

MEGA-CD DISC FORMAT
SPECIFICATIONS
(conforming to ISO9660)

REX SA 10

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1. OVERVIEW OF THE MEGA-CD DISC FORMAT

MEGA-CDs can play the following 8 or 12cm CD discs:

- (1) MEGA-CD game disc
- (2) Audio CD disc (CD-DA)
- (3) Karaoke CD disc (CD-G)
- (4) SONY EB formatted CD disc (CD-ROM)
- (5) Discs for personal computers conforming to the "YELLOW BOOK" specifications.

Discs (1) to (3) can be played with the resident programs on the MEGA-CD. To play discs (4) and (5), the special cartridge on the MEGA drive is needed.

MEGA-CD game disc features following:

- (1) The physical format conforms to the specifications (defined by Sony and Phillips) described in the "RED BOOK" and "YELLOW BOOK".
- (2) The logical format conforms to the MEGA-CD DISC FORMAT specifications (based on ISO9660).

Since the logical format complies with ISO9660, it is possible to create discs which can be used with other personal computers.

The MEGA-CD DISC FORMAT specifications (hereafter MDF) are used to create MEGA-CD game discs. This MDF features following:

- (1) The system can be booted without invoking cartridges, using only the game disc.
- (2) Conforming to the ISO specifications allows ease of use and facilitates third party involvement.

※ Conforming to ISO9660 (See Fig. 3-1)

The contents of logical sector numbers 0 to 15 are not normalized in the ISO9660 specifications. The system designer can use this area for programs to boot up the system or for information of protection. SDF can be used to define this area to allow the system to be booted from a MEGA-CD game disc. Logical sector numbers 16 and above are defined, conforming to ISO9660.

2. PHYSICAL FORMAT

The physical format conforms to the CD specifications of Sony and Phillips which are described in the "RED BOOK" and "YELLOW BOOK." Items specifically defined by SEGA in the specifications together with important related items are described below. Other items can be found in the "RED BOOK" or "YELLOW BOOK."

2-1 Partition and Configuration of Disc Areas (See Fig. 2-1)

Beginning at disc center and moving outward, the disc is divided and configured in the sequence:

read-in area, program area, read-out area.

TOC information is written in the read-in area in accordance with the "YELLOW BOOK." TOC data is the absolute frame time when index 01 of TNOs starts. To avoid problems, the start time of the read-out area is limited to the range (10:00:00 to 60:04:00). The program area is divided and configured in the sequence:

CD-ROM area (inner), CD-DA area (outer).

The CD-ROM and CD-DA areas are further divided into inner and outer areas in order that a CD-ROM track of a CD installed in an audio CD player will not be suddenly replayed when CD-DA tracks are being replayed. Hence, the above sequence and track configuration of CD-ROM and CD-DA areas should not be changed.

● Record area of the program area

The first frame of the program area is set at 00:00:00 (minute-second-frame), and the absolute time is measured from this point. The first two seconds of the program area are used for pause, and the first sector starts at 00:02:00. This sector is called sector #0. The last two seconds of the program area are used for pause, and the last sector is located at 60:01:74 (CD-S 20:01:74). The last frame of the program area is located at 60:03:74 (CD-S 20:03:74), two seconds after the last sector.

Therefore, the storage capacity of data is 60:00:00 (CD-S 20:00:00).

$75 \times 60 \times 60 = 270,000$ frame (sectors) (CD-S 90,000)

$270,000 \times 2KB = 540MB$ (CD-S 180MB)

2-2 Configuration of Tracks (See Fig. 2-1)

● Track number

The track number of the CD-ROM area is 01.

Track numbers on the CD-DA area can be assigned at any positions in intervals of four seconds or longer (excluding a pause at the beginning of tunes). Note that consecutive numbers should be used. (One track on the CD-DA area must be more than four seconds.)

The track number of the first tune is 02 followed by consecutive numbers up to 99.

● Pause between tracks

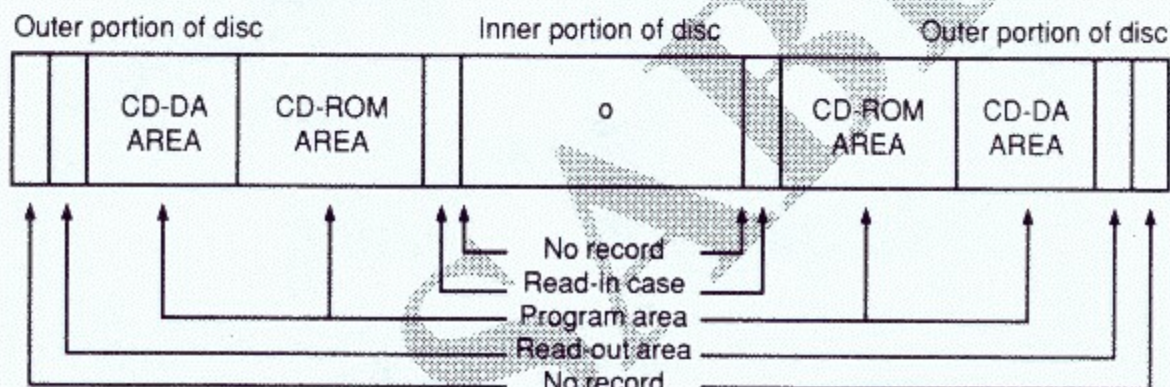
A two second pause (muting) is required before and after the CD-ROM track, before CD-DA tracks and after the last CD-DA track in accordance with the "YELLOW BOOK." This is to suppress (during seeking) final sounds of the previous tune when it is played with an audio player.

● CD-DA track

At least one tune of data should be stored on the CD-DA area. When no CD-DA data is required, a warning message can be stored such as "This MEGA-CD GAME disc should be replayed with MEGA-CD." This informs the user who may have put the disk in an audio CD player. If one tune of data exists, such a message is not required. This is because the user may want to listen to the music.

■Fig. 2-1

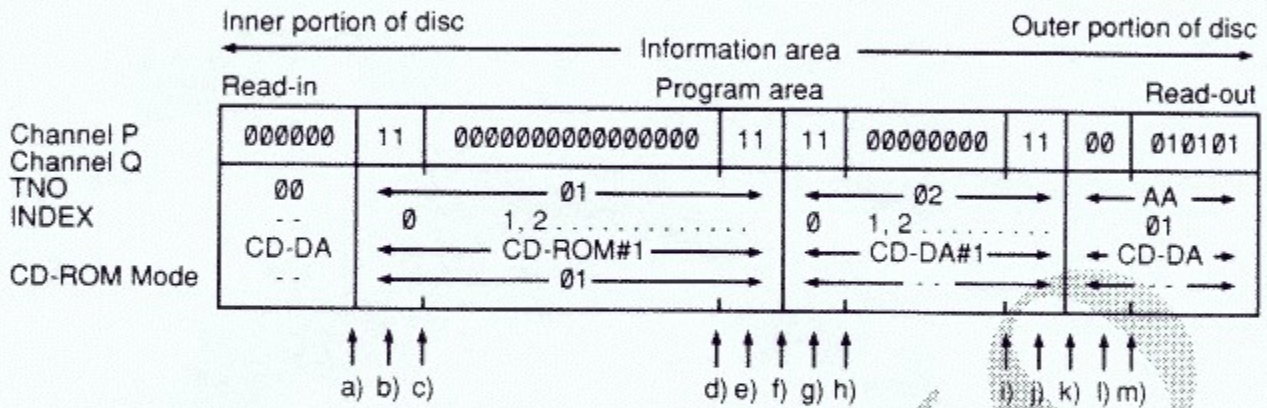
<Allocation and Structure of Disc Area>



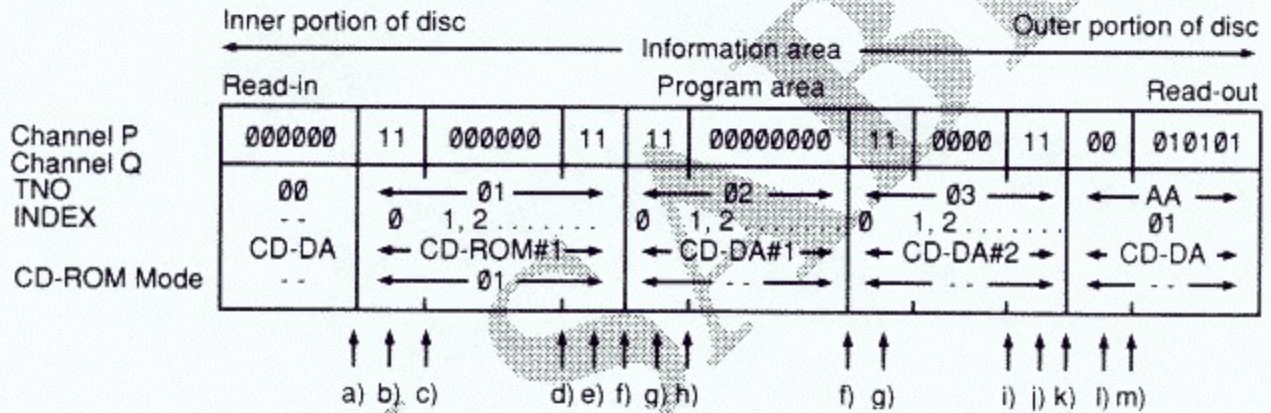
<Allocation of each track>

- 00:00:00 (ATIME: absolute time)
 - A "pause" of 2 seconds
 - 00:02:00 (Logical Sector Number 0)
 - End of user sector
 - Post-gap (≥ 2 seconds)
 - Point of TNO changes
 - Pause (≥ 2 seconds)
 - Start position of the first piece of music on the disc
 - End position of the last piece of music on the disc ($\leq 59:59:74$)
 - A "pause" of 2~3 seconds
 - The start of read-out track ($10:00:00 \leq 60:04:00$)
 - Channel P remains zero for 2~3 seconds.
 - P switches between 0 and 1 in a $2 \text{ Hz} \pm 2\%$ rhythm (duty cycle $50 \pm 10\%$)
- TNO: Track number

<Example #1>



<Example #2>



3. LOGICAL FORMAT

This chapter defines the logical format in the CD-ROM area.

3-1 Sector Structure

- **Sector (See Fig. 3-1)**

CD-ROM data can be stored in all the sectors from the first sector 00:02:00 to the last sector 60:01:74.

One sector contains one frame or 2048 bytes, and the data area can hold up to 270,000 (\$41EB0) sectors (CD-S 90,000). The serial sector numbers are assigned starting with 00:02:00, which means sector numbers #0 to #269,999 (\$41EAF) (CD-S 89,999) are used. Sector numbers #0 to #15 are reserved for the system area while #16 to #269,999 are used for the data area.

The data area contains 539.968 Mbytes in total (CD-S 179,968). Sectors #270,000 or below are reserved for the system (CD-S 90,000).

- **Sector modes**

The structure of each sector is mode 0, mode 1, or mode 2, which are defined in the "YELLOW BOOK." Mode 1 and mode 2 sectors cannot coexist in one track. Therefore, the CD-ROM track TNO=1 is in mode 1.

- **Address**

For mode 1 sectors, the first byte of sector #0 is made address 0 followed by consecutive addresses assigned in byte units.

Since 2048 bytes makes up one sector, the last address is 552,959,999 (\$20F57FFF) (CD-S 184,319,999: \$0AFC7FFF). For CD-DA frames of mode 2 sectors, the first address starts after these 2048 bytes.

■Fig. 3-1

<Structure of Sector>

absolute time	00:02:00	00:02:16	60:01:74
LSN	#0~#15	#16~#269999	
MDF	SYSTEM AREA Boot System	DATA AREA VD and Files (conforming to ISO9660)	RESERVED
address	0	32768(\$8000)	552959999 (\$20F57FFF)
LSN:	Logical Sector Number		
VD:	Volume Descriptor		

3-2 System Area

● System area (See Fig. 3-2)

The system area contains bootstrap information, initial programs, and file system programs. The booting sector is located on sector #0, and the system program sectors are on sectors #1 to #15.

(When the system programs occupy more than 30 Kbytes, system program sectors can be created in areas other than the system sector area. However, sectors that are both above #15 and below those used for VD cannot be used for this purpose.)

The booting sector contains following:

The system ID

Disk ID

Initial program code

One purpose of the system ID is to identify MEGA-CD game discs. One use of the disc ID is for controlling quality. The initial programs which contain the file system code and other data are always read at the beginning.

■Fig. 3-2

<The Structure of the System Area>

Address		
\$000000	System ID	sector #0 Boot sector
\$000100	DISC ID	
\$000200	Initial Program Code	
\$000800	System Program	sector #1~15 System Program sector
\$008000	VD Directory Path Table User File 0 User File 1 :	DATA AREA
\$20F57FFF		

3-3 Booting System

- **Booting programs (See Fig. 3-3)**

Booting programs are stored on the MEGA-CD. The system loads the booting sector, confirms a MEGA-CD disc is installed, and then loads the initial programs. The initial programs are usually stored in the region with byte addresses \$200 to \$600 in system sector #0. Hence, quick booting results since re-loading is not required.

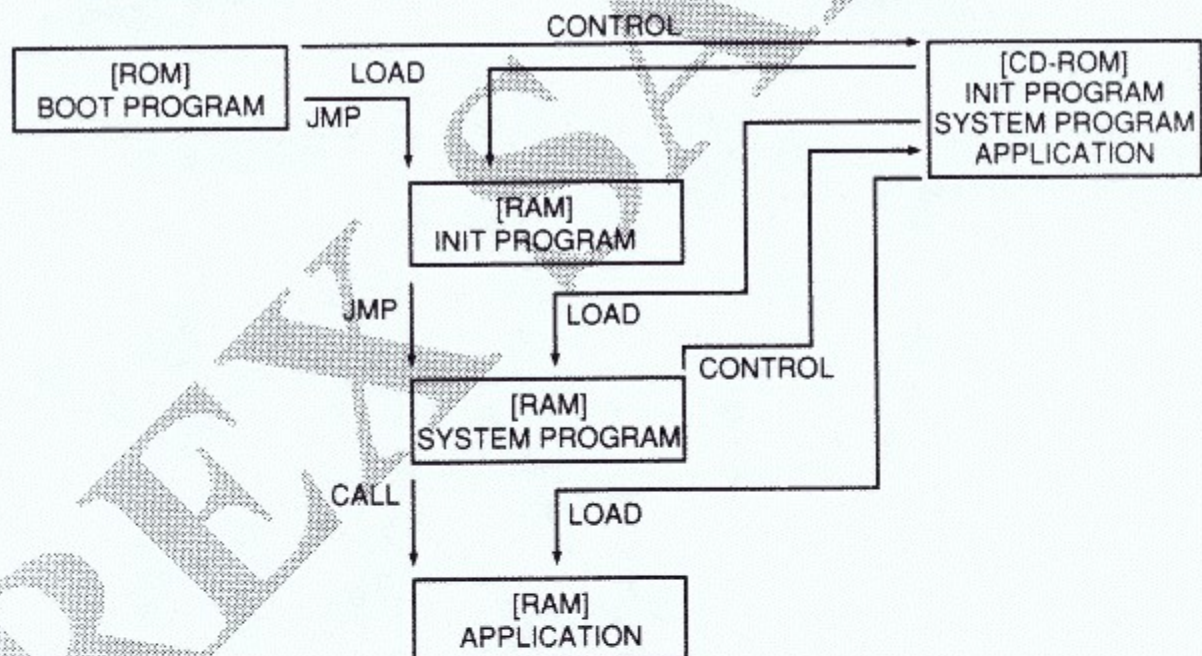
- **Initial programs**

Initial programs are stored on disc, loaded into memory, and executed. The initial programs display the company's logo while they load the system programs. After the system programs are loaded, system control is taken over by the application software.

- **System programs**

System programs are required to use CD-ROM discs which contain file system information or other data. The file system is designed for specific discs so that application software access speed is maximized. Application software may contain start-up, main programs, etc.

■ Fig. 3-3
<Figure of Boot System Image>



3-4 File System

The format conforms to the specifications defined in ISO9660.

VD : Volume Descriptor
 LSN : Logical Sector Number
 BP : Byte Pointer
 RBP : Relative Byte Pointer
 TP : Type
 N : Numerical value
 NL : Least Significant Byte First
 NM : Most Significant Byte First
 NB : Both-type orders
 ND : Any digit from ZERO to NINE
 A : A-characters (20-22/25-3F/41-5A/5F)
 D : D-characters (30-39/41-5A/5F)
 DS : D-characters, SEPARATOR1, SEPARATOR2 (2E/3B)
 DE : Directory Entry
 00 : Zero fill
 A1 : A1-characters ; A-characters + Kanji
 D1 : D1-characters ; D-characters + Kanji
 D1S : D1-characters, SEPARATOR1, SEPARATOR2 (2E/3B)

● Volume Descriptor

<Boot Record>

BP	TP	Field Name	:
1	N	Volume Descriptor Type	; VD = 0
2- 6		Standard Identifier	; 'CD001'
7	N	Volume Descriptor Version	; VD version=1
8- 39	A	A Boot System Identi	
40- 71	A	A Boot Identifier	
72-2048		Boot System Use	; not specified

Size:	Examples	:	Notes
1:	0	:	Fixed
5:	'CD001'	:	Fixed
1:	01	:	Fixed
32:	'SEGA MEGA CD	:	Fixed (' ': \$20)
32:	'Boot Identifier (Application)	:	User supplied
1977:	boot.system code	:	User supplied

<Volume Descriptor Set Terminator>

BP	TP	Field Name	:
1	N	Volume Descriptor Type	; VD = 255 (end)
2- 6		Standard Identifier	; 'CD001'
7	N	Volume Descriptor Version	; VD version = 1
8-2048		(Reserved for future standardization)	; (00) byte

<Primary Volume Descriptor>

BP	TP	Field name	:
1-	N	Volume Descriptor Type	: VD = 1 (Normal)
2- 6		Standard Identifier	: 'CD001'
7	N	Volume Descriptor Version	: VD version = 1
8	00	Unused Field	: (00) byte
9- 40	A	System Identifier	:
41- 72	D	Volume Identifier	:
73- 80	00	Unused Field	: (00) byte
81- 88	NB	Volume Space Size	:
89-120	00	Unused Field	: (00) byte
121-124	NB	Volume Set Size	:
125-128	NB	Volume Sequence Number	:
129-132	NB	Logical Block Size	:
133-140	NB	Path Table Size	:
141-144	NL	Location of Occurrence of Type L Path Table	:
145-148	NL	Location of Optional Occurrence of Type L Path Table	:
149-152	NM	Location of Occurrence of Type M Path Table	:
153-156	NM	Location of Optional Occurrence of Type M Path Table	:
157-190	DE	Directory Record for Root Directory	:
191-318	D	Volume Set Identifier	:
319-446	A	Publisher Identifier	:
447-574	A	Data Preparer Identifier	:
575-702	A	Application Identifier	:
703-739	DS	Copyright File Identifier	:
740-776	DS	Abstract File Identifier	:
777-813	DS	Bibliographic File Identifier	:
814-830	ND	Volume Creation Date and Time	:
831-847	ND	Volume Modification Date and Time	:
848-864	ND	Volume Expiration Date and Time	:
865-881	ND	Volume Effective Date and Time	:
882	N	File Structure Version	:
883	00	(Reserved for future standardization)	: (00) byte
884-1395		Application Use	: not specified
1396-2048		(Reserved for future standardization)	: (00) byte

<Primary Volume Descriptor Sample>

Size:	Examples	: Notes
1	: 01	: Fixed
5	: 'CD001'	: Fixed
1	: 01	: Fixed
1	: 00	: Fixed
32	: 'SEGA MEGA CD	: Fixed (' ': \$20)
32	: 'Volume Identifier	: User supplied
8	: 0000000000000000	: Fixed
8	: 1EB00004, 00041EB0	: Auto Write (≤00041EB0)
32	: 00, 00, 00, 00,.....00	: Fixed
4	: 0100, 0001	: Fixed
4	: 0100, 0001	: Fixed
4	: 0008, 0800	: Fixed
8	: XXXXXXXX, XXXXXXXX	: Auto write
4	: XXXXXXXX	: Auto write
4	: 00000000	: Fixed
4	: XXXXXXXX	: Auto write
4	: 00000000	: Fixed
34	:	: Auto write
128	: 'Volume Set Identifier	: User supplied
128	: 'Publisher Identifier	: User supplied
128	: 'Data Preparer Identifier	: User supplied
128	:	: Fixed
37	: 'Copyright File Identifier	: User supplied
37	:	: User supplied
37	:	: User supplied
17	: 00000000 00000000 00000000 00000000 00	: Fixed
17	: 00000000 00000000 00000000 00000000 00	: Fixed
17	: 00000000 00000000 00000000 00000000 00	: Fixed
17	: 00000000 00000000 00000000 00000000 00	: Fixed
1	: 01	: Fixed
1	: 00	: Fixed
512	: 00,00,00,00,.....00	: Fixed
653	: 00,00,00,00,.....00	: Fixed

<Supplementary Volume Descriptor>

BP	TP	Field Name	
1	N	Volume Descriptor Type	; VD=2 (supplement)
2- 6		Standard Identifier	; 'CD001'
7	N	Volume Descriptor Version	; VD version=1
8	00	Volume Flags	;
9- 40	A1	System Identifier	;
41- 72	D1	Volume Identifier	;
73- 80	00	Unused Field	; (00) byte
81- 88	NB	Volume Space Size	;
89-120	00	Escape Sequences	; 32 byte
121-124	NB	Volume Set Size	;
125-128	NB	Volume Sequence Number	;
129-132	NB	Logical Block Size	;
133-140	NB	Path Table Size	;
141-144	NL	Location of Occurrence of Type L Path Table	;
145-148	NL	Location of Optional Occurrence of Type L Path Table	;
149-152	NM	Location of Occurrence of Type M Path Table	;
153-156	NM	Location of Optional Occurrence of Type M Path Table	;
157-190	DE	Directory Record for Root Directory	; 34 byte
191-318	D1	Volume Set Identifier	;
319-446	A1	Publisher Identifier	;
447-574	A1	Data Preparer Identifier	;
575-702	A1	Application Identifier	;
703-739	D1S	Copyright File Identifier	;
740-776	D1S	Abstract File Identifier	;
777-813	D1S	Bibliographic File Identifier	;
814-830	ND	Volume Creation Date and Time	;
831-847	ND	Volume Modification Date and Time	;
848-864	ND	Volume Expiration Date and Time	;
865-881	ND	Volume Effective Date and Time	;
882	N	File Structure Version	;
883	00	(Reserved for future standardization)	; (00) byte
884-1395		Application Use	; not specified
1396-2048		(Reserved for future standardization)	; (00) byte

<Supplementary Volume Descriptor Example>

Size:	Examples	Notes
1	: 02	; Fixed
5	: 'CD001'	; Fixed
1	: 01	; Fixed
1	: 00(JIS)	; User supplied
	or 01(Shift JIS)	
32	: 'SEGA MEGA CD	; Fixed (' ': \$20)
32	: 'Volume name	; User supplied
8	: 0000000000000000	; Fixed
8	: 1EB00004, 00041EB0	; Auto Write (≤ 00041EB0)
32	: 00, 00, 00, 00,.....00	; User supplied
4	: 0100, 0001	; Fixed
4	: 0100, 0001	; Fixed
4	: 0008, 0800	; Fixed
8	: XXXXXXXX, XXXXXXXX	; Auto write
4	: XXXXXXXX	; Auto write
4	: 00000000	; Fixed
4	: XXXXXXXX	; Auto write
4	: 00000000	; Fixed
34	:	; Auto write
128	: 'Volume set identifier	; User supplied
128	: 'Publisher identifier	; User supplied
128	: 'Data preparer identifier	; User supplied
128	: '.....	; Fixed
37	: 'Copyright file identifier	; User supplied
	or '.....	
37	: 'Abstract file identifier	; User supplied
	or '.....	
37	: 'Bibliographic file identifier	; User supplied
	or '.....	
17	: 'yyyymmddhhmmssss', XX	; User supplied
	or 00000000 00000000 00000000 00000000 00	
17	: 'yyyymmddhhmmssss', XX	; User supplied
	or 00000000 00000000 00000000 00000000 00	
17	: 00000000 00000000 00000000 00000000 00	; Fixed
17	: 00000000 00000000 00000000 00000000 00	; Fixed
1	: 01	; Fixed
1	: 00	; Fixed
512	: 00,00,00,00,.....00	; Reserved
653	: 00,00,00,00,.....00	; Fixed

● Directory

Directories are used to manage a specially structured file system.
The format defined by ISO9660 is used.

<Format of a Directory Record>

BP	TP	Field Name	
1	N	Length of Directory Record (LEN_DR)	:
2	N	Extended Attribute Record Length	: = 0
3- 10	NB	Location of Extent	:
11- 18	NB	Data Length	:
19- 25	N	Recording Date and Time	:
26		File Flags	:
27	N	File Unit Size	: = 0
28	N	Interleave Gap Size	: = 0
29- 32	NB	Volume Sequence Number	: = 1
33	N	Length of File Identifier (LEN_FI)	: (MAX 12)
34-(33+LEN_FI) D1S		File Identifier	:
(34+LEN_FI)00		Padding Field	: (00) byte
(LEN_DR-LEN_SU+1)-LENDR		System Use	: LEN_SU bytes = 0

NOTE: LEN_SU denotes length of System Use field.

<Recording Date and Time>

RBP	TP	Field Name	
1	N	Number of years since 1900	:
2	N	Month 1 to 12	:
3	N	Day 1 to 31	:
4	N	Hour 0 to 23	:
5	N	Minute 0 to 59	:
6	N	Second 0 to 59	:
7	N	Offset from Greenwich Mean Time in number of 15 min intervals from -48(West) to +52(East)	: = 0

<File Flags>

bit 0	Existence	:
bit 1	Directory	:
bit 2	Associated File	:
bit 3	Record	:
bit 4	Protection	:
bit 5	Reserved	:
bit 6	Reserved	:
bit 7	Multi-Extent	: = 0

- **Path table**

The format defined by ISO9660 is used.

<Path Table Record>

1	N	Length of Directory Identifier (LEN_DI)	:	
2	N	Extended Attribute Record Length	:	= 0
3 -6	N	Location of Extent	:	
7 -8	N	Parent Directory Number	:	
9-(8+LEN_DI)	D1	Directory Identifier	:	
(9+LEN_DI)	00	Padding Field	:	(00) byte

3-5 User File Table

User files reside on the user sector area. Each file is always consecutively configured. The lower 11-bits of the file's start address are always set to 0 (starting on a sector boundary). The file sizes are written in the directory in bytes. The blank space in the last sector of the file is filled with \$FF. The \$FF are read and stored in the buffer, but never passed to the application software.

3-6 Others

● Restrictions on the directory structure

The following restrictions apply to the directory structure to implement fast access and save memory. The restrictions are valid for the version 1.00 file system. Since the file system is fixed on disc, fast access is realized by storing the file path table on memory. This feature is quite different from other systems.

- (1) The same restrictions as for MS-DOS apply for filenames.
- (2) Usually subdirectories are not used. When they are used, the version of the file system should be upgraded.
- (3) The number of files on disc is fixed in the file system. This allows the path table to be kept in a special file on RAM, thus eliminating a useless buffer.

● Multi-volume

This is not supported by version 1.00.

● Interleaf in the ISO specifications

This is not supported by version 1.00. This function must be implemented by application programs.

● Booting sector

The booting sector is #0 in the standard settings. Spare copies of the booting sector can be stored in #1 to #15. However, this must be done in such a way that the system program sectors are consecutive.

● Line speed

The line speed of MEGA-CD game discs is fixed at 1.25m/sec to improve the accuracy of track jump access and increase the seeking speed.

Appendix 1. Glossary

CD-DA

Compact Disc Digital Audio
CD-DA area

CD-DA Area

Digital Audio data is written on this CD-DA Area. Since the data is written conforming to "RED BOOK," the CD-DA Area can be played with a audio CD player.

CD-G (CD-Graphics)

Karaoke CD disc

CD-ROM Area

Data like programs, graphics, sound, etc. are written in this area. Since the data is written conforming to the logical format, the data can be load easily.

CD-S (CD Single)

8cm CD disc

DISC

Physical disc. It is used to distinguish from the floppy disk. So-called CD media.

ISO9660

The international standard that is used for the logical format of CD-ROM.

MEGA-CD

CD-ROM drive for MEGA-drive. MEGA-CD is used to supply game programs or the like via CD-ROM disc.

P CODE

The data in P channel of the Subcode. P code conforms to "RED BOOK" and indicates the pause status.

Q CODE

The data in Q channel of the Subcode. Q code conforms to "RED BOOK" and used for absolute time, relative time, song number, etc.

RED BOOK, YELLOW BOOK

The specification about the physical format of CD-DA and CD-ROM.

MEGA-CD DISC FORMAT

Logical format for MEGA-CD conforming to ISO9660.

TOC

Table of contents

SUB-CODE

Sub-code is the data written in a gap between the CD data. 1 sector has 96 bytes. Each bit corresponds to P-W channel.

SECTOR

One sector is made up of one frame or 2048 bytes (2336 bytes for mode 2). This is the standard unit to read CD-ROM data.

ABSOLUTE TIME

Absolute time applies the address on DISC. Data is written continuously in unit of minutes, seconds and frame. Program area is accessed according to the absolute time.

TRACK

Track is the recording area for a song defined in the CD-DA. The length is changable. 1 to 99 (decimal system) track can be used to write. Track No. 0 is used to write the TOC information of read in area.

VOLUME

Volume means all the data written in a DISC.

VOLUME SET

Volume set means all the data written in DISCS if the series of data is written in more than one DISC.

REX SABLE

Appendix 2. System ID

System ID area serves to identify a SEGA disc and gives boot up information SEGA.
(Also see Fig. A-2)

● Disc identifier

Disc identifier to identify MEGA-CD discs. This is used to distinguish the MEGA-CD disc from other CD-ROM discs and audio CD discs. The booting programs check the installed disc.

Identifier "SEGADISCSYSTEM" means a SEGA system disc, and Identifier "SEGADATADISC" means a data disc.

● SEGA system disc

This is MEGA-CD Disc Format formatted and contains the booting program.
The file system can be used.

● Data disc

This is MEGA-CD Disc Format formatted and contains no booting program.
The file system can be used.

● Volume name

Disc names in ASCII code.

● Volume version

The version number is indicated here in 4-digit BCD notation. \$00 to \$99 are used in the pre-released version (write-once disc) while \$100 is used in the first released version.

● Volume type

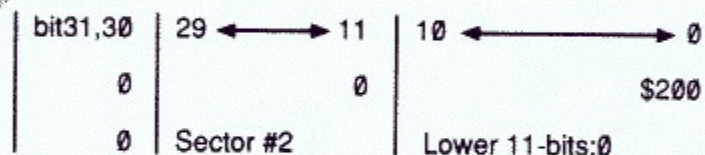
The medium type is indicated. The CD-ROM is read-only.
(Bit0=1, other bits are set to 0.)

● System name, version

Name and version for identifying the system programs.

● IP address

● SP address



● IP load size Load size : (Usually \$600)

● SP load size Load size : (Usually \$7800) *\$7200*

● IP entry address Program start offset address

● SP entry address Program start offset address

● IP work RAM size ... Required work RAM size in bytes

● SP work RAM size .. Required work RAM size in bytes

※ IP : Initial program

SP : System program

■Fig. A-2
<System ID>

	\$04	\$08	\$0C	
\$000	DISC attribute			
\$010	Volume name		0	Volume System
\$020	System name		0	Volume Type
\$030			System VER.	0
\$040	IP address	size of IP load	entry address of IP	size of IP work RAM
\$050	SP address	size of SP load	entry address of SP	size of SP work RAM
\$0FF	system reservation area			176 BYTE

Appendix 3. Disc ID

DISC ID serves to manage the quality of discs as products and to test products. The contents are managed by SEGA (Also see Fig. A-3).

- **Hardware designation**

For the MEGA DRIVE : 'SEGA MEGA DRIVE'
For the GENESIS : 'SEGA GENESIS'

- **Company name or Company code**

Input '(C)' and four characters for company name or company code here.
Intercompany or outside developer (C) SEGA
Third party developer (C) T-XX(Company code)

- **Input domestic-version of the game title**

- **Input overseas-version of the game title**

- **Code representing disc type, product code and version.**

GM (Game), AI (Educational) (Example: 'GM T-12345-00')
Product codes are pre-designated for each game. Version numbers increase with every change that is made following the initial release of a game.

- **The control information identifies the type(s) of I/O device(s) used to support game-play. The control information codes (ASCII) are as follows:**

Master System Joystick	: O
MEGA Drive (Genesis) Joystick	: J
Keyboard	: K
Serial I/O (RS232C)	: R
Printer	: P
Tablet	: T
Trackball	: B
Paddle controller	: V
Analog joystick	: A
Mouse	: M

- **Modem info (See MEGA DRIVE (GENESIS) MANUAL)**

'MO'	: 'Company code', 'xx,y', 'zz'	
xx	: Game No.	
y	: Version No.	
zz	: Modem info	
10	Only Japan	With Mike
30	Only Overseas	With Mike
50	Japan & Overseas	With Mike

- **Regional compatibility is designated using the codes listed below:**

Japan : J
 USA : U
 Europe : E

- **SPACE**

Prohibited to use.

- For any open addresses, fill in with the ASCII code-equivalent of "SPACE" (20H).
- See "GENESIS SOFTWARE DEVELOPMENT MANUAL" for detail of each item.

■ Fig. A-3
 <DISC ID>

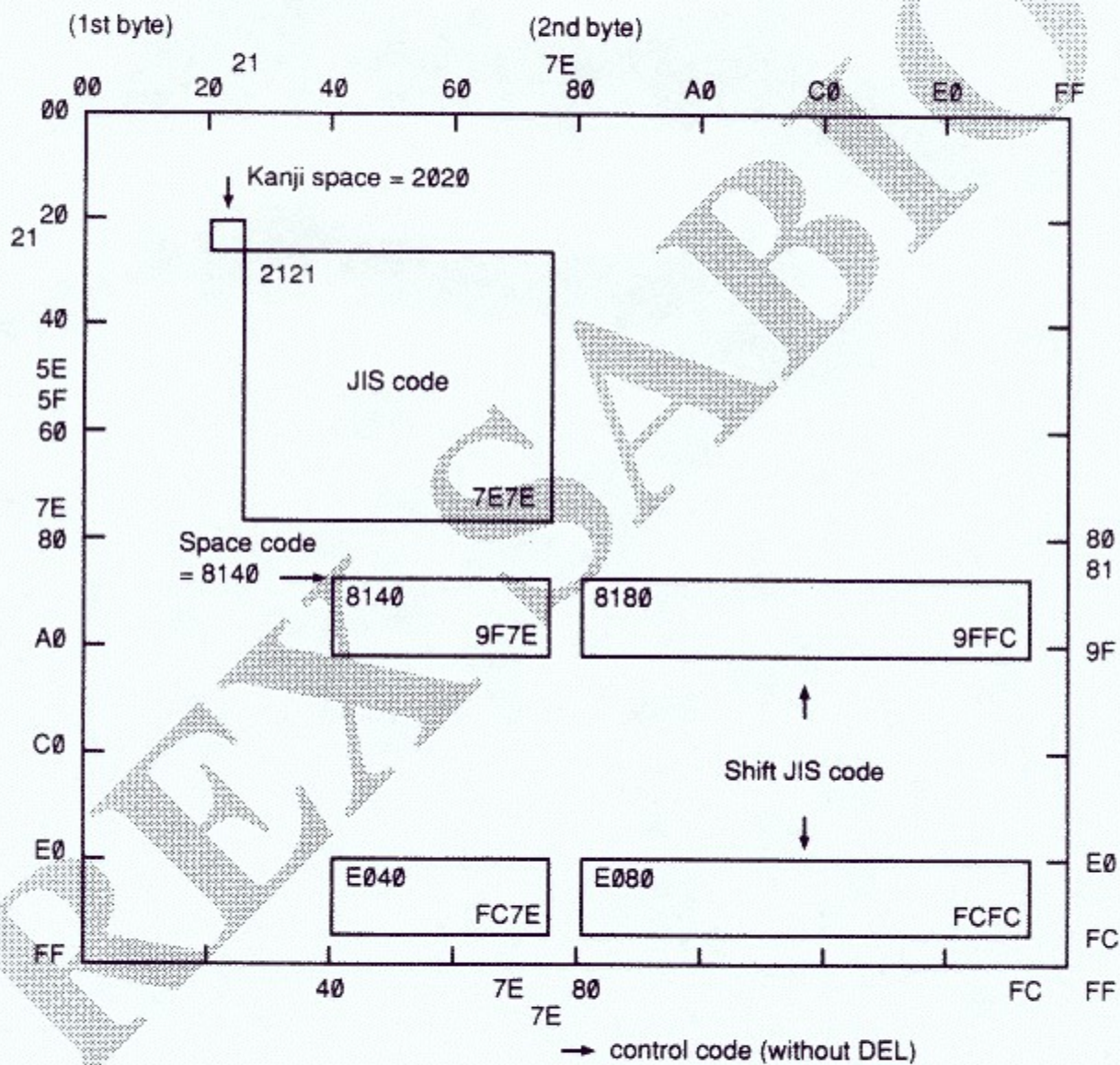
100H	Hardware designation	
110H	Company code, Date	
120H	Domestic game title	
150H	Overseas game title	
180H	Disc type, Product No., Version	Space
190H	I/O info	
1A0H	Space	
1B0H	Space	Modem info
1C0H	Modem info	Space
1D0H	Space	
1F0H	Regional compatibility	
1FFH		

Appendix 4. Area for defining Japanese codes

● Kanji

The shift codes in Figure A-4 are used for kanji character codes.

■ Fig. A-4
 <Definition of Japanese code area>



1 byte code area: 20-7E, A0-E0
 2 byte code area: 2020, 2121-7E7E
 8140-9F7E, 8180-9FFC
 E040-FC7E, E080-FCFC

Rex Sabro

SEGA-CD TECH BULLETIN

To: Sega-CD Developers
From: S. Bayless

Date: 6/16/92
CC: J. Huether
T. Reuterdaahl

Subject: The U.S. BIOS

Although you haven't seen it yet, SOJ is currently revising the BIOS for the U.S. market. While most of the changes are cosmetic, there are a couple that aren't.

Security Code

The block of code that puts up the Sega logo, prints a copyright message and plays the little "Segaaa" sound bite has been changed significantly. This has two effects. First, you'll be getting an assembly language file with a bunch of DC.B's in it which you'll need to put at the beginning of your IP before the new ROM will accept it. Second, you'll need to change the values stored in the ID Block of your boot sector.

Boot Sector

Because the security code has gotten quite a bit bigger, you'll almost certainly have to change your System ID to handle an IP larger than \$600 bytes. The "normal" System ID shown on pages 18 and 19 of the Mega-CD Disk Format Manual shows the IP and SP addresses like this:

```

;Disk Address,Load Size,Entry Offset,Work RAM
DC.L $00000200,$00000600,$00000000,$00000000 ;IP
DC.L $00000800,$00007800,$00000000,$00000000 ;SP

```

Note that IP starts at \$200, which is just past the ID Blocks, and SP starts at \$800 which is the beginning of Sector 1. (Remember, each sector is \$800 bytes long.) Incidentally, the \$7800 in the manual is wrong. It should be \$7200, since it's intended equal the number of bytes remaining between the end of IP and the end of sector 15.

With the new security code, IP spills over into Sector 2 and the new System Area structure (see page 6 of the Mega-CD Disk Format Manual) looks like this:

\$000000	System ID	Sector #0	Boot Sector
\$000100	Disc ID		

\$000200	IP Code		
\$001000	SP Code	Sector #1~#15	SP Sector
\$008000	VD		Data Area
	Directory		
	Path Table		
	User File 0		
	User File 1		
	.		
	.		
	.		

The original BIOS seems to have been hard wired for an IP that stayed within sector 0, so you have to kind of lie to it when IP gets bigger than that. According to SOJ, the value in the IP Start field should point to the beginning of the first byte in IP *after* the first \$600 bytes. This would mean that you'd always use \$800 (since anything smaller would fit in sector 0 and you wouldn't have to mess with any of this in the first place). It also implies that IP can't extend beyond the end of sector 1, but I haven't confirmed that yet.

The value in the IP Load Size field should be equal to the size of IP - \$600. In my first attempt with this, I just padded IP out to the end of sector 1, so the length I used was \$800, which translates to "load the whole sector".

Finally, you'll need to change the SP Start field to reflect the fact that it now begins in the next sector. The value here should be \$1000, i.e. the beginning of sector 2. You may also want to change the SP Load Size field to reflect its smaller maximum size, assuming you pad the thing out like some people do.

So, the new "normal" System ID would contain entries that looked something like this:

```

;Disk Address,Load Size,Entry Offset,Work RAM
DC.L $00000800,$00000800,$00000000,$00000000 ;IP
DC.L $00001000,$00007000,$00000000,$00000000 ;SP

```