Specifications

Model

GD-ROM Format Specification Details
Ver. 1.32

Model No.

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			SEGA Consumer Product Development Headquarters
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<< Revisions >>

Rev	Change Order No.	Reasons for Revision	Date	No. Pages	Created	Exam	Apprv
C		First printing	4/14/97		Nakayama		
E		Converted _0d.Doc to Word95 format	4/23/97		Nakayama		
1.00		Inserted "The Relationship between Frames and Sectors"	5/16/97		Nakayama		
1.01		Changed project name from DURAL to GUPPY and multiple revisions to each section	7/24/97		Nakayama		
1.02		Continued volume track numbers	7/29/97		Nakayama		
1.03		Added Highwits and YAMAHA comments	8/1/97		Nakayama		
1.04		Changed Figure 1 to Word format and slightly edited each part	9/3/97		Nakayama		
1.05		Deleted physical format, added absolute time	10/13/97		Nakayama		
1.06		Changed chapter organization	11/20/97		Nakayama		
1.07		Moved volume structure to different chapter	12/2/97		Nakayama		
1.08		Changed single density media information structure Edited track structure and TOC structure	1/6/98		Nakayama		
1.09		Miscellaneous corrections in each section	1/9/98		Nakayama		
1.10		Instituted GD-ROM Format Specification (Ver. 0.08) for programmers	2/2/98		Nakayama		
1.20		Changed document format according to differences with GD-ROM Format Specification for programmers	2/18/98		Nakayama		
1.20		Changed title, but not version number. Miscellaneous corrections in each section	2/23/98		Shoji		
1.21		Added 1sec of PostGap to the pattern III in the High-Density Area Track Structure (Figure 3-1)	6/17/98		Nakayama		
1.27		Added max value to both single/double density area Deleted 1 sec of PostGap from the end of Audio in pattern III Modified max value in high dens area and gap location Modified figures 2-1, 3-1, 4-4, 6-2, 6-3	7/1/98		Nakayama		
1.28		Modified Figure 5-3	7/31/98		Nakayama		
1.31		Added Figure 2-1 Modified Figure 3-1, 4-1, 5-1, 5-2, 5-3. Added “note” on Page7 Changed Line3 on Page11 MODE0 -> MODE1	11/11/98		Nakayama		
1.32		Modified Figure 2-1 Max/03:59:74 -> C2:29:11 Modified Figure 4-1	3/17/99		Nakayama		

Contents

1. Overview

This document supplements the GD-ROM format specifications with information particular to hardware engineering.

The specifications include proprietary technological intellectual property of Sega which must be protected against disclosure to third parties.

2. GD-ROM Physical Layout Specification

<23.0㎜		A TIme		
		97:30:00	×1 Lead in Start	
24.80㎜	**Lead-in** ×1.0			
～25.0㎜		99:59:74	×1 Lead in end	
		00:00:00	×1 Program Start	
	Program Area (4min.) ×1.0			
	Area=Normal density			
		Max		
27.89㎜		03:59:74	×1 Program end	
		04:00:00	×1 Lead out Start	
	Lead-out (90 Sec) ×1.0			
28.90㎜		05:29:74	×1 Lead out end	
		05:30:00	mirror #1 Start	
	Mirror #1 (50 um)			
28.95㎜		05:34:40	mirror #1 end	
		05:34:41	×1 Logo Start	
	SEGA Logo ×1.0			
30.95㎜		08:37:65	×1 Logo end	
		08:37:66	mirror #2 Start	
	Mirror #2 (50 um)			
31.00㎜		08:46:52	mirror #2 end	
		F0:00:00	×1.8 Lead in Start	
	Lead-in (0.5mm) ×1.8			
31.50㎜		F1:28:74	×1.8 Lead in end	
		10:00:00	×1.8 Program Start	
	Program Area (>1GB) ×1.8			
	Area=High density			
		min. : HEX BCD 00～C8、F0，F1		
		Sec. : BCD BCD 00～59		
		Max		
58.00㎜		C2:29:11	×1.8 Program end	(max value for write physically)
		C2:29:12	×1.8 Lead out Start	
	Lead out ×1.8			
59.00㎜		C8:02:07	×1.8 Lead out end	

Figure 2-1: Physical Layout Specification

3. Single-Density Area Format

3.1 Single-Density Area Track Structure

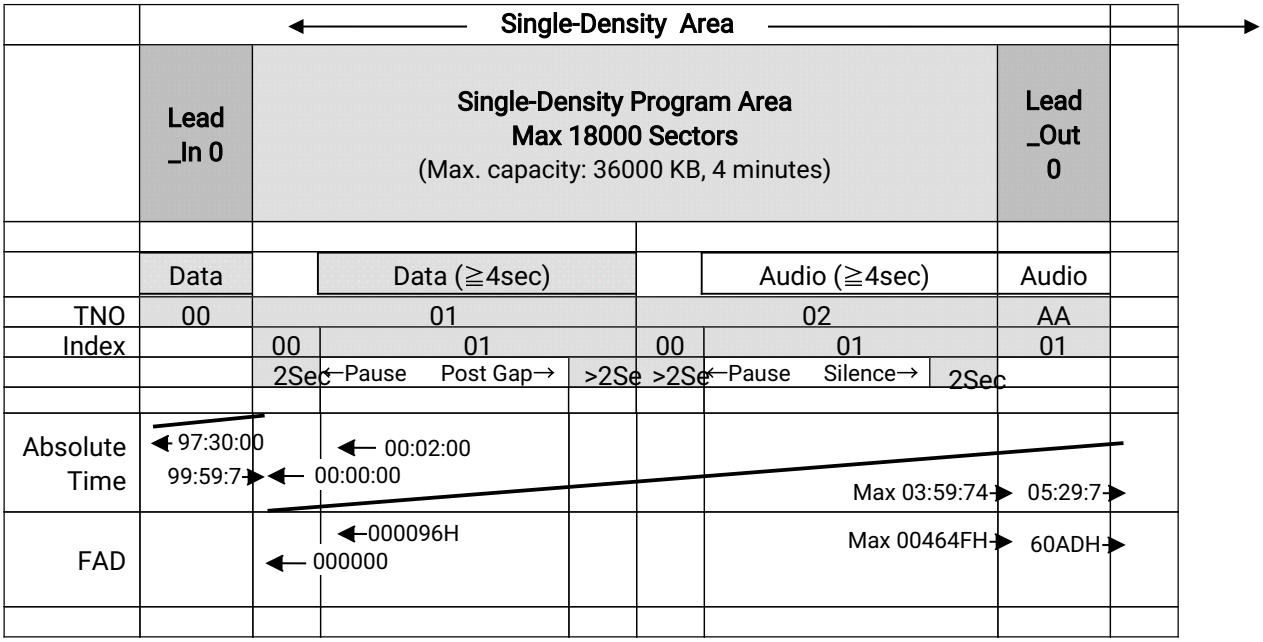

Figure 3-1: Single-Density Area Track Structure

4. High-Density Area Format

4.1 High-Density Area Track Structure

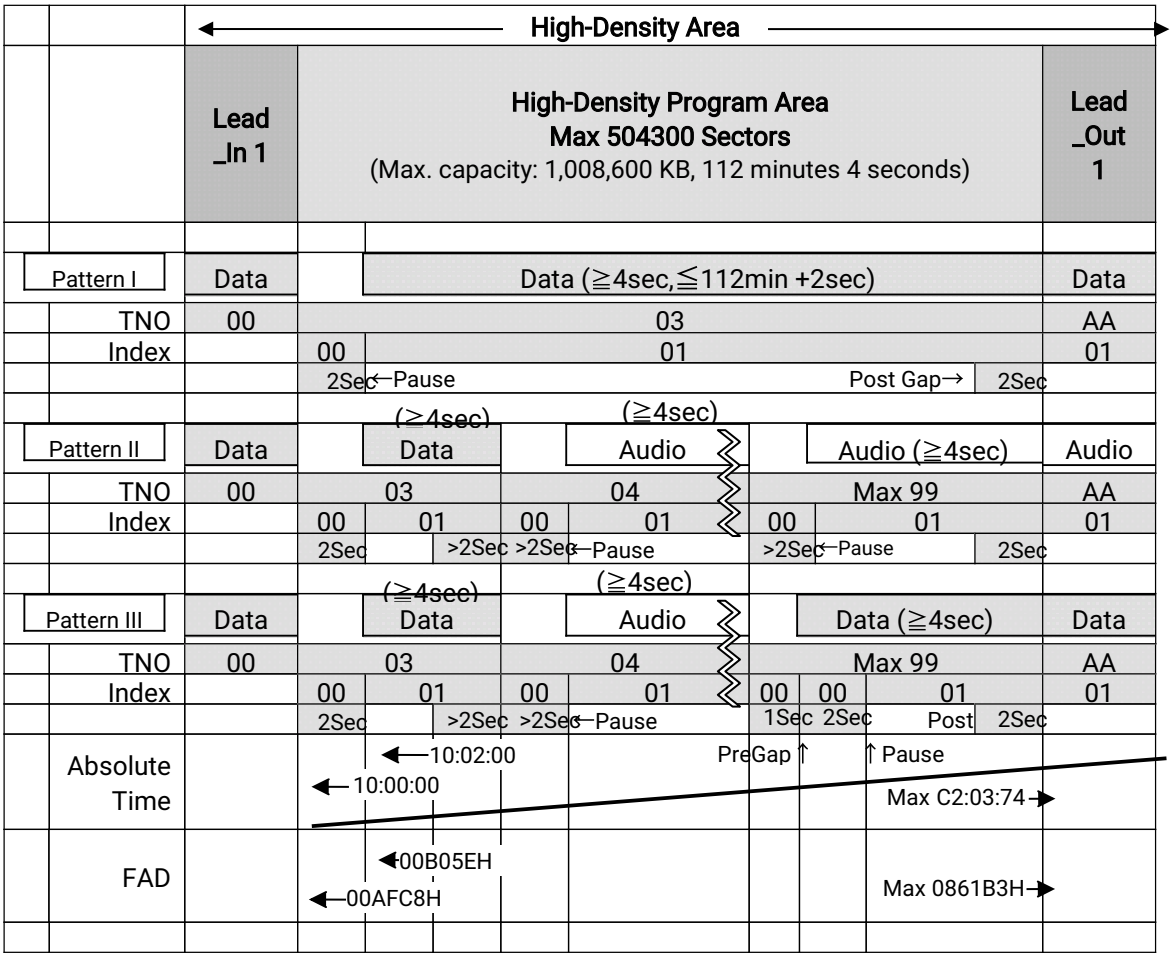

Figure 4-1: High-Density Area Track Structure

Note: Max value for the real data in High-Density Area is defined as 112min 00sec 00. Therefore, max value for absolute time within High-Density program area is C2:03:74 (122 min 03 sec 74).

5. Lead-In Area (TOC 1)

The TOC (Table of Contents) consists of pointers to the recording locations in the Lead In Area's Subcode Q channel on the disc, following the Red Book standard.

The TOC DATA here describes TOC1 (Table of Contents 1) in the Lead-In Area (Lead_In 1) in the High-Density Area.

In TOC1, the same subcode block is repeated three times within the Lead-In 1 Area.

It does not support Mode2 format, so the PSec value of Point=A0 is 00.

The ZERO field member of the High-Density Area is 00h.

	S0	S1	Control	ADR(address)	TNO(trackno.)	Point	Time			Zero	PTime			CRC
							Min	Sec	Frame		PMin	PSec	PFrame	
bit	1	1	4	4	8	8	8	8	8	8	8	8	8	16

Figure 5-1: Subcode Q Channel

Control/ ADR		TNO	Point	Min	Sec	Frame	Zero	PMin	PSec	PFrame
*1	1	00	03 to 99	"Min, Sec, Frame" indicates the disc's absolute time.			00	Track starting frame address (BCD value) indicated by the Point value		
*1	1	00	A0				00	Starting track number (BCD value 03 to 99)	00	00
*1	1	00	A1				00	Last track number (BCD value 03 to 99)	00	00
*1	1	00	A2				00	Lead_out 2 starting frame address (BCD value)		

※1 Control	Description	
MSB→00x0←LSB	2 audio without	
00x1	2 audio with pre-emphasis	
01x0	data track	
0x0x	digital copy prohibited	
0x10	digital copy permitted	

Figure 5-2: TOC 1 Values

The "PMin, PSec, PFrame" values as they change with the "Point" value are shown below.

ADR＝1 (Mode1)

Point=03～99 The "PMin, PSec, PFrame" values give the start position of the track indicated by "Pointer".

Point=A0 "PMin" indicates the program area's first record track number value, 03.
"PSec" indicates 00 as the disc type is Mode1 and GD_DA.
"PFrame" indicates 00.

Point=A1 "PMin" indicates the program area's last record track number value.
"PSec, PFrame" indicate 00.

Point=A2 "PSec, PSrame, PFrame" indicate the Lead Out Area's start position.

Examples of the TOC in "Lead In 1" of the High-Density Area, with Pattern III track structure, are shown below.

Frame	CTL&ADR	TNO	Point	M:S:F	Zero	PM:PS:PF
:	:	:	:	:	:	:
n+0	01	00	A0	F0:59:69	00	03:00:00
n+1	01	00	A0	F0:59:70	00	03:00:00
n+2	01	00	A0	F0:59:71	00	03:00:00
n+3	01	00	A1	F0:59:72	00	05:00:00
n+4	01	00	A1	F0:59:73	00	05:00:00
n+5	01	00	A1	F0:59:74	00	05:00:00
n+6	01	00	A2	F1:00:00	00	C0:29:12
n+7	01	00	A2	F1:00:01	00	C0:29:12
n+8	01	00	A2	F1:00:02	00	C0:29:12
n+9	41	00	03	F1:00:03	00	10:02:00
n+10	41	00	03	F1:00:04	00	10:02:00
n+11	41	00	03	F1:00:05	00	10:02:00
n+12	01	00	04	F1:00:06	00	20:02:00
n+13	01	00	04	F1:00:07	00	20:02:00
n+14	01	00	04	F1:00:08	00	20:02:00
n+15	01	00	05	F1:00:09	00	A0:02:70
n+16	01	00	05	F1:00:10	00	A0:02:70
n+17	01	00	05	F1:00:11	00	A0:02:70
:	01	00	A0	F1:00:12	00	03:00:00
:	01	00	A0	F1:00:13	00	03:00:00
:	01	00	A0	F1:00:14	00	03:00:00
:	:	:	:	:	:	:

Frame	CTL&ADR	TNO	Point	M:S:F	Zero	PM:PS:PF		Pre Gap Time	
n+0	01	00	A0		00	03:00:00	10:02:00	**MODE1**	**03**
n+3	01	00	A1		00	05:00:00			
n+6	01	00	A2	Absolute	00	C0:29:12	20:02:00	**GD-DA**	**04**
n+9	41	00	03	Time	00	10:02:00			
n+12	01	00	04		00	20:02:00	A0:02:70	**MODE1**	**05**
n+15	41	00	05		00	A0:02:70			
:	:	:	:	:	:	:	C0:29:12		

Figure 5-3: Examples of Lead_In 1 TOC

6. Sector Structure

6.1 Sectors

The GD-ROM sector structure complies with the Red Book and Yellow Book standards. The CD Audio sector structure is shown in Figure 6-1, and the CD-ROM sector structure is shown in Figure 6-2 below.

The GD-ROM data sector structure uses Mode1 in Figure 6-2, which does not support the MODE 2 data sector structure (XA, etc.).

The header values for **Min, Sec, and Frame** (sector, block) shown in Figure 6-1 are each two-digit BCD (4-bit base 10) displays. However, since the largest possible BCD Min value would be 99, in the high-density format area, the 10's digit of minutes must be displayed in hexadecimal, and the maximum measurement is extended to F9 Min 59 Sec 74 Sectors (160 minutes).

Frame Format of CD-DA Audio

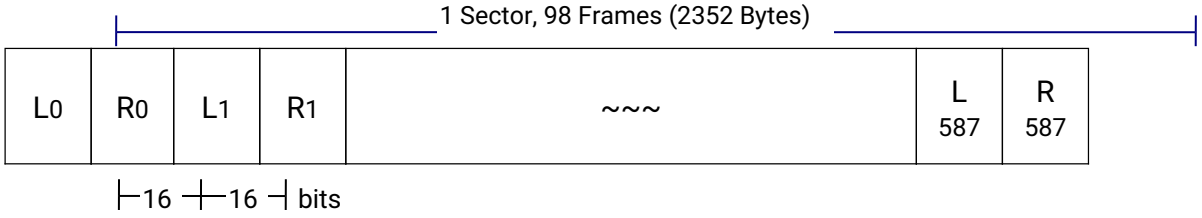

Figure 6-1: CD-Audio Frame Format

Sector Format of CD-ROM (MODE1)

1 Sector, 98 Frames (2352 Bytes)

	Sync signal	Header (4)				User data	EDC	SPACE	ECC	
MODE1	[12]	Min [1]	Sec [1]	Frame [1]	Mode [1]=1	DATA [2048]	[4]	- 00 - [8]	P Parity [172]	Q Parity [104]

	Sync signal	Header (4)				Subheader	User data	EDC	ECC	
MODE2 FORM1	[12]	Min [1]	Sec [1]	Frame [1]	Mode [1]=2	[8]	DATA [2048]	[4]	P Parity [172]	Q Parity [104]

	Sync signal	Header (4)				Subheader	User data	EDC
MODE2 FORM2	[12]	Min [1]	Sec [1]	Frame [1]	Mode [1]=2	[8]	DATA [2324]	[4]

Figure 6-2: CD-ROM Sector Format

Data Sector Structure

MODE1: This mode consists of 2048-byte User Data a 4-byte error detection flag area and a 276-byte error correction area for flag error control.

MODE2: This mode consists of FORM1 for code data and FORM2 for voice and images. In Mode2, the SPACE area (8 bits) of Mode1 serves as a subheader between the Header and User data. Because FORM2 does not require strict additional error correction, the 276-byte ECC area, which uses P/Q parity in FORM1, is instead allocated to the 2324-byte User data area.

6.2 Frame/Sector Relationship

Each frame consists of 24 symbols, with a symbol being 8 data bits (1 byte). Interleaving is applied to this data to make an [F1] frame. Therefore, an [F1] frame consists of 24 symbols (bytes) or 192 data bits.

The [F1] frame is divided into groups of 12 symbols, and a four-symbol-long flag error correction CIRC (Cross Interleave Reed-Solomon Coding) is appended to each group of 12 symbols. The result is an [F2] frame. So an [F2] frame consists of 32 symbols (bytes) or 256 data bits.

In addition, an 8-bit-long subcode is appended as a control byte to form an [F3] frame. This includes a subcode data CIRC. Therefore, an [F3] frame consists of 33 symbols (bytes), or 264 data bits.

Each symbol of the [F3] frame is modulated using EFM (Eight-to-Fourteen Modulation), and each symbol (that is, 8 data bits) is converted into 14 channel bits. At this time, the arrangment of the [F3] frame is changed, and the final frame is made by adding a margin bit (connection bit), which becomes a 3-channel-bit-long gap, with each symbol having a 4-channel-bit-long synchronous header and control byte. Thus, the frame formed in this way is 588 channel bits long. Each frame created through the above processes has a set time length of 136 μS.

A sector is made by grouping 98 of the [F3] frames described above, so 1 sector consists of 57,624 channel bits or 7,203 bytes. Depending on the development environment, 1 sector may also be called a block.

The above relationships are shown in Figure 6-.

Note: CD Block Access Units are generally as follows:

Frame Address (FAD)	---Units of access counted in sector units immediately after the end of the Lead In 1 area.
Logical Sector No. (LSN)	---Counted in sector units with absolute time 00:02:00 as 0. Also called the Logical Block Number (LBN).
Absolute Time (ATime)	---Counted in units of time from 00:00:00 immediately after the end of the Lead In 1 area.

Frame Addresses (FAD) and Logical Sector Numbers (LSN) are related as follows:

Frame Address (FAD) = 96H + Logical Sector Number (LSN)

Absolute Time (ATime) and Sectors (1 sector = 2048 bytes) are related as follows:

1 second = 75 sectors

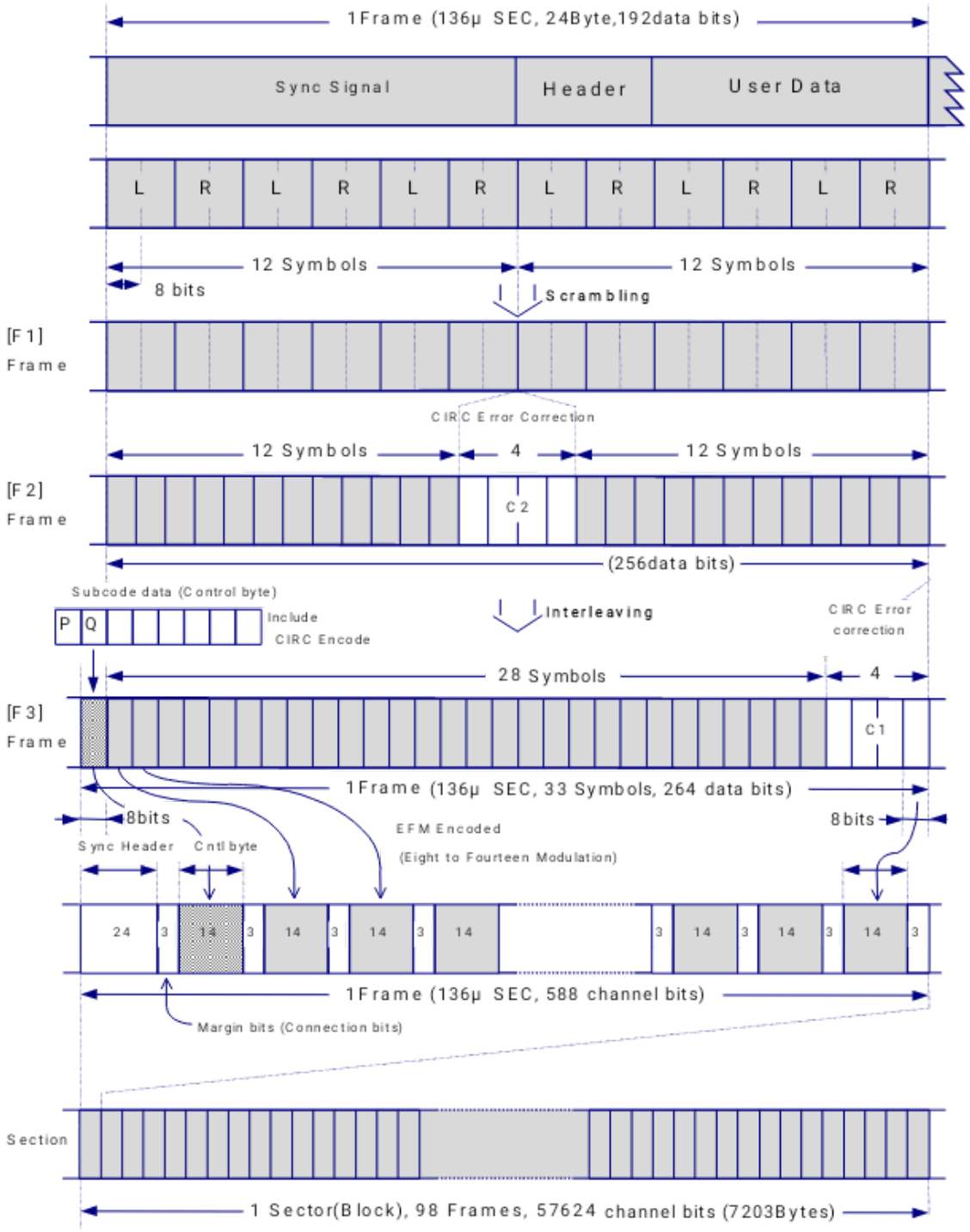

Figure 6-3: Frame/Sector Relationship

7. Subcode Information

7.1 Subcode Data Structures

P Channel Information

P Channel	S0	S1	Music Header Signal (1-Filled for music separation, or 0-filled for other use)											
	1	1	4	4	8	8	8	8	8	8	8	8	8	16

98 bits (Data in 1 sector)

Figure 7-1: P Channel Information

Q Channel Information (TOC)

Q Data Area

Q Channel	S0	S1	Control	Address	00	Point	TIME			-00-	PTIME			CRC
							Min	Sec	Frame		PMin	PSec	PFrame	
	1	1	4	4	8	8	8	8	8	8	8	8	8	16

98 bits (Data in 1 sector)

Figure 7-2: Q Channel Information (TOC)

Q Channel Information (Ex.)

Q Data Area

Q Channel	S0	S1	Control	Address	TrackNo.	X	TIME			-00-	ATIME			CRC
							Min	Sec	Frame		AMin	ASec	AFrame	
	1	1	4	4	8	8	8	8	8	8	8	8	8	16

98 bits (Data in 1 sector)

Figure 7-3: Q Channel Information (Ex.)

R/W Channel Information (Ex.)

R	S0	S1	C	I	C	A	For CD-G,		←	←	←

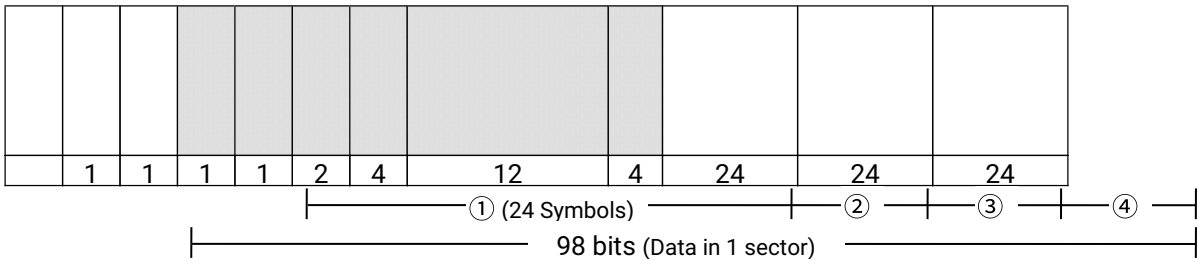

Figure 7-4: R/W Channel Information