

WORKING DRAFT

NCITS T10 1364-D

Revision 1
November 1, 1999

Information technology — Reduced Multimedia Commands

This is a draft proposed American National Standard under development by T10, a Technical Committee of the National Committee for Information Technology Standardization (NCITS). As such, this is not a completed standard and has not been approved. The Technical Committee may modify this document as a result of comments received during public review and its approval as a standard.

Permission is granted to members of NCITS, its technical committees and their associated task groups to reproduce this document for the purposes of NCITS standardization activities without further permission, provided this notice is included. All other rights are reserved. Any commercial or for-profit replication or republication is prohibited.

T10 Technical Editor:
William McFerrin
Philips Electronics, NA
1860 Lefthand Circle
Longmont, CO 80501 USA
(303) 651-5408
(303) 682-3029 FAX

bmcferrin@aol.com

Reference numbers
ISO/IEC xxxxx:2000
ANSI NCITS.xxx-2000
Printed November 3, 1999

Points of contact

T10 Chair:

John B. Lohmeyer
Symbios Logic, Inc.
4420 Arrows West Drive
Colorado Springs, CO 80907
USA
(719) 533-7560
(719) 533-7036 FAX
john.lohmeyer@symbios.com
George O. Penokie
IBM

T10 Vice-chair:

Dept. 2B7
3605 Highway 52 N.
Rochester, MN 55901
USA
(507) 253-5208
(507) 253-2880 FAX
gop@us.ibm.com

NCITS Secretariat:

NCITS Secretariat
1250 I Street NW, Suite 200
Washington, DC 2000
USA

T10 Bulletin board:

T10 FTP:

T10 Home page:

T10 Reflector:

(202) 737-8888
(202) 638-4922 FAX
(719) 533-7950
[ftp.symbios.com/pub/standards/io/t10](ftp:symbios.com/pub/standards/io/t10)
<http://www.symbios.com/t10>
scsi@symbios.com
majordomo@symbios.com (to subscribe)

IEEE 1394 Reflector:

p1394@sun.com
bob.snively@sun.com (to subscribe)

Document distribution:

Global Engineering
15 Inverness Way East
Englewood, CO 80112-5704
USA
(800) 854-7179
(303) 792-2181
(303) 792-2192 FAX

American National Standard
for Information Systems –

Reduced MultiMedia Commands (RMC)

Secretariat

Information Technology Industry Council

Not yet approved

American National Standards Institute, Inc.

Abstract

This standard specifies the functional requirements for the Reduced Multimedia Command set (RMC). RMC permits multimedia storage logical units such as CD-ROM, CD-R, CD-RW, DVD-ROM, DVD-RAM, DVD-R, DVD-RW and DVD+RW to attach to computers and provides the definition for their use.

American National Standard

Approval of an American National Standard requires verification by ANSI that the requirements for due process, consensus and other criteria for approval have been met by the standards developer.

Consensus is established when, in the judgment of the ANSI Board of Standards Review, substantial agreement has been reached by directly and materially affected interests. Substantial agreement means much more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered and that effort be made towards their resolution.

The use of American National Standards is completely voluntary; their existence does not in any respect preclude anyone, whether he has approved the standards or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standards.

The American National Standards Institute does not develop standards and in no circumstances give interpretation on any American National Standard. Moreover, no person shall have the right or authority to issue an interpretation of an American National Standard in the name of the American National Standards Institute. Requests for interpretations should be addressed to the secretariat or sponsor whose name appears on the title page of this standard.

CAUTION NOTICE: This American National Standard may be revised or withdrawn at any time. The procedures of the American National Standards Institute require that action be taken periodically to reaffirm, revise, or withdraw this standard. Purchasers of American National Standards may receive current information on all standards by calling or writing the American National Standards Institute.

CAUTION NOTICE: The developers of this standard have requested that holder's of patents that may be required for the implementation of this standard, disclose such patents to the publisher. However, neither the developers nor the publisher has undertaken a patent search in order to identify which, if any, patents may apply to this standard.

Published by
American National Standards Institute
1430 Broadway, New York, NY 10018

Copyright © 2000 by American National Standards Institute
All rights reserved.

Printed in the United States of America

Table of Contents

1	SCOPE	1
2	REFERENCES	2
2.1	NORMATIVE REFERENCES	2
2.2	APPROVED REFERENCES	2
2.3	OTHER REFERENCES	2
3	DEFINITIONS, ABBREVIATIONS AND ACRONYMS	3
3.1	DEFINITIONS OF TERMS	3
3.2	CONVENTIONS	3
3.3	KEYWORDS	3
4	MEDIUM/DEVICE MODELS	4
4.1	CD MODEL	4
4.1.1	The CD Storage Unit	4
4.2	DVD MODEL	8
5	COMMANDS	9
5.1	INQUIRY COMMAND	10
5.2	MODE SENSE (6) COMMAND	11
5.2.1	Mode Sense Header	11
5.2.2	Page 0Ch: CD MAE Current Capabilities Page	12
5.2.3	Page 0Dh: DVD MAE Current Capabilities Page	13
5.3	READ PHYSICAL DISC INFORMATION COMMAND	15
5.3.1	Physical Disc Structure Header	15
5.3.2	CD Address Limits Block	15
5.3.3	ATIP Descriptor	16
5.3.4	DVD Address Limits Block	17
5.4	READ STREAM COMMAND	18
5.4.1	Reading CD Media	18
5.4.2	Reading DVD Media	20
5.5	SET MEDIUM SPEED COMMAND	21
5.6	WRITE STREAM COMMAND	22
5.6.1	Writing CD Medium	22
5.6.2	Writing DVD Medium	23

1 SCOPE

2 REFERENCES

2.1 NORMATIVE REFERENCES

2.2 APPROVED REFERENCES

2.3 OTHER REFERENCES

3 DEFINITIONS, ABBREVIATIONS AND ACRONYMS

3.1 DEFINITIONS OF TERMS

3.2 CONVENTIONS

3.3 KEYWORDS

4 MEDIUM/DEVICE MODELS

The model for medium controlled by the RMC device is oriented toward native medium structure. The medium is viewed as containing a sequence of medium specific storage units. Each storage unit may contain one or more sectors. For a specific medium, the number of sectors within a storage unit is fixed.

Since the RMC device is oriented toward the native medium structure, it is not referred to as a drive, but a Medium Access Engine (MAE). The MAE will provide access only to storage units. The hosting device must separate sectors.

4.1 CD MODEL

A CD medium is viewed as a sequence of storage units, where each storage unit contains exactly one sector. CD standards specify that the sector contained within a storage unit must be one of 6 types:

- CD Digital Audio,
- Mode 0 Data,
- Mode 1 Data,
- Mode 2 Formless Data,
- Mode 2 Form 1 Data,
- Mode 2 Form 2 Data

Mode 0 data and Mode 2 formless are rarely used. Refer to the MMC-2 standard for specific format definitions.

4.1.1 The CD Storage Unit

A CD storage unit contains 96 bytes of sub-channel data interleaved among 2352 bytes of main channel data. A CD medium is 120 mm disc with a continuously recorded groove beginning near a diameter of 50 mm and spiraling outward to a diameter near 118 mm.

Data is recorded in a continuous stream of “small” blocks. Each byte of a “small” block is encoded with an 8 bit to 14 bit modulation (EFM) code. Three merging bits are appended. The merging bits are chosen to provide minimum low-frequency signal content and optimize phase lock loop performance. Each “small” block consists of 588 EFM bits (see Table 1). This “small” block is referred to as an EFM block.

1 synchronization pattern (24 + 3 bits)	1 byte of sub- channel data (14 + 3 bits)	12 bytes of main channel data (12 x (14 + 3) bits)	4 bytes of CIRC code (4 x (14 + 3) bits)	12 bytes of main channel data (12 x (14 + 3) bits)	4 bytes of CIRC code (4 x (14 + 3) bits)
588 bits					

Table 1: EFM Block layout and definition

A CD storage unit consists of 98 contiguous EFM blocks. This yields $24 \times 98 = 2352$ bytes of main channel data per frame and 2 symbols of sub-channel synchronization and 96 bytes of sub-channel data. A recorded CD is a succession of CD storage units.

Each CD storage unit begins with the first sub-channel sync byte and ends with the 96th sub-channel data byte. A CD storage unit is constructed from EFM blocks is shown in Table 2. This is a logical representation since EFM blocks are physically interleaved. Precise CD storage unit boundaries do not exist, however, it can be accurately stated that for $0 \leq k \leq 2352$, the k^{th} main channel byte of CD storage unit N+1 is in exactly the same EFM block position, 98 EFM blocks after the k^{th} main channel byte of CD storage unit N.

F	.	.	.
R	.	.	.
A	.	.	.
M	EFM block 94	Sub-channel data byte 92	24 bytes main channel data
E	EFM block 95	Sub-channel data byte 93	24 bytes main channel data
	EFM block 96	Sub-channel data byte 94	24 bytes main channel data
N	EFM block 97	Sub-channel data byte 95	24 bytes main channel data
	EFM block 98	Sub-channel data byte 96	24 bytes main channel data
F	EFM block 1	Sub-channel sync byte 1	24 bytes main channel data
R	EFM block 2	Sub-channel sync byte 2	24 bytes main channel data
A	EFM block 3	Sub-channel data byte 1	24 bytes main channel data
M	EFM block 4	Sub-channel data byte 2	24 bytes main channel data
E	.	.	.
	.	.	.
N+1	EFM block 97	Sub-channel data byte 95	24 bytes main channel data
	EFM block 98	Sub-channel data byte 96	24 bytes main channel data
F	EFM block 1	Sub-channel sync byte 1	24 bytes main channel data
R	EFM block 2	Sub-channel sync byte 2	24 bytes main channel data
A	EFM block 3	Sub-channel data byte 1	24 bytes main channel data
M	EFM block 4	Sub-channel data byte 2	24 bytes main channel data
E	.	.	.
	.	.	.
N+2	EFM block 97	Sub-channel data byte 95	24 bytes main channel data
	EFM block 98	Sub-channel data byte 96	24 bytes main channel data
	EFM block 1	Sub-channel sync byte 1	24 bytes main channel data
	EFM block 2	Sub-channel sync byte 2	24 bytes main channel data
	EFM block 3	Sub-channel data byte 1	24 bytes main channel data
	EFM block 4	Sub-channel data byte 2	24 bytes main channel data
	.	.	.

Table 2: CD Storage Unit Structure from EFM blocks**4.1.1.1 Sub-Channel**

Each sub-channel data byte is labelled according to bit position:

EFM Block Sub-Channel Byte							
P	Q	R	S	T	U	V	W
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Table 3: Sub-channel byte

The 96 sub-channel data bytes are separated into bytes associated with the sub-channel letter. For example, the P sub-channel is separated into bytes as follows:

EFM BLOCKS	P BIT	P BYTE
1	SYNC 0	-
2	SYNC 1	-
3	0	0
4	1	
5	2	
6	3	
7	4	
8	5	
9	6	
10	7	
11	0	1
12	1	
13	2	
14	3	
15	4	
16	5	
17	6	
18	7	
.	.	.
.	.	.
.	.	.
91	0	12
92	1	
93	2	
94	3	
95	4	
96	5	
97	6	
98	7	

The byte construction for Q through W sub-channels is identical.

P and Q sub-channels provide information about the recording of the accompanying main channel.

P has a fixed value throughout the storage unit.

Q consists of 10 bytes of data and 2 bytes of CRC.

R-W sub-channel is define only for audio tracks. It is most often unused and is set to zeros. When used, it carries line graphics, MIDI Control, or text.

4.1.1.2 CD Storage Unit Addressing

The CD recorded medium is divided into 3 specific areas: disc lead-in, disc program area, and disc lead-out.

DISC PROGRAM AREA : This is also known as the user area of the disc. For example, on an audio CD, this is where the music is recorded.

CD players and readers follow the groove by following the presence of EFM. When there is no EFM, the player/reader is lost. The lead-in and lead-out provide zones of protection while the player/reader is seeking near the edges of the program area.

DISC LEAD-IN : The lead-in is a zone of protection from unrecorded areas near the disc center. The lead-in also contains information about program area stored in the sub-channel Q.

DISC LEAD-OUT : The lead-out is a zone of protection from unrecorded areas near the disc's outer edge.

Time addresses always occupy 3 bytes, each with a 2 digit BCD time value. For this reason, each time unit is restricted to the range of 00..99.

A CD medium is addressed in time according to play time of CD audio. Each storage unit has an audio play time of $1/75^{\text{th}}$ of a second. In that context, the storage unit is referred to as a CD frame. The first storage unit of the disc program area is labelled as zero minutes, zero seconds, and zero frames. Each successive storage unit advances by frame, until frame 74 then second, until second 59 then minute.

The maximum capacity of a CD program area is 80 minutes (00:00:00 through 79:59:74). The disc lead-out will proceed for at least 1:30:00, but typically not more than 3:00:00. Logically, addressing continues through 99:59:74. That storage unit is defined to be the storage unit which immediately precedes 00:00:00.

As illustrated in Figure 1, the address space is circular with an arc of non-existent addresses.

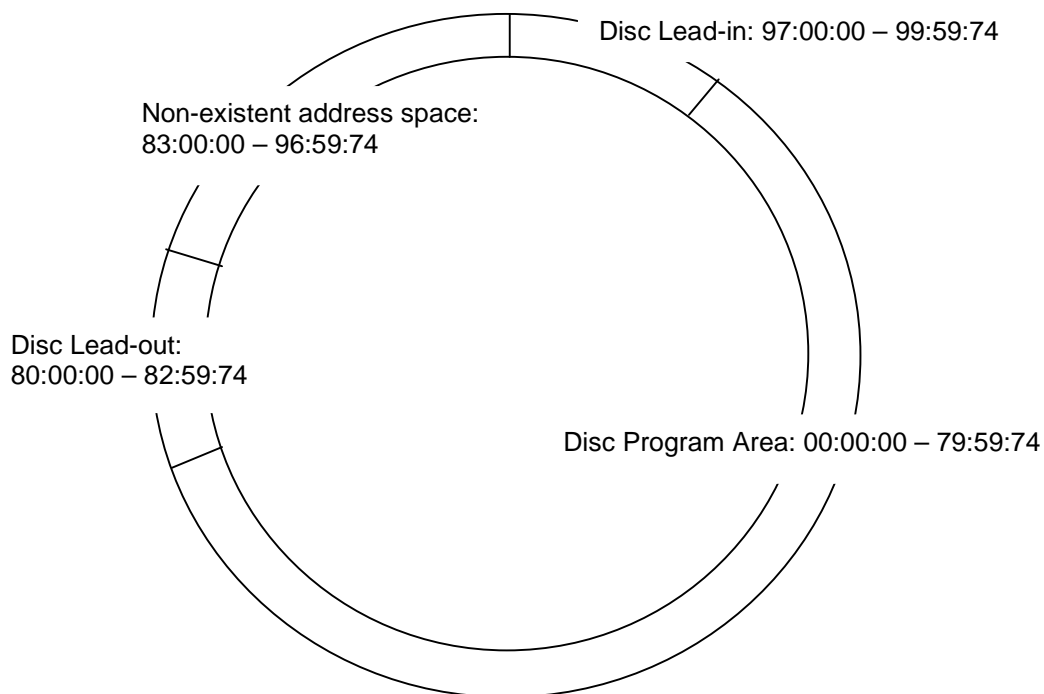


Figure 1: The Circular Nature of CD Addressing

4.2 DVD MODEL

A DVD medium is viewed as a sequence of storage units, where each storage unit contains exactly 16 sectors. DVD medium is less complex than CD medium. There is exactly one sector type for DVD medium: 2048 bytes.

DVD also has the three areas of medium: disc lead-in, disc program area, and disc-lead-out with similar purposes. DVD also provides for dual layer medium, which nearly doubles the capacity of the disc. Logically, this simply extends the address space of a DVD disc.

DVD is addressed by linear sector address. The first sector of the program area is always 30000h. At the program area, the disc lead-out begins and proceeds until physical end of medium. The disc lead-in begins at 0h and continues through 2FFFFh. Typically, the disc lead-in is not directly accessible by the host.

Disc Lead-in: 000000 – 02FFFFh	Disc Program Area: 030000h - > 200000h	Disc Lead-out
-----------------------------------	---	---------------

Figure 2: DVD Linear Addressing

5 COMMANDS

Table 4: REDUCED MULTIMEDIA COMMANDS

COMMAND	Op Code	Support	Reference
GET EVENT STATUS NOTIFICATION	4Ah	Mandatory	MMC-2
INQUIRY	12h	Mandatory	SPC-2
LOAD/UNLOAD MEDIUM	A6h	See Note 1	MMC2
MECHANISM STATUS	BDh	See Note 1	MMC-2
MODE SENSE (10)	5Ah	Mandatory	RMC
PREV/ALLOW MEDIUM REMOVAL	1Eh	Mandatory	MMC-2
READ PHYSICAL DISC INFORMATION	51h	Mandatory	RMC
READ DVD STRUCTURE	ADh	See Note 2	MMC-2
READ STREAM	BEh	Mandatory	RMC
REPORT KEY	A4h	See Note 2	MMC-2
REQUEST SENSE	03h	Mandatory	SPC-2
SEND DVD STRUCTURE	BFh	See Note 2	MMC-2
SEND KEY	A3h	See Note 2	MMC-2
SET MEDIUM SPEED	BBh	Mandatory	RMC
START/STOP UNIT	1Bh	Mandatory	MMC-2
TEST UNIT READY	00h	Mandatory	SPC-2
WRITE STREAM	BFh	See Note 3	RMC

Notes:

1. These commands are mandatory only when an integrated changer is attached to the device.
2. These commands are mandatory only when the device has DVD read capability.
3. These commands are mandatory only when the device has write capability.

5.1 INQUIRY Command

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (12h)							
1	Reserved							
2	Reserved							
3	Reserved							
4	Allocation Length							
5	Control							

The MAE returns standard INQUIRY information as shown in table 3.

Table 5: MAE Inquiry Data

Bit	7	6	5	4	3	2	1	0
Byte								
0	Peripheral Qualifier =000b			Peripheral Device Type = 1 0101b				
1	RMB = 1	Reserved						
2	ISO/IEC Version		ECMA Version			ANSI Version		
3	Reserved				Response Data Format = 010b			
4	Reserved							
5	Reserved							
6	Reserved							
7	Reserved							
8	Vendor Identification							
...								
15								
16	Product Identification							
...								
31								
32	Product Revision Level							
...								
35								

Peripheral Qualifier is 000h, indicating that a device is currently attached.

Peripheral Device Type is type 15h, the Multimedia MAE device type.

RMB is set to 1, indicating that medium for this device is removable.

ISO/ECMA Version, ECMA Version, ANSI Version are set to 03.

Response Data Format is set to 010b, indicating compliance to SPC.

Vendor Identification contains eight bytes of ASCII data identifying the vendor of the product. The data shall be left aligned within this field.

Product Identification contains sixteen bytes of ASCII data as defined by the vendor. The data shall be left-aligned within this field.

Product Revision Level contains four bytes of ASCII data as defined by the vendor. The data shall be left-aligned within this field.

5.2 MODE SENSE (6) Command

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (5Ah)							
1	Reserved				DBD	Reserved		
2	PC		Page Code					
3	Reserved							
4	Allocation Length							
5	Control							

The MAE supports only the 6 byte form of the MODE SENSE command and shall return a 4 byte header and the CD-MAE Capabilities page.

The DISABLE BLOCK DESCRIPTORS (DBD) bit shall be set to one.

The PAGE CONTROL (PC) field defines the type of mode parameter values to be returned in the mode page. If the MAE does not support the MODE SELECT Command, Current values, Saved values, and Default values shall be identical, and the Changable values shall report all zeros.

5.2.1 Mode Sense Header

The MAE returns a 4 byte header, Table 6, in response to the MODE SENSE command..

Table 6: MAE MODE SENSE Data Header

Bit	7	6	5	4	3	2	1	0
Byte								
0	Mode Data Length = 13h							
1	Medium Type							
2	Device Specific Parameter							
3	Reserved							

The medium type is not used and shall be zero.

For a MAE, the Device Specific Parameter is not defined and shall be set to zero.

5.2.2 Page 0Ch: CD MAE Current Capabilities Page

The CD Capabilities Page (page code = 0Ch) specifies the read and write capabilities as it applies to CD media. The format of the CD Capabilities Page is shown in Table 7.

Table 7: CD Current Capabilities Page

Bit	7	6	5	4	3	2	1	0
Byte								
0	PS	Resv	Page Code (0Ch)					
1	Page Length (0Eh)							
2	Maximum Read Speed (KB/Second)							
3								
4	Current Read Speed (KB/Second)							
5								
6	Reserved				CAV	RDATA	ATIP	RCDRW
7	Reserved							
8	Reserved							
9	Maximum Write Speed (KB/Second)							
10								
11	Current Write Speed (KB/Second)							
12								
13	Reserved					WDATA	WCDRW	WCDR
14	Reserved							
15	Reserved							

The PS bit shall be cleared to zero since, the CD MAE has no requirement for saving mode pages.

Bytes 2 through 8 are reserved for stating read capabilities:

The Maximum Read Speed is reported in K-bytes per second (K = 1024 bytes). This value is rounded.

The Current Read Speed is reported in K-bytes per second (K = 1024 bytes). This value is rounded

When CAV = 0, the MAE is reporting read speeds as a fixed rate over the entire disc.

When CAV = 1, the MAE is reporting read speeds as the maximum rate over the entire disc.

When RDATA = 0, the MAE provides only RED BOOK capabilities when reading.

When RDATA = 1, the MAE supports all main channel instructions in the Read CD Stream command.

When ATIP = 0, the MAE cannot decode ATIP on discs with an encoded ATIP.

When ATIP = 1, the MAE is capable of decoding ATIP on discs with encoded ATIP.

When RCDRW = 0, the MAE does not support reading CD-RW media.

When RCDRW = 1, the MAE supports reading CD-RW media.

Bytes 9 through 16 are reserved for stating write capabilities:

The Maximum Write Speed is reported in K-bytes per second (K = 1024 bytes). This value is rounded.

The Current Write Speed is reported in K-bytes per second (K = 1024 bytes). This value is rounded.

When WDATA = 0, the MAE provides only RED BOOK capabilities when writing.

When WDATA = 1, the MAE supports all main channel instructions in the Write CD Stream command.

When WCDR = 0, the MAE does not support writing CD-R media.

When WCDR = 1, the MAE supports writing CD-R media.

When WCDRW = 0, the MAE does not support writing CD-RW media.

When WCDRW = 1, the MAE supports writing CD-RW media.

5.2.3 Page 0Dh: DVD MAE Current Capabilities Page

The DVD Capabilities Page (page code = 0Dh) specifies the read and write capabilities as it applies to DVD media. The format of the DVD Current Capabilities Page is shown in Table 8.

Table 8: DVD Current Capabilities Page

Bit	7	6	5	4	3	2	1	0
Byte								
0	PS	Resv	Page Code (0Dh)					
1	Page Length (0Eh)							
2	Maximum Read Speed (KB/Second)							
3								
4	Current Read Speed (KB/Second)							
5								
6	Reserved			ROM	RAM	+RW	-RW	R
7	Reserved							
8	Reserved							
9	Maximum Write Speed (KB/Second)							
10								
11	Current Write Speed (KB/Second)							
12								
13	Reserved				RAM	+RW	-RW	R
14	Reserved							
15	Reserved							

The PS bit shall be cleared to zero since, the CD MAE has no requirement for saving mode pages.

Bytes 2 through 8 are reserved for stating read capabilities:

The Maximum Read Speed is reported in K-bytes per second (K = 1024 bytes). This value is rounded.

The Current Read Speed is reported in K-bytes per second (K = 1024 bytes). This value is rounded

When ROM = 0, the MAE is not capable of reading DVD-ROM medium.

When ROM = 1, the MAE is capable of reading DVD-ROM medium.

When RAM = 0, the MAE is not capable of reading DVD-RAM medium.

When RAM = 1, the MAE is capable of reading DVD-RAM medium.

When +RW = 0, the MAE is not capable of reading DVD+RW medium.

When +RW = 1, the MAE is capable of reading DVD+RW medium.

When -RW = 0, the MAE is not capable of reading DVD-RW medium.

When -RW = 1, the MAE is capable of reading DVD-RW medium.

When -R = 0, the MAE is not capable of reading DVD-R medium.

When -R = 1, the MAE is capable of reading DVD-R medium.

Bytes 9 through 16 are reserved for stating DVD write capabilities:

The Maximum Write Speed is reported in K-bytes per second (K = 1024 bytes). This value is rounded.

The Current Write Speed is reported in K-bytes per second (K = 1024 bytes). This value is rounded.

When RAM = 0, the MAE is not capable of writing DVD-RAM medium.

When RAM = 1, the MAE is capable of writing DVD-RAM medium.

When +RW = 0, the MAE is not capable of writing DVD+RW medium.

When +RW = 1, the MAE is capable of writing DVD+RW medium.

When -RW = 0, the MAE is not capable of writing DVD-RW medium.

When -RW = 1, the MAE is capable of writing DVD-RW medium.

When -R = 0, the MAE is not capable of writing DVD-R medium.

When -R = 1, the MAE is capable of writing DVD-R medium.

5.3 READ PHYSICAL DISC INFORMATION Command

The READ PHYSICAL DISC INFORMATION Command (Table 9) command returns information describing the physical structure of the currently mounted medium.

Table 9: READ PHYSICAL DISC INFORMATION Command Descriptor Block

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

5.3.1 Physical Disc Structure Header

Table 10: Physical Disc Information Header

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

Medium Types:

0	Stamped CD	80h	Reserved for DVD
1	CD-R	81h	Reserved for DVD
2	CD-RW	82h	Reserved for DVD
3 – 0Fh	Reserved for other CD types	83h – 8Fh	Reserved for DVD
10h – 7Eh	Reserved for other medium types	90 - FEh	Reserved for other medium types
7Fh	Medium not present	FFh	Medium not present

5.3.2 CD Address Limits Block

When medium type indicates that a CD medium is mounted, the CD Address limits block follows the Physical Disc Information Header.

Table 11: CD Address Limits Block

Bit	7	6	5	4	3	2	1	0
Byte								
0	Reserved							ATIP
1	Disc Lead-in Start Address: minutes							
2	Disc Lead-in Start Address: seconds							
3	Disc Lead-in Start Address: frames							
4	Reserved							
5	Disc Lead-out Start Address: minutes							
6	Disc Lead-out Start Address: seconds							
7	Disc Lead-out Start Address: frames							

When ATIP = 0, the Disc is either a stamped CD or the drive is not capable of decoding ATIP. If the Disc Type is reported as Non-ATIP, an ATIP section will not be appended. When ATIP = 1, the drive is capable of decoding ATIP and this disc contains ATIP. An ATIP descriptor shall be appended.

The Disc Lead-in Start Address and Disc Lead-out Start Address are reported according to the setting of the ATIP bit:

When ATIP = 0, the Disc Lead-in Start Address reports the binary equivalent of the ATIP reported start time of lead-in and the Disc Lead-out Start Address reports the binary equivalent of the ATIP reported last possible start time of lead-out.

When ATIP = 1, the Disc Lead-in Start Address reports 97:30:00. For non-ATIP discs, this is the binary equivalent of the lead-out reported in the last TOC on the disc.

5.3.3 ATIP Descriptor

When the ATIP bit in the CD Address Limits Block is set to one, the ATIP Descriptor follows.

Table 12: ATIP Descriptor

Bit	7	6	5	4	3	2	1	0
Byte								
16	1	Target Writing Power			Resv	Reference Speed		
17	0	Disc Application Code						
18	1	disc type	Disc sub-type			A1	A2	A3
19	Reserved							
20	ATIP Start Time of Lead-in (Min)							
21	ATIP Start Time of Lead-in (Sec)							
22	ATIP Start Time of Lead-in (Frame)							
23	Reserved							
24	ATIP Last Possible Start Time of Lead-out (Min)							
25	ATIP Last Possible Start Time of Lead-out (Sec)							
26	ATIP Last Possible Start Time of Lead-out (Frame)							
27	Reserved							
28	0	Lowest Usable CLV Write Speed			Highest Usable CLV Write Speed			
29	0	Power Multiplication Factor			Target y value of Mod/Pwr Function			Resv
30	1	Recommended Erase/Write Power			Reserved			
31	Reserved							
32-34	A2 Values							
35	Reserved							
36-38	A3 Values							
39	Reserved							

5.3.4 DVD Address Limits Block

When medium type indicates that a DVD medium is mounted, the DVD Address limits block follows the Physical Disc Information Header.

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB) Lowest Accessible Address (LSB)							
1								
2								
3								
4	(MSB) Highest Accessible Address (LSB)							
5								
6								
7								

The accessible addresses are first restricted by the physical limits of the medium and secondly by the copy protection feature of the medium. The Lowest Accessible Address will not be smaller than 30000h.

5.4 READ STREAM Command

The READ STREAM allows the host to read the data from a sequence of storage units. It is the host's responsibility to separate sector data from the received storage units. Once the data stream has started, the MAE may terminate this command for only one of three reasons:

- Tracking cannot be maintained,
- End of medium has been encountered,
- The host has failed to maintain the stream.

Table 13: READ STREAM Command

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (BEh)							
1	Reserved							CD Data
2	Reserved							
3	(MSB) <div>Read Start Address</div>							
4								
5								
6								
7	(LSB)							
8	Reserved							
9	Reserved							
10	Reserved							
11	Control							

5.4.1 Reading CD Media

The Read Start Address identifies the storage unit which contains the first sector of the desired range. For CD, this address is expressed in CD time (MSF) format (see Table 14). Each time element is coded as a binary number.

Table 14: Read Start Address Format

ADDRESS BYTE	CONTENT
0	Reserved (Must be Zero)
1	Minute
2	Second
3	Frame

CD Data identifies the synchronization boundary rule for determining storage unit bounds. Sub-channel data is automatically re-synchronized with each sub-channel sync pattern or upon a max count reached with a sub-channel flywheel.

When CD Data = 0, main channel boundaries are determined by the sub-channel synchronization pattern.

When CD Data = 1, main channel boundaries are determined by the main channel synchronization pattern. Main channel is automatically re-synchronized with each main channel sync pattern or upon a max count reached with a main channel flywheel.

If CD Data = 1, a preceding sub-channel sync has been located, and a main channel pattern cannot be located, the command shall be terminated with a CHECK CONDITION status and sense data shall be set to MEDIUM ERROR, NO REFERENCE POSITION FOUND (03/06/00).

It is important to note that detected errors in the data shall NOT cause the Read Stream Command to terminate.

The drive must return 2464 bytes of data for each storage unit read. The format of that data is shown in Table 15.

Table 15: Read Stream Data Format for CD Storage Units

Field	Field Offset	Field Size
Main Channel Data	0	2352
Sub-Channel Q	2352	12
Storage Unit Status	2364	1
Reserved	2365	2
Sub-channel P	2367	1
Sub-channel	2368	96
End of Sector	2464	-

Main Channel Data This field contains 2352 bytes of main channel data.

Sub-Channel Q This field contains the 10 bytes of sub-channel Q data and 2 bytes of sub-channel Q CRC.

Storage Unit Status Storage unit status defines the status of sector synchronization and the data quality (See Table 16).

Table 16: Storage Unit Status

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
BLANK	C2	0	0	MC ESYNC	MC FSYNC	SC ESYNC	SC FSYNC

When SC ESYNC = 0, the sub-channel sync pattern is timed correctly relative to the sync flywheel counter.
When SC ESYNC = 1, the sub-channel sync pattern is early relative to the sync flywheel counter.

When SC FSYNC = 0, the sub-channel sync pattern is timed correctly relative to the sync flywheel counter.
When SC LSYNC = 1, the sub-channel sync pattern is late relative to the sync flywheel counter.

When CD Data = 0, SC ESYNC and SC LSYNC are used to determine the correctness of the sector boundary selected. When CD Data = 1, SC ESYNC and SC LSYNC define only the sync boundary status of the sub-channel.

MC ESYNC and MC FSYNC are meaningless when CD Data = 0.

CD Data	SC ESYNC	SC FSYNC	MC FSYNC	MC FSYNC	Meaning
0	0	0	-	-	Correct audio sector boundaries
0	0	1	-	-	Possible long sector preceeds this one
0	1	0	-	-	Possible short sector preceeds this one
0	1	1	-	-	-
1	0	0	0	0	Correct main channel boundary
1	0	1	1	1	Possible long sector preceeds
1	1	0	0	0	Possible short sector preceeds
1	1	1	1	1	Correct main channel boundary

When SC ESYNC is set to one, the end of sub-channel for this sector has been determined by an early sync pattern.

When SC FSYNC is set to one, the end of sub-channel for this sector has been determined exclusively by flywheel.

NOTE: Whenever both SC ESYNC and SC FSYNC are cleared to zero, the sector sub-channel was bounded normally.

When BLANK = 0, some part of the region containing the storage unit was recorded.

When BLANK = 1, no recording was found in the region of the storage unit.

NOTE: When the medium is CD-RW and Blank is cleared to zero, it is still possible that the sector is logically erased.

When C2 = 0, no C2 errors were indicated.

When C2 = 1, some C2 ECC flags were detected while reading this sector.

5.4.2 Reading DVD Media

The Read Start Address is a standard DVD LBA. The storage unit for DVD is the user data content of the ECC block, 16 sectors of 2048 bytes each. For this reason, the Read Start Address must have the low order 4 bits set to zero.

The CD Data bit has no meaning for DVD and is ignored.

The MAE must return 32,772 bytes of data for each storage unit read. The format of that data is shown in .

Table 17: Read Stream Data Format for DVD Storage Units

Field	Field Offset	Length
Relative Sector 0 Data	0	2048
Relative Sector 1 Data	2048	2048
Relative Sector 2 Data	4096	2048
...
Relative Sector 15 Data	30720	2048
EDC Status, byte 0	32768	1
EDC Status, byte 1	32771	1
Reserved	32770	2
End of Data	32772	-

The entire storage unit is processed by the error correction function within the MAE. EDC is checked in each sector of the storage unit and the pass/fail status of that EDC check is reported in the EDC status bytes. The format of the EDC status bytes is shown in Table 18.

Table 18: EDC Status Field Format

Bit	7	6	5	4	3	2	1	0
Byte	EDC fail, sector 7	EDC fail, sector 6	EDC fail, sector 5	EDC fail, sector 4	EDC fail, sector 3	EDC fail, sector 2	EDC fail, sector 1	EDC fail, sector 0
Byte	EDC fail, sector 15	EDC fail, sector 14	EDC fail, sector 13	EDC fail, sector 12	EDC fail, sector 11	EDC fail, sector 10	EDC fail, sector 9	EDC fail, sector 8

It is important to note that detected errors in the data shall NOT cause the Read Stream Command to terminate.

5.5 SET MEDIUM SPEED Command

The SET CD SPEED (See Table 19) command provides a means for the Initiator to set the spindle speed independently for reading and writing.

Table 19: SET MEDIUM SPEED Command Descriptor Block

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (BBh)							
1	Reserved							
2	(MSB) Logical Unit Read Speed (Kbytes/sec) (LSB)							
3								
4	(MSB) Logical Unit Write Speed (Kbytes/sec) (LSB)							
5								
6	Reserved							
7	Reserved							
8	Reserved							
9	Reserved							
10	Reserved							
11	Control							

The Logical Unit Read Speed parameter contains the requested data rate the Logical Unit should use. The Logical Unit may choose to select the speed specified or any slower rate. A value of FFFFh will set the Logical Unit Read Speed to the maximum supported. Requesting a speed faster than the Logical Unit supports shall not generate an error. The actual speed set is returned in the CD Capabilities Mode page. (See 5.2.2).

The Logical Unit Write Speed parameter contains the requested data rate the Logical Unit should use. The Logical Unit may choose to select the speed specified or any slower rate. A value of FFFFh will set the Logical Unit Write Speed to the maximum supported. Requesting a speed faster than the Logical Unit supports shall not generate an error. The actual speed set is returned in the CD Capabilities Mode page. (See 5.2.2).

5.6 WRITE STREAM Command

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation Code (BFh)							
1	Reserved							
2	Reserved							
3	(MSB)							
4								
5								
6								
7	Reserved							
8	Reserved							
9	Reserved							
10	Reserved							
11	Control							

The Write Start Address is the address of the first medium storage cell to be written.

Writing shall begin with Write Start Address and proceeds until the no more data has been received from the host. The MAE shall write only complete storage units.

5.6.1 Writing CD Medium

Since only medium oriented addressing is used, the Write Start Address and Write Stop Address must be expressed in MSF format as shown in Table 20.

Table 20: Write Start Address Format

ADDRESS BYTE	CONTENT
0	Reserved (Must be Zero)
1	Minute
2	Second
3	Frame

The format for storage cell data from the host shall be 2464 bytes organized as in Table 21.

Table 21: CD Write Sector Format

Field	Field Offset	Field Size
Main Channel Data	0	2352
Sub-channel Q	2352	12
Reserved	2364	3
Sub-channel P	2367	1
Sub-channel P-W (Raw)	2368	96
End of Sector	2464	-

The MAE will modify no data, therefore all formatting must be done by the host prior to sending the data.

The host must terminate a write by terminating the data transfer at a storage cell boundary. So, if during writing, the MAE detects that the data stream has terminated, the MAE shall stop the write at a storage cell boundary and terminate the command GOOD status. Sense shall be set to NO ERROR and the information bytes shall be set to the ATIP address following the write termination. It is the responsibility of the host to determine the seriousness of the stream loss and apply any required recoveries.

5.6.2 Writing DVD Medium

The DVD storage cell consists only of the user data from a single DVD ECC block. That block contains exactly 16 sectors of 2048 bytes each. Thus, the DVD storage cell is 32,768 bytes.

The host must terminate a write by terminating the data transfer at a storage cell boundary. So, if during writing, the MAE detects that the data stream has terminated, the MAE shall stop the write at a storage cell boundary and terminate the command GOOD status. Sense shall be set to NO ERROR and the information bytes shall be set to the medium address following the write termination.

Since each DVD storage cell is writable as a single unit, any error associated with stream loss is recoverable.