30	02	can not read medium - incompatible format
37	00	rounded parameter
39	00	saving parameters not supported
3A	00	medium not present
3D	00	invalid bits in identify message
3E	00	logical unit has not self-configured yet
3F	00	target operating conditions have changed
3F	01	micro code has been changed
3F	02	changed operation definition
3F	03	inquiry data has changed
40	00	diagnostic failure on component NN (80h-FFh)
43	00	message error
44	00	internal target failure
45	00	select or reselect failure
46	00	unsuccessful soft reset
47	00	SCSI parity error
48	00	initiator detected error message received
49	00	invalid message error
4A	00	command phase error
4B	00	data phase error
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 TOC
5A	00	operation request or state change input (unspecified)
5A	01	operator medium removal request
5B	00	log exception
5B	01	threshold condition met
5B	02	log counter at maximum
5B	03	log list codes exhausted
63	00	end of user area encountered on this track
64	00	illegal mode for this track

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TABLE 2-32 RESERVE (16H)

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Operation Code (16h)							
1	Logical Unit No.			3rdPty	3rd Party Device ID			Ext (0)
2	Reservation ID (00h)							
3	Extent List length (00h)							
4	Extent List length (00h)							
5	Reserved							

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2.32   Reserve (16h)

Operation Code is (16h).

3rdPty

> Set to one if the initiator requests third-party reservation.

3rd Party Device ID

> The SCSI ID of another initiator for which the logical unit shall be reserved.

Ext. (Extent) is not supported. This bit must be 0.

Reservation ID is not supported. This byte must be 00h.

Extent List length is not supported. These bytes must be 00h.

The initiator uses this command to exclusively reserve the specified logical unit.   Area reservations using the **Extent** bit are not supported. If the **3rd Party** bit is 1, the logical unit is reserved for another SCSI device specified by the **3rd Party Device ID**. The initiator can change the reservation by issuing a new RESERVE UNIT command to the reserved unit. In this case, the previous reservation is released when the new reservation is received.

The reserved condition is maintained until the original initiator issues another valid RESERVE UNIT command or a RELEASE UNIT command; when a BUS DEVICE RESET message is issued by any initiator; or when a hardware reset condition occurs. In the latter two reset cases, a UNIT ATTENTION condition is reported for the next SCSI command.

Any reservation request by an initiator for a logical unit that has been reserved by another initiator is rejected, and a RESERVATION CONFLICT status is returned.

If the **3rd Party** bit is 1, the logical unit is reserved for the SCSI device indicated by the **3rd-Party Device ID**. The reserved state is maintained as described previously. Any release request is ignored, and a GOOD status is returned if it comes from an initiator other than the one that issued the reservation command.

TABLE 2-33 REZERO UNIT (01H)

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Operation Code (01h)							
1	Logical Unit No.				Reserved			
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							

2.33   Rezero Unit (01h)

Operation Code is (01h).

The drive loads the specified logical unit (if necessary), spins up the disc (if stopped), moves the head to the start track of the disc, and holds it there until an inactivity time-out occurs. If the initiator requests a disconnect, the drive disconnects from it during load and seek operations. This command does not affect modes specified by the MODE SELECT command.

TABLE 2-34 SEEK(6) (0BH)

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Operation Code (0Bh)							
1	Logical Unit No.			Logical Block Address (MSB)				
2	Logical Block Address							
3	Logical Block Address (LSB)							
4	Reserved							
5	Reserved							

2.34 Seek(6)

Operation Code is (0Bh).

The drive seeks to the specified logical block address and then holds at that track until an inactivity time-out occurs.

TABLE 2-35 SEEK(10) (2BH)

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Operation Code (2Bh)							
1	Logical Unit No.			Reserved				0
2	Logical Block Address (MSB)							
3	Logical Block Address							
4	Logical Block Address							
5	Logical Block Address (LSB)							
6	Reserved							
7	Reserved							
8	Reserved							
9	Reserved							

2.35   Seek(10) (2Bh)

Operation code is (2Bh).

The drive seeks to the specified logical block address and then holds at that track until an inactivity time-out occurs.

TABLE 2-36 SEND DIAGNOSTIC (1DH)

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Operation Code (1Dh)							
1	Logical Unit No.			PF	Res	Self	Reserved	
2	Reserved							
3	Allocation length (MSB)							
4	Allocation length (LSB)							
5	Reserved							

TABLE 2-36A   SEND DIAGNOSTIC DATA FORMAT

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Reserved							
1	Parameter Length (06h)							
2	ROM Diagnostic							
3	RAM Diagnostic							
4	Data Buffer Diagnostic							
5	Interface Diagnostic							
6	Reserved							
7	Reserved							

2.36 Send Diagnostic (1Dh)

Operation code is (1Dh).

PF must be 0.

Self (Self-Test bit) if "1" (ONE), default self-test is executed. If "0" (ZERO), send diagnostic data issued.

Allocation length set to 0 when Self bit is one.   When Self bit is 0, set to 8h.

This command reports the results of the drive's power-on self test (when the self bit is one). If test is successful, GOOD status is returned. If a problem was detected, Check Condition with sense key HARDWARE ERROR is returned. Use RECEIVE DIAGNOSTIC RESULTS to determine the problem area.

If self bit is zero, target returns GOOD status after received specified CDB and parameter list.

A Result of the test will be returned by the RECEIVE DIAGNOSTIC RESULT command.

The Send Diagnostic data consists of 8-byte parameters as shown in the following table:

Parameter Length is the number of bytes of the SEND DIAGNOSTIC parameter excluding itself. This is fixed to 06h.

ROM Diagnostic
>   Bit 0 = 1, test the SCSI controller ROM.
>   Bit 1 = 1, test the drive controller ROM.

RAM Diagnostic
>   Bit 0 = 1, test the SCSI controller RAM.
>   Bit 1 = 1, test the drive controller RAM.

Data Buffer Diagnostic
>   Bit 0 = 1, test the SCSI controller data buffer.
>   Bit 1 = 1, test the drive controller data buffer.
>   Bit 2 = 1, test the ECC RAM in the drive controller.

Interface Diagnostic
>   Bit 0 = 1, test interface between the SCSI controller and the drive controller.
>   Bit 1 = 1, test interface between the drive controller and the mechanism.

T ABLE 2-37 SET CD-ROM SPEED(1) (DAH)

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Operation Code (DAh)							
1	Reserved							
2	Speed							
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	Reserved							
8	Reserved							
9	Reserved							
10	Reserved							
11	Reserved							

2.37   Set CD-ROM Speed(1) (DAh)

Operation code is (DAh).

The Set CD-ROM Speed command provides a means for initiator to set the spindle motor speed.

Speed Field Value		Description
00h	:	Normal Speed
01h	:	2x Speed
03h	:	4x Speed
FFh	:	Maximum Speed
Other Value	:	Any other value not specified will set the drive to maximum Speed

Drive Differences:

DRM-602x   The DRM-602x does not support 4x speed. A speed setting value of 03h will not cause an error, but set the drive to 2x speed.

DRM-624x, DRM-604x, DR-U124x, DR-UA124X, and DR-D504X

These drives do not support 2x Speed. A speed setting value of 01h will not cause an error. However, the drive will automatically be set to 4x speed.

T<small>ABLE</small> 2-38 SET CD-ROM SPEED(2) (BB<small>H</small>)

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

2.38   Set CD-ROM Speed(2) (BBh)

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.

TABLE 2-39 START/STOP UNIT (1BH)

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Operation Code (1Bh)							
1	Logical Unit No.			Reserved				Immed
2	Reserved							
3	Reserved							
4	Reserved						LoEj	Start
5	Reserved							

2.39 Start/Stop Unit (1Bh)

Operation code is (1Bh).

Immed (Immediate)

When the immediate bit is 1, status is returned before executing the command . When it is 0, status is returned after the operation is completed.

LoEj (Load Eject)

When LoEj is 1 and Start is 0, the drive ejects the magazine.

Start

When Start is 1, the disc tray is loaded, the disc is spun up, and the laser and servo system are turned on. When it is 0, the disk is spun down.

T ABLE 2-40 STOP PLAY/SCAN (4EH)

Byte/Bit	Bit							
	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							

2.40   Stop Play/Scan (4Eh)

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

T<small>ABLE</small> 2-41 TEST UNIT READY (00<small>H</small>)

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Operation Code (00h)							
1	Logical Unit No.			Reserved				
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							

2.41   Test Unit Ready (00h)

Operation Code is (00h).

The TEST UNIT READY command checks that a cartridge is loaded and that the drive is ready to operate. "Ready" has different meanings depending on whether the drive has accessed a logical unit by loading the disc tray:

Before access to logical unit :   Magazine is inserted and the drive is ready to read.

After an access to logical unit: A disc is in the specified logical unit (or tray) and is ready to be accessed.

The TEST UNIT READY command does not load the logical unit's tray. (See REZERO UNIT) See 1.3 for Disc Status Information.

A Not Ready condition can occur when:
  (1) No magazine is inserted in the drive.
  (2) The magazine cannot be inserted or ejected.
  (3) The drive cannot read TOC information on a disc.
  (4) There is no disc present.

TABLE 2-42 VERIFY(10) (2FH)

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Operation Code (2Fh)							
1	Logical Unit No.			Reserved		Blkvry	Bytchk	RelAdr
2	Logical block address (MSB)							
3	Logical block address							
4	Logical block address							
5	Logical block address (LSB)							
6	Reserved							
7	Verification length (MSB)							
8	Verification length (LSB)							
9	Reserved							

2.42   Verify(10) (2Fh)

Operation code is (2Fh).

Logical Block Address is the address at which the verify operation shall begin.

Verification Length is the number of logical blocks to be verified.

This command requests the drive to check the specified blocks on the disc based upon the error recovery parameter setting (see MODE SELECT command). No data transfer on the SCSI bus occurs.

NOTE: The **BlkVry** (Blank verify), **BytChk** (Byte Check) and **RelAdr** bits in byte 1 are not supported, and should be set to 0.

TABLE 2-43 VERIFY(12) (AFH)

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Operation Code (AFh)							
1	Logical Unit No.			Reserved		0	0	0
2	Logical block address (MSB)							
3	Logical block address							
4	Logical block address							
5	Logical block address (LSB)							
6	Verification Length (MSB)							
7	Verification Length							
8	Verification Length							
9	Verification Length (LSB)							
10	Reserved							
11	Reserved							

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2.43 Verify(12) (AFh)

Operation code is (AFh).

See VERIFY(10) for complete description of this command.

TABLE 2-44 WRITE BUFFER (3Bн)

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Operation Code (3Bh)							
1	Logical Unit No.			Reserved			Mode	
2	Buffer ID (00h)							
3	Buffer offset (MSB)							
4	Buffer offset							
5	Buffer offset (LSB)							
6	Transfer length (MSB)							
7	Transfer length							
8	Transfer length (LSB)							
9	Reserved							

TABLE 2-38A   WRITE BUFFER HEADER

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

2.44 Write Buffer (3Bh)

Operation Code is (3Bh).

Mode specifies meaning of the Buffer Offset field.

Buffer ID is not supported. This byte must be 00h.

Buffer Offset is the byte offset in the buffer where the data shall be stored. This must be 0 through 15.

Transfer Length is the number of bytes to be transferred in the DATA OUT phase. This must be the data length to be sent plus 4 bytes (header size).

This command is to be used with the READ BUFFER command to test the reliability of the command buffer memory in the drive, and of the SCSI bus. The drive does not access any discs.

Mode	Definition
00b	Header, data, and buffer offset are 0s.
01b	Buffer offset indicates the offset of the buffer at which data are to be stored.
10b	Reserved
11b	Reserved

The transfer length must include the 4-byte header, therefore, the actual data length to be stored is the transfer length minus 4 bytes. As the buffer length of the drive is 16 bytes, the maximum number of bytes that can be specified for Buffer Offset is 15, and the maximum for Transfer Length is 20.

If Transfer length is larger than 20, a Check Condition is returned with the sense key "ILLEGAL REQUEST." Check Condition will also be returned if the Buffer Offset + Transfer Length is larger than 20.

If Buffer Offset is not 0 when Mode is 00h, Check Condition is returned.

Refer to Table 2-38A on the opposite page for the 4-byte header of 00h's must be sent preceding the test data.

TABLE 2-45 WRITE CDP (E3H)

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Operation Code (E3h)							
1	Logical Unit No.			Reserved				
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	Reserved							
8	Transfer length (MSB) (00h)							
9	Transfer length (LSB) : <= 14h							
10	Reserved							
11	Reserved							

2.45 Write CDP (E3h)

Operation Code is (E3h).

Transfer Length is the number of bytes of CDP command data to be sent.

This command sends alphanumeric Player Control commands to the drive. The drive returns the command status after the player control command is transferred to the drive controller chip. A GOOD status indicates only that the command was syntactically correct. The READ CDP command must be used to determine the results of the operation.

(See Appendices A and B for details on audio functions.)

The Player Control command data can contain up to 21 characters including a Carriage Return (0Dh). If *Transfer Length* is larger than 21, Check Condition is returned with sense key ILLEGAL REQUEST and sense code 24h, "Invalid Command Block Other Than 20 or 21".

IMPORTANT: THE COMMAND STRING MUST BE TERMINATED WITH A CARRIAGE RETURN

Data after a Carriage Return is ignored. When there is no Carriage Return, Check Condition is returned with sense key ILLEGAL REQUEST, sense code "Error in Parameter List" (26h).

When media change is prohibited by the PREVENT/ALLOW MEDIA REMOVAL command, the magazine eject command "Z0" is ignored. When the command string consists of multiple request commands (such as "?Z"), only the status of the first command is returned by the READ CDP command.

TABLE 2-46 READ CD-DA (D8H)

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Operation Code (D8h)							
1	Logical Unit Number			Reserved				
2	(MSB)							
3								
4	Starting Logical Block Address							
5	(LSB)							
6	Reserved							
7	(MSB)							
8	Transfer length							
9	(LSB)							
10	Sub Code							
11	Reserved							

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2.46   Read CD-DA (D8h)

IMPORTANT: This command applies only to models DRM-602X, DRM-624X, and the DR-U Series drives.

Operation Code is (D8h).

The READ CD-DA command requests that the drive transfer CD-DA data and/or Sub Code data.

The **Starting Logical Block Address** specifies the block where the READ operation begins. The definition of the starting logical block address is as follows:

Starting Logical Block Address = (M-Ms) * 60 * 75 + (S-Ss) * 75 + (F-Fs)

(M, S, F) = absolute MSF address of the requested starting logical block
(Ms, Ss, Fs) = absolute MSF address of the first block of the first track

Sub Code Field:

Sub Code Field	CD-DA block length	Description
00h	2352 bytes	CD-DA data with no Sub Code
01h	2368 bytes	CD-DA data with Sub Q Code
02h	2448 bytes	CD-DA data with all Sub Code
03h	96 bytes	All Sub Code only
04 ~ FFh	Reserved	

If the **Sub Code** field is set to **00h**, the drive returns the CD-DA data without Sub Code data. (Each block consists of 2352 bytes of digital audio data without any Sub Code data.)

If the **Sub Code** field is set to **01h**, the drive returns the CD-DA data with Sub Q data.   Each block consists of 2368 bytes which includes 2352 bytes of digital audio data, 10 bytes of Sub Q data and 6 bytes of zeros. Note: 16 bits of CRC for the Sub Q data are not transferred.

If the **Sub Code** field is set to **02h**, the drive returns the CD-DA data with all Sub Code data. (Each block consists of 2448 bytes which includes 2358 bytes of digital audio data and 96 bytes of Sub Code data.)

If the **Sub Code** field is set to **03h**, the drive returns 96 bytes of all Sub Code data only.

The **Transfer Length** specifies the number of contiguous CD-DA data blocks to be transferred.

NOTES:

1) The CD-DA block lengths are totally irrelevant to the logical block length set by the Mode Select(6) command. This command would not change the block length field in the MODE SELECT command.

2) While the SCSI buffer is being filled, the drive is able to prepare with no overlap or missing data in response to the consecutive commands which read contiguous CD-DA blocks.

When the host cannot read the data quick enough and the buffer is full, the drive will stop refilling the buffer. The host is still capable of reading all CD-DA data in the SCSI buffer with consecutive read commands without overlap or missing bits at the block boundary. Once the buffer is full, the first read command to read the next sequential CD-DA block(e.g. X+1) after the last CD-DA block(e.g. X) in the buffer will cause a Check Condition with a sense key of 05h and an additional sense code of BAh(buffer overflow). There is no check condition for a read command which does not request block X+1(e.g. a Read(X+2, 1) command). In addition, a second read command which requests block X+1 will not get a check condition.

For Example (In case that the last CD-DA block stored in the buffer is X): In a Read(X-2, 5) command to read block X-2 to X+2, the drive returns three CD- DA data blocks and then a check condition. The drive returns the block X+1 address in the information bytes(byte 3 to 6) of a subsequent Request Sense command. There are no overlap of missing bits for blocks X-2, X-1 and X. Block X and X+1 are not transferred. That is; in case of reading CD-DA blocks, the drive has only rough access. Once the data stream from the media has been stopped, it is unable to have such pin-point access as in CD-ROM blocks. (Each CD-ROM block always includes the CD-ROM Header that provides the pin-point access.)

3) The volume level control is not performed on any SCSI CD-DA data. Analog audio output is not performed while SCSI CD-DA data is in transaction, either.

4) The drive transfers data to the host at the burst transfer rate for the entire block of data. The drive's firmware overhead should only occur at a block boundary. Upon completion of the read operation, the drive enters the Hold Track state during inactive time.

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TABLE 2-47 READ CD-DA MSF (D9H)

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Operation Code (D9h)							
1	Logical Unit No.			Reserved				
2	Reserved							
3	Starting M Field							
4	Starting S Field							
5	Starting F Field							
6	Reserved							
7	Ending M Field							
8	Ending S Field							
9	Ending F Field							
10	Sub Code							
11	Reserved							

2.47   Read CD-DA MSF (D9h)

IMPORTANT: This command applies only to models DRM-602X, DRM-624X, and the DR-U Series drives.

Operation Code is (D9h).

Starting M, S, F Fields indicates the absolute MSF address where the operation begins.

Ending M, S, F Fields indicates the absolute MSF address where the operation ends. If the ending address is smaller than the starting address, check condition will be returned. The sense key is set to Illegal Request (05h), the additional sense code is set to Invalid field in CDB (24h).

Sub Code Field - for details, refer to the READ CD-DA command.

The READ CD-DA MSF command requests that the drive transfer CD-DA data.

The data transfer length (bytes) is calculated as follows;

Data Transfer Length = [(Me-Ms) * 60 * 75 + (Se-Ss) * 75 + (Fe-Fs)] * CD-DA Block length

> $(Ms, Ss, Fs) = $ Starting MSF address
> $(Me, Se, Fe) = $ Ending MSF address

NOTE: The drive transfers the entire block of data to the host at SCSI bus burst transfer rate. The drive's firmware overhead should only occur at a block boundary. Upon completion of the read operation, the drive enters Hold Track State during inactive time.

T ABLE 2-48 READ CD-XA (DB H)

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Operation Code (DBh)							
1	\multicolumn{3}{c}{Logical Unit No.}	\multicolumn{5}{c}{Reserved}					
2	(MSB)							
3	Starting Address							
4								
5	(LSB)							
6	CD-XA Format							
7	(MSB)							
8								
9	Transfer Length							
10	(LSB)							
11	Reserved							

2.48   READ CD-XA (DBh)

IMPORTANT: This command applies only to models DRM-602X, DRM-624X, and the DR-U Series drives.

Operation Code is (DBh).

Starting Address specifies the block where the operation begins.

Transfer Length specifies the number of contiguous CD-XA blocks to be transferred.

The READ CD-XA command requests that the drive transfer CD-XA data to the host.

The **Starting Address** is defined as follows.

Starting Address = M * 60 * 75 + (S-2) * 75 + F
M, S & F = the absolute MSF address of the requested starting address

CD-XA Format Field:

CD-XA Field	CD-XA Block Length	Description
00h	2048 bytes	User data only (no sub header)
0Fh	2352 bytes	All CD-XA sector data
1Fh	2646 bytes	All data with 294-byte Error Flags
Other Codes	Reserved	

When the **CD-XA Format** field is set to **00h**, the drive returns 2048 bytes CD-XA data in the user data area without any Sub-header data. If the requested block is in a CD-XA Mode2/Form2 sector, only 2048 bytes user data will be returned and the remaining data will be discarded.

When the **CD-XA Format** field is set to **0Fh**, the drive returns all 2352 bytes CD-XA sector data.

When the **CD-XA Format** field is set to **1Fh**, the drive returns the CD-XA data with Error Flag data. Each block consists of 2646 bytes which includes the entire block of 2352 bytes CD-XA data and a block of 294 bytes Error Flag data.

NOTE: The CD-XA block length is totally irrelevant to the logical block length set by Mode Select Command.

TABLE 2-49 READ ALL SUBCODE (DFH)

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

2.49   Read All SubCode (DFh)

IMPORTANT: This command applies only to models DRM-602X, DRM-624X, and the DR-U Series drives.

Operation Code is (DFh)

Transfer Length indicates the number of contiguous sub-code frames to be transferred. Each sub-code frame consists of 96-byte data.

Read All Subcode command directs the target to transfer real-time sub-code data (P-W) to the initiator while the audio is being played.

The initiator must hold while the current sub-code is being retrieved from the disc.

If the **Transfer Length** is zero, sub-code data will not be transferred. In this case, however, it is not considered an error.

In the event the sub-code buffer is full in the drive, the drive will stop storing sub-code data into the buffer. However, the data in the buffer is accessible by this command.

The drive will quit the operation with a Check Condition status once the buffer overflows or there is no more valid sub-code data in the buffer. The sense key is set to 05h and the additional sense code is to BFh. The Check Condition for buffer overflow occurs only for the READ ALL SUBCODE command.

If the target is not playing the audio, the drive will return a Check Condition status. The sense key is set to 05h and the additional sense code is to 64h.

NOTE: The drive transfers an entire block of data at SCSI bus burst transfer rate. The drive's firmware overhead only occurs at a block boundary. Upon completion of the read operation, the drive enters the Hold Track state during the inactivity time.

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APPENDIX A   PIONEER CD-ROM DRIVES - AUDIO FUNCTIONS

The CD-ROM drives consist of two logical subsystems - a CD reader and a controller. The controller receives SCSI commands, and sends commands to the reader for execution as needed. This allows audio commands to be executed in the background. At times, the two subsystems may be operating independently.

In addition to the normal audio commands, the CD-ROM drives support the Pioneer Laser Disc Player control commands. These alphanumeric mnemonics may be sent to the drive using the vendor-unique command WRITE CDP (**C**haracter **D**evice **P**layer). The WRITE READ CDP command strings are passed through the controller directly to the reader. The controller checks the length and termination of the command string, and, if valid, returns a GOOD status. The controller will generate a Check Condition with a sense key of ILLEGAL REQUEST if the string is not valid. The controller then passes the command string to the reader for execution. To receive the results of the command string, the initiator must use the READ CDP command to get the status from the reader. The reader passes the result data through the controller. Invalid commands or execution errors will not cause SCSI errors, but will be reported by the READ CDP command.

Certain types of data, such as the disc TOC, are stored by the controller once they have been read from the disc. If a disc has been accessed, a READ TOC command will not require a disc access, which could include a disc change. Instead, the TOC data is transferred from controller memory.

APPENDIX B   AUDIO PLAYER COMMANDS

Addressing Modes

Block	MMSSFF	Specifies Minutes, Seconds, and Frames.
Index	I I	Specifies pre-mastered indices
Time	MMSS	Specifies Minutes and Seconds (Frame 0)
Track	TT	Specifies the beginning of track TT

Player Modes

P00	**Home**	No disc is loaded. Magazine not inserted.
P00	**Home**	No disc is loaded. Magazine inserted.
P01	**Park**	The disc is loaded, but not spinning.
P03	**Stop**	
P04	**Play**	The drive is playing audio.
P06	**Pause**	The disc is spinning, but audio play has been paused.

The following table lists the Command Mnemonic and explanation for each player command.

CM	Command	Drive Action
?A	Address Request	Returns a 10-digit string (TTIIMMSSFF) representing Track number, Index number, and P-code time for the current address. In Park mode, the string is XXXXXXXXXX, at lead-in 0000000000. At lead-out, the string is AA01000000.
?B	Block Request	Returns a six digit string representing the current address in MMSSFF format. In Park mode, XXXXXX is returned. 000000 is returned when the current address is in the lead-in area.
BK	Block Mode	Sets the addressing mode to Block mode. All subsequent addresses must be in MMSSFF format.
CL	Clear	Clears the buffer which stores the stop marker. Will also cancel search mode or play modes.
?G	Catalog Request	Returns the disc's 13 digit catalog number. If the disc does not have a catalog number, or if no disc is loaded, the string will be all "X"s.
?I	Index Request	Returns a four digit string representing the track number and index number. In Park mode, XXXX is returned. 0000 is returned when the current address is in the lead-in area, and AA01 when in the lead-out area.

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CM	Command	Drive Action (*continued*)
IX	Index Mode	Sets the addressing mode to Index mode. All subsequent addresses will be interpreted as indices.
?K	Disc Status Request	Returns an eight character string representing the attributes of the currently loaded disc. (N1 - N8) N1: Disc Loaded 0: No 1: Yes X: Unknown N2: Audio Track 0: Not Present 1: Present X: Unknown N3: Data Track 0: Not Present 1: Present X: Unknown N4: CDV 0: No 1: Yes X: Unknown N5: CD-I 0: No 1: Yes X: Unknown N6-8: Reserved (All X)
n KL	Key Lock	Enables or disables the front panel eject button. *n* = 0: Enabled. *n* = 1: Disabled
LO	Lead Out	Lead Out Address
NF	Scan Forward	Scans forward about 15 seconds, with audio attenuated by 12 dB.
NR	Scan Reverse	Scans backwards about 15 seconds, with audio attenuated by 12dB.
?O	Read ISRC	Returns the 15 digit International Standard Recording Code for the current track. (DRM-604X series only)
?P	Mode Request	Returns three digit string representing player mode: P00 - Home (No Magazine), P01 - Park Mode, P04 - Play Mode, P06 - Pause Mode, P20 - Home Mode (Magazine Inserted)
PA	Pause	Enters Pause mode at the current address.
PL	Play	Enters Play mode and begins audio play.
?Q	TOC Request	Returns TOC data as a 10 digit string (FFLLEEEEEE), where FF represents the first track, LL represents the last track number, and EEEEEE represents the lead-out address in MMSSFF format.
?*n* Q	TOC Request	Returns TOC data for track *n* as an eight digit string (EEEEEETT), where EEEEEE represents the absolute start address of the track in MMSSFF format, and TT represents the track type. 00 means audio, 04 means data.
?R	Track Request	Returns a two digit string representing the current track. In Park mode, XX is returned. 00 is returned when the current address is in the lead-in area, an AA when in the lead-out area.
RJ	Reject	Stops the disc and enters Park mode.
SA	Start	Starts disc rotation. The drive will pause at the beginning of the first audio track.
a SE	Search	Searches to address *a* and enters Pause mode.
a SM	Stop Marker	Sets a stop marker at address *a*. When the stop marker is reached, the drive enters Pause mode. Stop markers are cleared by CL and RJ commands.

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CM	Command	Drive Action (*continued*)
?T	Time Request	Returns a four digit string representing the current time in MMSS format. In Park mode, XXXX is returned. 0000 is returned when the current address is in the lead-in area.
TM	Time Mode	Sets the addressing mode to Time mode. All subsequent addresses must be in MMSS format.
TR	Track Mode	Sets the addressing mode to Track Mode. All subsequent addresses must be in TT format, specifying a track number.
n VL	Volume	Sets the audio playback level, from 0 to 255.
?X	CDP Model	Returns the revision of the CDP ROM Example: "P150801"
?Z	Disc Query	Returns a three digit number representing the currently loaded disc. If there is no disc loaded, "XXX" will be returned.
ZO	Eject Magazine	Ejects the magazine.
ZR	Disc Return	Unloads the currently loaded logical unit (tray).
n ZS	Disc Select	Loads disc *n* (1-6). After the disc is loaded, the drive goes into Park mode.

Player Command Error Messages

Return	Error	Explanation
R	(GOOD)	The command completed successfully.
E00	Communication Error	Error in command, command too long
E04	Feature not Available	Unusable command, wrong mode, bad track
E06	Missing Argument	A required parameter was not supplied
E11	Disc not Present	No disc loaded, magazine not inserted
E12	Address Error	Search address not found
E13	Focus Error	Focus lost (Hardware problem)
E14	Spindle Unlocked	The spindle is not locking
E16	Eject Received	Front panel Eject button pressed before command finished
E90	Panic - Mechanical	A non-recoverable error has occurred in a mechanical operation such as loading.
E91	Can't Eject Magazine	
E92	Can't Load	
E96	Can't Start	Drive was unable to spin-up the disc
E99	Panic	A non-recoverable operational error has occurred.

Example

To load Disc 3 and start playing from 21m 34s 16bl, use the command 3ZSSABK213416SEPL<CR>. **3ZS**: Load Disc 3 **SA**: Start rotation **BK**: Block Addressing **213416SE**: Search to 21 Minutes, 34 Seconds, 16 Blocks **PL**: Begin Play.

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APPENDIX C   DRIVE VERSION DIFFERENCES

DRM-602X

2900   Current Version

DRM-604X

2401   Current Version
          Does Not Support SCSI-2

2403   Supports SCSI-2
          Supports Multi-session Photo CD.

DRM-1804X

0100   Current Version

APPENDIX D   PRODUCTS DEFAULT DATA

D.1   Product data of Applied Model Number 3 (Inquiry Data)

TABLE D-1A   DR-U124X   INQUIRY DATA FORMAT

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Peripheral Qualifier			Peripheral device type (05h)				
1	RMB=1	Reserved						
2	0		0			ANSI version : 2		
3	0	TIOP=1	Reserved			Response format : 2		
4	Additional length : 42 (2Ah)							
5	Reserved							
6	Reserved							
7	0	0	0	Sync=1	0	Reserve	0	0
8 ~ 15	Vendor name (8-byte ASCII code) Continue "PIONEER"							
16 ~ 31	Product inquiry data (16-byte ASCII code) Continue "CD-ROM DR-124X"							
32 ~ 35	Revision number (ASCII code) Ex."0100"							
36	Release Version : 20h							
37 ~ 46	Revision Date(10-byte ASCII code) Continue Ex. "1995/02/08"							

TABLE D-1B   DR-UA124X   INQUIRY DATA FORMAT

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Peripheral Qualifier			Peripheral device type (05h)				
1	RMB=1	Reserved						
2	0		0			ANSI version : 0		
3	0	TIOP=1	Reserved			Response format : 1		
4	Additional length : 42 (2Ah)							
5	Reserved							
6	Reserved							
7	0	0	0	Sync=1	0	Reserve	0	0
8 ~ 15	Vendor name (8-byte ASCII code) Continue "PIONEER"							
16 ~ 31	Product inquiry data (16-byte ASCII code) Continue "CD-ROM DR-124X"							
32 ~ 35	Revision number (ASCII code) Ex."0100"							
36	Release Version : 20h							
37 ~ 46	Revision Date(10-byte ASCII code) Continue Ex. "1995/02/08"							

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TABLE D-1C   DRM-624X INQUIRY DATA FORMAT

Byte	Bit							
	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral device type (05h)				
1	RMB=1	Reserved						
2	0		0			ANSI version : 2		
3	0	TIOP=1	Reserved			Response format : 2		
4	Additional length : 42 (2Ah)							
5	Reserved							
6	Reserved							
7	0	0	0	Sync=1	0	Reserve	0	0
8 ~ 15	Vendor name (8-byte ASCII code) Continue "PIONEER"							
16 ~ 31	Product inquiry data (16-byte ASCII code) Continue "CD-ROM DRM-624X"							
32 ~ 35	Revision number (ASCII code) Ex."0100"							
36	Release Version : 20h							
37 ~ 46	Revision Date(10-byte ASCII code) Continue Ex. "1995/02/08"							

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D.2   CD-ROM Ability Mechanical Status Page Default Data

TABLE D-2A   PAGE CODE 2AH : CD-ROM CAPABILITIES AND MECHANICAL STATUS PAGE DEFAULT
DATA

Byte	Bit							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Reserved	Reserved	Page Code (2Ah)					
1	Page Length (0Eh)							
2	Reserved							
3	Reserved							
4 ~ 7 32-bit field of Capability bits	Reserved	Multi Session =1	Mode 2 Form 2 =1	Mode 2 Form1 =1	Reserved	Reserved	XA Commands =0	AudioPlay =0
	Reserved	ISRC =1	UPC =1	C2Po supported =0	R-W Dec. =1	R-W Supported =1	CD-DA String =1	CD-DA Commands =1
	Loading Mechanism Type 124X=001b,624X=000b			Reserved	Eject =1	Prevent JP =1	Lock State	Lock =1
	Reserved						Sp.Mute =1	Sp.volume =1
8	(MSB) Maximum Speed Supported (in KBps)							
9	DR-UA124X=706,DR-U124X/DRM-624X=777 (LSB)							
10	(MSB) Number of Volume Levels Supported							
11	= 256 (LSB)							
12	(MSB) Buffer Size supported by Drive (in KBytes)							
13	= 128 (LSB)							
14	(MSB) Current Speed Selected (in KBps)							
15	DR-UA124X=706,DR-U124X/DRM-624X=777 (LSB)							
16	Reserved							
17-20	Reserved							

APPENDIX E   CD-ROM COMMAND LIST (BY CODE)

TABLE E-1   CD-ROM COMMAND LIST BY CODE

| Code | Command Name | Applied Model | | | Sense Data |
		1	2	3	Contents of Information Bytes
00h	TEST UNIT READY	yes	yes	yes	
01h	REZERO UNIT	yes	yes	yes	
03h	REQUEST SENSE	yes	yes	yes	
08h	READ (6)	yes	yes	yes	Logical Block Address
0Bh	SEEK (6)	yes	yes	yes	Logical Block Address
12h	INQUIRY	yes	yes	yes	
15h	MODE SELECT (6)	2	2	yes	
16h	RESERVE	yes	yes	5	
17h	RELEASE	yes	yes	5	
1Ah	MODE SENSE (6)	2	2	yes	
1Bh	START/STOP UNIT	yes	yes	yes	
1Ch	RECEIVE DIAGNOSTIC RESULTS	yes	yes	yes	
1Dh	SEND DIAGNOSTIC	yes	yes	yes	
1Eh	PREVENT/ALLOW MEDIUM REMOVAL	yes	yes	yes	
25h	READ CD-ROM CAPACITY	yes	yes	yes	Logical Block Address
28h	READ (10)	yes	yes	yes	Logical Block Address
2Bh	SEEK (10)	yes	yes	yes	Logical Block Address
2Fh	VERIFY (10)	yes	yes	--	Logical Block Address
3Bh	WRITE BUFFER	yes	yes	5	
3Ch	READ BUFFER	yes	yes	yes	
40h	CHANGE DEFINITION	1	--	--	
42h	READ SUB-CHANNEL	yes	yes	yes	
43h	READ TOC	4	yes	yes	
44h	READ HEADER	yes	yes	yes	Logical Block Address
45h	PLAY AUDIO (10)	yes	yes	yes	Logical Block Address
47h	PLAY AUDIO MSF	yes	yes	yes	Logical Block Address
48h	PLAY AUDIO TRACK/INDEX	yes	yes	yes	Logical Block Address
49h	PLAY TRACK RELATIVE (10)	yes	yes	yes	Logical Block Address
4Bh	PAUSE/RESUME	yes	yes	yes	Logical Block Address
4Eh	STOP PLAY/SCAN	--	--	yes	
55h	MODE SELECT (10)	2	2	yes	
5Ah	MODE SENSE (10)	2	2	yes	
A5h	PLAY AUDIO (12)	yes	yes	yes	Logical Block Address
A8h	READ (12)	yes	yes	yes	Logical Block Address
A9h	PLAY TRACK RELATIVE (12)	yes	yes	yes	Logical Block Address
AFh	VERIFY (12)	yes	yes	--	Logical Block Address
B9h	READ CD MSF	--	--	3	Logical Block Address
BAh	AUDIO SCAN (1)	--	--	7	Logical Block Address
BBh	SET CD-ROM SPEED (1)	--	--	yes	
BEh	READ CD	--	--	3	Logical Block Address
CDh	AUDIO SCAN (2)	yes	yes	7	Logical Block Address
D8h	READ CD-DA	--	yes	3	Logical Block Address
D9h	READ CD-DA MSF	--	yes	3	Logical Block Address
DAh	SET CD-ROM SPEED (2)	yes	yes	yes	
DBh	READ CD-XA	--	yes	yes	Logical Block Address
DFh	READ ALL SUBCODE	--	yes	7	Logical Block Address
E0h	READ DRIVE STATUS	yes	yes	yes	
E3h	WRITE CDP	yes	yes	yes	
E4h	READ CDP	yes	yes	yes	

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CD-ROM SCSI-2 Command Set

Reference Manual Version 3.1

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